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중국의 물류네트워크 및 경제발전*

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Logistics network and economic development in China

Kevin Li · Guanqiu Qi

Abstract

Logistics network has been increasingly acknowledged as one of the important driving force for economic development in China. With the scope of logistics effect broadening and the development of logistics infrastructure, both logistics network and economy in terms of GDP in China has experienced rapid development hand in hand.

This paper investigates the relationship between logistics network and economic growth, using a dataset covering 31 provinces over the period from 2003 to 2012 in China. Factor analysis is applied to obtain a total evaluation of logistics function defining the impact of logistics network on the national economy growth. According to fixed effect panel data approach, a significant and positive impact of logistics network on economic growth in China is found, meanwhile, a comparative analysis regarding economic development between coastal provinces and interior provinces is also conducted. The results suggest that the impact of logistics network on economic growth is higher in eastern provinces than that in western provinces. The policy implication for other nations, in particular for developing nations, is logistics network should be regarded as an important driving force for economic development, and investment should be made in advance to achieve the best efficiency in economic development and planning.

Key words : logistics network, economic growth, fixed panel data model, factor analysis

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Ⅰ. Introduction

In the 1960s, American scholar Drucker brought forward the doctrine that logistics was the gloomy mainland of economic field and more scholars started to study logistics theory. Drucker stated that there was interrelation between logistics industry and economic development (De′murger, 2001; Khadaroo & Seetanah, 2008). Some other points, such as developing logistics industry brings logistics system's reformation (David, 2001; Hong *et al.,* 2011); and on the other hand, logistics capital have a significant positive impact on the county's output.(Ozbay *et al.,* 2007), were suggested.

According to the National Bureau of Statistics of China, the Gross Domestic Products (GDP) of China increased radically from RMB 4,545.62 billion in 1980 to RMB 519,470.10 billion in 2012. China's economy is growing rapidly after reforming and opening up in1978 and in 2010 has became the second largest economy in the world. Meanwhile, with the gradual expansion of trade flows involving domestic trade and foreign trade, the transport networks and logistics industry had played a more important role. Also, it stimulated the need to develop logistics market, improve logistics management, and promote hinterland physical infrastructure, both in terms of quality and quantity.

The purpose of this paper is to provide more detailed insights into the significance of logistics development to economic growth in China. Specifically, the first is to identify some important factors affecting the logistic development; the second is to obtain a comprehensive assessment of each province regarding the level of the logistics development, and the third is to evaluate the contribution of logistics development to economic growth.

The rest of this paper is structured as follows: Section II provides a comprehensive literature review pertaining to the relationship between logistics development and economic growth. Concepts and characteristics of logistics in China are introduced in Section III. Data and methodology are presented in Section IV and the empirical results as well as discussion are reported in Section V. Conclusion is summarized in Section VI.

Ⅱ. Literature Review

There are types of theories on the relationship between logistics development and economic growth, i.e., two streams of theories including "logistics-promote" and "economy-pull". Specifically, the former theory addresses that logistics network can contribute to economic growth in terms of further investment of the transport infrastructure, promotion of e-business, and decrease of waste of storage house resource (Hong *et al.,* 2011; De′murger, 2001). On the other hand, the latter suggests that economic growth is able to increase the demand for logistics service. Moreover, logistics network level is determined by economic growth level (Jiwattanakulpaisarn *et al.,* 2011). Accordingly, the relationship between logistics development and economic growth is becoming a hut issue for researcher. Some researches have been done aiming to find the relationship. From 1960s, American scholar Drucker proposed the doctrine that logistics is the gloomy mainland of economic field and more scholars started to study logistics theory. Logistics industry is regarded as the main support and fundamental industry of economic development. Wang (2010) found that the degree of logistics development is one of the symbols of upgrading and completing national strength, and is described as the accelerator on promoting economic development. Thereafter many researches started to consider the interrelation between Logistics development and economic growth. Previous studies have recognized various determinants contributing to economic growth. For example, investment in transportation which is widely recognized and studied by scholars; investment in E-commerce, because Bosworth and Triplett (2000) found that E-commerce has played a great role on economic development and profoundly affected people's economic life; public infrastructures; investment in logistics capital; FDI; government consumption; population growth or density, human capital. But in this research, by reviewing previews researches on the relationship between logistics development and economic, this thesis generally regarded transportation as the most represented opinion and analyzed relationship between them both in qualitative and quantitative method. (Mody & Wang, 1997; Demurger, 2001; Goh & Ling, 2003; Ding *et al.*, 2008; Hooi Hooi Lean, 2014).

Consider, for example, the situation in China. First, in China it is widely accepted that 'road leads to prosperity'. According to this, some policy-makers have been encouraged to make huge investments in expanding the nation's transport network. Obviously, transport infrastructure investment has a capability of increasing productivity and bringing up economic growth. For instance, China is building transport infrastructure like railway or highway at an unprecedented speed, linking its cities with high-speed railways. Shirley and Winston (2004) stated that investment in highway and high-speed railway can bring benefits by lowering inventories, and generated the cost saving benefits, while investment in telecommunications can generate benefits due to improved marketing information(Madden & Savage, 2000). Researchers found that the improvement of infrastructure was not a sufficient condition for regional development, both transport and telecommunication facilities had become growth engines during this period, also many other factors played a role in economic growth(Mody & Wang, 1997; Rietveld, 1994; Banister & Berechman, 2001; Demurger, 2001; Bose *et al.*, 2005; Deng, 2013; Hooi, 2014). Ding *et al.*, (2008) found that telecommunication infrastructure did enhance economic growth and there was an obvious regional income convergence in China from 1986 to 2002. The main problems in China's logistics distribution were undeveloped infrastructure, government regulations; regional protection and fragmented distribution channels throughout the country and the aged infrastructure, archaic and ling equipment and the lack of qualified logistics person cannot meet the vibrant demand in the economy. (Jiang & Prater, 2002; Goh & Ling, 2003). Banister and Thurstain-Goodwin (2011) suggested the transport investment affected the local economy at three different levels: firstly, at the macroeconomic level, regional network effects could be identified as measured through changes in output and productivity. Secondly, at the meso level, the impacts relate more to agglomeration economies and labour market effects. Finally, at the micro level, the impacts are determined by the land and property market effects. Most of the previous studies have used a production function model with a similar structure. While logistics infrastructure leads to economic growth through the following mechanisms: Firstly, investment in infrastructure increases the demand for goods and services. Secondly, the improvement of logistics infrastructure reduces travel time, and passenger and freight transporters gain directly from time and cost savings (Gunasekera *et al.*, 2008). Thirdly, a better infrastructure attracts foreign direct investment (Hong *et al.*, 2011), which is an important engine of economic growth in China.

Second, there is a rapid growth of research on e-commerce and economic growth. E-commerce has become a hot issue with the rapid development of computer, network, and information and communication technology. It has played a great role on economic development and profoundly affected people's economic life (Bosworth, 2000). In China, with the development of computer technology and networking, e-commerce has entered a stage of large scale development. As the number of internet users, growth and the steady improvement of the national economy, B2B and online ecommerce industry as the representative of China have made a substantial contribution to the GDP (Lu, 2012). The telecommunication infrastructure, investment, and FDI enhanced economic growth as the relationship is significantly positive and there was an obvious regional income convergence in China. (Ding *et al.*, 2008; Yang, 2011)

Third, research on logistics capital and economic growth states that investment in logistics can not only increase the demand for goods and services, but also improve the efficiency of logistics systems by reducing travel time and cost (Roller & Weverman, 2001; Gunasekera *et al.*, 2008).

Fourth, research on foreign direct investment (FDI) and economic growth is attractive as FDI is widely regarded as an important engine of economic growth in China, which can be reflected by the popularity of the development of logistics zones (Lu & Yang, 2006).

Fifth, as for the research methods, more attention has been paid to quantitative approaches to examine the relationship between logistics development and economic growth. Among them, Granger causality test is widely used. For instance, an interaction relationship between logistics development and economic growth was found (Bose & Haque, 2005; Sahoo & Dash, 2007; Zhang, 2010). The other popular quantitative method is regression technique aiming to examine the magnitude of their interdependence (Wang, 2010; Chen, 2010).

Finally, particular concerns also have been given to regional analysis of the relationship between logistics development and economic growth in China. A case study of Zhejiang province showed the existence of interaction relationship between logistics development and economic growth (Liu & Li, 2007). Other studies contributing to this issue can be found in Yang (2009), Zheng (2009), Zhang (2010), Luo (2011), Liu (2012) and so on. Liu (2012) found that, Qin Huangdao port logistics and regional economic development consists of a mutual have long-term effect of dynamic linear system, but different is, Goods growth is to promote the increase of the GDP throughput Granger causes, but the influence of the reverse is not significant. This shows that the port logistics development of Qin Huangdao city can improve economic growth. While a number of studies have been done in the literature, several basic questions remain unsolved. On one hand, previous studies tend to focus on only one type of logistics infrastructure, like highway investment, railway length (Fleisher & Chen, 1997), cargo turnover, freight volume individually to test the relationship between logistics development and economic growth, which cannot capture the impact of total logistics ability. On the other hand, they didn't use some comprehensive data, and their data used didn't reflect the whole logistics development. Many empirical studies have confirmed the effect of logistic development on economic growth. Panel data mean sectional time-series data which is a dataset in which the behavior of entities are observed across time.

Ⅲ. Concepts and Characteristics of Logistics in China

Logistics means more than handling, transport, and storage of goods today. Logistics has its origins in the military. From that perspective, it applies to the process of supplying a theater of war with troops, equipment and supplies. Today logistics development in China is fundamental to its economic growth. China's logistic is growing at an extraordinary rate; because of the rapid expansion of the country's industrial economy base. Chinese economic growth has been heavily dependent on logistics since 1980s. China needs to develop its logistics market, management, and hinterland transportation infrastructure, both in terms of quality and quantity, if it aims to be maintaining the current levels of development.

The government has acknowledged that efficient transport and logistics is the key for long development and it should commit huge funds to build airports, roll out a national expressway network and, expands and upgrades the country's railway system.

China has built a comprehensive transportation system of railways, highways, and airports. A big part of China's transport system has been built since 1949 and especially since the beginning of the 80s. However, the development of the country in these transport infrastructures varies extremely according to the region, with important local disparities: bad equipment in the West of the country, in particular the Tibet, due to its reliefs, and then the Xinjiang, the Inner Mongolia and the Yunnan. The western urban regions, between the metropolises of Wuhan, Shanghai, Xi'an and Harbin are much better handed out.

Hong and Liu (2007) found that most of the logistics companies in China provided limited value-added service to customers and society. The industry provides only traditional services, such as transportation, distribution and warehousing. Only a small number of companies had "high-level" activities, such as logistics system design and information management. The World Bank's Logistics Performance Index shows there are some problems in the logistics industry of China. At an international rank of 27, China lead the developing countries, but still lags significantly behind some industrial nations, and was far behind Germany, Singapore, and Sweden. Without doubt, the logistics industry in China is robust in its growth. However, it still faces many challenges. Like: 1, Logistics concentration remains scattered; 2, Total logistics costs stay high; 3, Warehousing management has room to grow; 4, Logistics burden of high toll fees; 5, Stringent regulation hinders logistics growth-- Licensing applications; 6, Constraints on human resources; 7, Corruption. Numerous small-sized enterprises offer similar but limited services without nationwide coverage, while the supply of logistics facilities in some districts is either insufficient or redundant. Also, constraints on logistics facilities and human capital, as well as expensive logistics costs, add further burdens to logistics users and operators. Although the government has adopted promulgated numbers of measures to support the development of the logistics industry, policy execution sometimes hinders that growth.

The government is fully aware of how possible inefficiencies in the logistics are impacting economic growth, and is in the gradual process of addressing these through a combination of regulatory measures. The government's 11th Five Year Plan, running from 2005 to 2010, sets out key investment areas for transport infrastructure projects.

Ⅳ. Data and Methodology

Based on the theory of logistics network and economy growth, firstly, this research aims to identify main factors affecting the performance of logistics development by using factor analysis and then to obtain a total evaluation of logistics

Table 1. Descriptive statistics of all variables

Variables symbol	Variables
X1	Passenger traffic
X2	Passenger kilometers
X3	Freight traffic
X4	Freight ton-kilometers
X6	Possession of civil transport deadweight ton
X5	Possession of civil transport vessel
X7	Possession of civil transport vessels
X8	Internet users
X11	Pieces of express mail services
X12	Length of railways in operation
X13	Length of highways
Y	P-GDP
X9	Ratio of transport investment to total social investment
X10	Ratio of transport employed persons to total social employed persons

function. Then, with the help of a panel data model with fixed effect, the relationship between logistics development and economic growth is quantitatively examined under the framework of production function.

1. Data Resources and Indexes Selection

The sample data is mostly collected from China's National Bureau of Statistics and available from the Statistics website. There are 13 variables selected in the research overall 31 provinces from 2001-2012 in China which has not been tried yet and this paper will try to test the relationship between logistics network and economic growth. As showed in Table 1, all data are annual data and they are transformed to the natural logarithmic form. Research uses econometric analytical method, taking the gross domestic product as the explained variable (Y) to show the level of economic development, taking the 13 variables shown in Table 1 as the explaining variable to show the development level of logistics industry.

The variables in this paper are selected following the guidance of the previous literature (Demurger, 2001; Datta and Agarwal, 2004; Ding et al., 2008). Some variables have been applied, for example, the provincial economic data of GDP, real GDP per capita, physical capital stock, labour force (David Yossi, 2001; Yang Shao, 2010). For example, In addition, Roller and Waverman (2001) tested the relationship between logistics network and economic growth from a total output, demand and disaggregate output perspective.

2. Main Method: Panel Data Analysis

Following Cai (2006), a panel production function model is considered in this paper. Cai (2006) regarded the logistics industry as a function of economic growth. Besides this, physical capital stock and labor force are also considered in this study. Transport infrastructure, mainly including roads, railroads, airports and seaports, has often been claimed as an important determinant of productivity and economic growth. According to China's National Bureau of Statistics, transportation accounts for the largest component of total logistics costs in China, with around 55 percent (RMB 2.1 trillion)[1], followed by inventory storage costs (RMB 1.2 trillion) and management costs (RMB 500 billion) in 2012. From this data, we can see logistics cost is key to total logistics industry in China. In this paper, to reflect the level of infrastructure of each province, factors like total investment in fixed assets of transport, storage, post and telecommunication, railway length, number of fixed line telephones for will be used to check the actual strength of different provinces.

Panel data means data series observations of a number of individuals, observations in panel data involve at least two dimensions; one is a cross-sectional dimension, indicated by subscript *i*, and other one is a time series dimension, indicated by subscript *t*.

$$Y_{it} = \alpha_1 + \beta' X_{it} + u_{it}$$

1) CIA – The World Factbook(ed.), https://www.cia.gov/library/publications/the-world-factbook/geos/ch.html.(last retrieved 01/2011.)

Where i=1, ⋯, N , t =1, ⋯, T. The stochastic process {yit} is used for panel individuals. To avoid spurious regression, the series considered in a particular study should be stationary, which can be checked by employing unit root test. The main panel data method has clear advantages in considering cross-section data and time series data together. Moreover, by identifying fixed effects, this model is helpful to consider differences between individuals, and it is able to improve the estimation efficiency. Also, co-integration test can be used to test the long run equilibrium relationship between variables with the same order of integration. Consequently, a three-step procedure is proposed: In step 1, the panel-based unit root test is proposed which allows for individual special intercepts and time trends. Step 2 will estimate the ratio of long run to short run innovation standard deviation of each individual. In the final step, we will estimate the panel pooled model with fixed effect. The subsidiary method in this research is factor analysis, factor analysis is a statistical method which is used to describe variability among observed, correlated variables in terms of a potentially lower number of unobserved variables called factors. And Factor analysis searches for such joint variations in response to unobserved latent variables. Specifically, there are 13 original variables regarding logistics network in this research. Due to the potential multicollinearity existing among the original variables, factor analysis is used for dimension reduction and simplicity.

3. Subsidiary Method: Factor Analysis

The subsidiary method in this research is factor analysis-factor analysis[2] is a statistical method which is used to describe variability among observed, correlated variables in terms of a potentially lower number of unobserved variables called factors. Factor analysis (FA) which is a method first introduced by Thurstone(1931), is performed to reduce correlational variables into a smaller number of factors by examining pattern of correlations between observed variables. In other words, it means highly correlated variables are likely influenced by the same factors while lowly correlated variables are likely influenced by different factors. Consider a set of m observable and correlated random variable, $x_1, x_2, \cdots, x_m$. By using FA, original variables can be written as linear combinations of n unobserved random factors plus the error terms. Then, the specification is:

$$
\begin{aligned}
x_1 &= a_{11}f_1 + a_{12}f_2 + \cdots + a_{1n}f_n + \varepsilon_1 \\
x_2 &= a_{21}f_1 + a_{22}f_2 + \cdots + a_{2n}f_n + \varepsilon_2 \\
&\vdots \\
x_m &= a_{m1}f_1 + a_{m2}f_2 + \cdots + a_{mn}f_n + \varepsilon_m
\end{aligned}
\tag{1}
$$

where f_i, i=1, 2, ⋯, n denotes the unobserved random factors while ε_i is the error terms. To reduce the number of variables, n should be lower than m. Furthermore, ε_i are independently distributed with zero mean and finite variance, which maybe not as same as for all i. Factors, $f_1, f_2, \cdots f_n$, are uncorrelated. By solving (1), a number of correlated variables can be transformed into a smaller number of uncorrelated factors containing most original information. More

2) http://en.wikipedia.org/wiki/Factor_analysis

technique details can be found in Akaike(1987), Ledesma and Valero-Mora(2007). And Factor analysis is used to search joint variations related to unobserved latent variables. Specifically, there are 13 original variables regarding logistics network in this research. Due to the potential multi-collinearity existing among the original variables, factor analysis is used for dimension reduction and simplicity.

Ⅴ. Empirical Results and Analysis

Firstly, the suitability of factor analysis has to been checked before analysis, which is achieved by KMO test. According to the result presented in Table 2, KMO statistic values between 0 and 1, the degree which is closer to 1 means that a correlation between variables is strong and the results of factor analysis are better. The corresponding values of the corresponding suitability of factor analysis as followed in the table: (see Table 2). As showed in Table 3, KMO〉 0.7, and Bartlett's test χ^2= 3979.791, P 〈0.05. So form this P value, the analysis can be carried out and the original variables are suitable for factor analysis. Therefore, this study applies SAS9.2 statistical analysis software to conduct factor analysis of the original data.

Secondly, by using the factor analysis, four factors can be identified, factor 1, 2, 3 and 4, which accounts for more than 80% of the total variation. with the help of principal component analysis method, the original 13 indicators belong to four main factors, which can fully reflect the original factor structure evaluation information.

From Table 4, there are four main factors F1, F2, F3, and F4 in order to get the logistics evaluation after factor analysis system, in this paper, we named F1 industry indicators because variables belong to it are mostly represent the industry development level, like passengers in traffic, then we name F2 infra indicators and named F3 to development indicators, F4 is named to been human indicators. According to the proportion and size of load about each indicator on each of the main factors, that can be seen (see Table 4). Meanwhile, the score and coefficient of

Table 2. Suitability of Factor Analysis

KMO statistics	Factor analysis for degree	KMO statistics	Factor analysis for degree
≥0.9	fit well	0.6-0.7	Average
0.8-0.9	suitable	0.5-0.6	inappropriate
0.7-0.8	general	≤0.5	unearthly

Table 3. KMO and Bartlett's Test of Sphericity results

KMO test	Bartlett's test		
KMO	χ^2	DF	P
0.788	3979.79122968	78	0.000

each factor can be obtained and reported in Table 5. Then, According to the factor score, taking Variance contribution rate of each of the main factors as the weight proportion of the total variance contribution rate of re-weighted average, a comprehensive evaluation model will be developed:

$$F= 0.6014\ F1+ 0.1856\ F2+ 0.1104\ F3+ 0.1025\ F4$$

F indicates logistics composite situation score, F1-F4 factors represented by the factor scores calculated by Factor score function. With higher score of F, it means more higher the level of logistics situation.

Thirdly, to estimate the panel model with fixed effect, the following steps can be followed. Step 1 is to check whether the series is stationary. As shown in Table 6, Δln value is less than 0.05, so all variables are stationary after taking first difference. LLC, ADF-Fisher unit root tests provided in Eviews 6.0 are applied.

In step 2, From the Table 7, in the test result, P value is less than 0.05, also in Table 8, p val-

Table 4. The Evaluation Indicator System

system	Sub-system	indicators
logistics indicators	F1: Industry Indicators	X1; X2 X3 X4 X7 X5 X6 X8 X11
	F2: Infra Indicators	X12 X13
	F3: Development Indicators	X9
	F4: Human Indicators	X10

Table 5. Factor Score Coefficient

variables	F1	F2	F3	F4
X1	0.15235	0.02215	0.04307	-0.24912
X2	0.04456	0.13608	0.14313	-0.12097
X3	0.03539	0.16839	0.09601	0.12892
X4	0.13171	-0.07201	-0.03252	0.50368
X5	0.23874	0.04487	-0.15258	-0.00822
X6	0.07765	-0.22307	0.26806	0.1906
X7	-0.18203	-0.09204	0.63897	-0.1974
X8	0.25601	0.01528	-0.14674	-0.05414
X9	0.20866	-0.22022	-0.35178	-0.27228
X10	-0.05271	0.075	-0.05709	0.53401
X11	0.35433	-0.19029	-0.23621	-0.02819
X12	-0.08405	0.42285	-0.14187	0.16798
X13	0.00863	0.3074	-0.04915	-0.17376

Table 6. Results of unit root test and co-integration test

	LLC	ADF-Fisher
lnGDP	0.0332	1.0000
⊿lnGDP	0.0000	0.0000
lnK	0.0000	0.7905
⊿lnK	0.0000	0.0342
lnL	0.0000	0.4189
⊿lnL	0.0000	0.0007
lnH	0.0001	0.9870
⊿lnH	0.0000	0.0010
lnT2	0.0000	0.0760
⊿lnT2	0.0000	0.0000

Table 7. Kao Residual Co-integration Test

	t-Statistic	Prob.
ADF	-4.645937	0.0000

Table 8. Pedroni Residual Co-integration Test

	Statistic	Prob.	Weighted Statistic	Prob.
Panel PP-Statistic	-11.00300	0.0000	-14.50906	0.0000
Panel ADF-Statistic	-5.235763	0.0000	-8.177906	0.0000

ue is 0 means the impact of logistics to economic is significance and positive. Co-integration test is conducted to investigate long term relationship between variables, which is reported in Table 7 and Table 8. As indicated by Kao residual co-integration test and Pedroni Residual Co-integration Test, a long term equilibrium relationship is suggested between logistics development and economic growth.

Step 3 is to estimate a pooled regression model as a benchmark model. From Table 9, the coefficient of variable F and GDP is 0.232 which means when logistics development increases 1 unit; the total GDP will increase 1.232 units. It is clearly seen that all inputs involving capital, labor and logistics have significant and positive contribution to economic growth, which is reflected by the corresponding p-values. Moreover, the economy presents a slight effect of increasing return to scale because the sum of all coefficients except constant is more than one.

Table 9. linear regression results

Variable	Coefficient	t-Statistic	Prob.
C	0.563	13.09	0.000
LNK	0.452	18.83	0.000
LNL	0.364	15.83	0.000
LNF	0.232	19.30	0.001
R-squared	0.9536		
Prob(F-statistic)	0.000000		

Table 10. Results of Hausman test

Variable	(b)FE	(B) RE
C	0.643	0.582
LNK	0.537	0.553
LNL	0.465	0.467
LNF	0.104	0.049
Prob〉chi2 =	0.000000	

Table 11. Fixed-effects model

Variable	Coefficient	t-Statistic	Prob.
C	0.582	12.90	0.000
LNK	0.553	19.75	0.000
LNL	0.467	16.10	0.000
LNF	0.494	35.30	0.001
R-squared	0.9637		
Prob〉 chi2 =	0.000000		

The following step is to estimate the panel data model. Before estimating the model, to decide between fixed or random, we use the Hausman test where the null hypothesis is that the preferred model is random effects vs. the alternative the fixed effects. The test result is given in Table 10. According to the p-value (smaller than 0.05), a fixed effects model rather than a random-effects model is suggested. Then, a panel data model with fixed effect is estimated and reported in Table 11. From this table, we find that the coefficient of logistics development is 0.494, which is positive and significant meaning the impact of logistics development on economic growth is significance and positive. Moreover, from the perspective of elasticity, one unit change in logistics development will result in 0.494 unit changes in economic growth. Compared the contribution of labor and logistics development to economic growth, it is clear that logistics development is more substantial.

Finally, to investigate the disparities of the impact of logistics network on economic growth, a cross-region analysis is also performed in this research. Though the development of modern logistics is going into the rapid growth stage in China recent years, China logistics network is still in the primary modern logistics. Some provinces like Hubei, Hena which is located inland is lower intensification, specialization and standardization compared with modern logistics in coastal developed area like Shanghai, Zhejiang province. To identify the impact of logistics on economic growth across regions, we classify the provinces into 4 regions (see Figure 1) based on their geographical location, as we all know one of the basic characteristics of the Chinese economy is unequal development across regions: the developed eastern coastal region, the developing central region, and the lagging western region. The classification is preferred for the reason that there is a significant difference in growth rates and logistics network between the coastal provinces and interior provinces and on average, coastal region is better than interior region and others regions:

1. Eastern Region: Beijing, Tianjin, Hebei, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong and Hainan.(see Figure 1: region 1)
2. Northeast Region: Liaoning, Jilin and Heilongjiang. (see Figure 1: region 2)
3. Middle Region: Shan-xi, Anhui, Jiangxi, Henan, Hubei and Hunan.(see Figure 1: region 3)
4. West Region: Inner Mongolia, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia and Xinjiang.(see Figure 1: region 4)

The cross-region estimation coefficient for logistics development is shown in Table 12. lNF means the comprehensive development level in this area and then Checked the relationship of it with GDP of China, from the table, P value is less than 0.05, the coefficient of East Region between GDP is 0.526, which means logistics development has the highest contribution to economic growth in the eastern region, followed by the northeast region, middle region, and the lowest contribution appears in the western region. It seems that Chinese government should make right policy for western China and be helpful to reduce regional inequality.

Fortunately, in recent years, the government takes some measures to deal with the problem

〈Table 12〉 Comparison of regions fixed effects model

Variable	Coefficient	Prob.
LNF ER	0.526	0.000
LNF NR	0.195	0.028
LNF MR	0.136	0.002
LNF WR	0.124	0.005

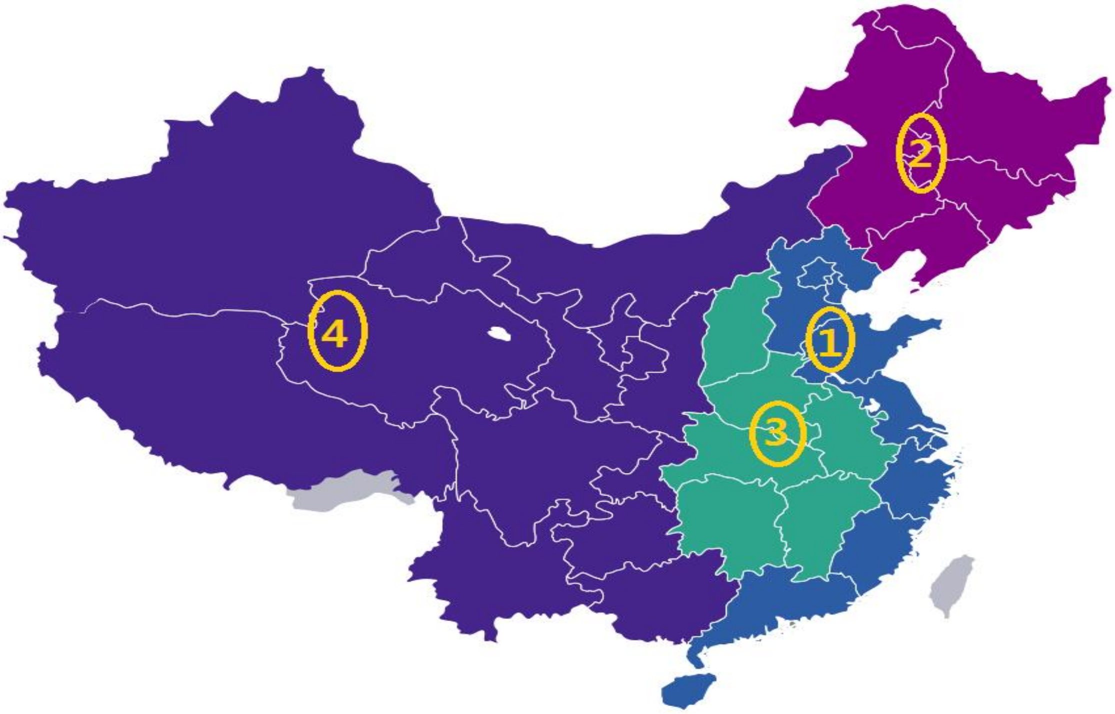

Figure 1. Map of Chinese economic regions

of regional inequality, among which, to develop logistics systems in Western and Central China is an important action. According to the sequences of introduction in each provinces, the level of economic development has presents the difference in each province. With the economic globalization and information of today, each province in China must pay attention to the advantage of the favorable development of logistics to seize the opportunity to achieve the economic catch-up strategy for this century.

VI. Conclusions

This paper provided more detailed insights into the significance of logistics network to economic growth based on the data of 31 provinces of China from 2003 to 2012 for using a comprehensive model. According to the results of factor analysis results, for operating evaluation model, logistics composite situation score F can be obtained to present the comprehensive assessment of each 31 province about the level of their logistics network. On the other hand, following the panel data analysis, the impact of logistics development on economic growth is significance and positive, while compared the contribution of labor and logistics development to economic growth, it is clear that logistics development is more substantial.

Moreover, as there are many provinces in

China, the level of logistics development also different with each other, according to the analysis, we found that the logistics development has the highest contribution to economic growth in the eastern region, followed by the northeast region, middle region, and the lowest contribution appears in the western region. It appears that Chinese government should make focused policy for western part of China and to reduce regional inequality between east and western part of China. while, high logistics ability encourages better regional economic cooperation. Improve- ment of regional logistics ability in China will cut down logistics costs and enhance intra-regional trade and other activities.

The policy implication for other nations, in particular for developing nations, is logistics network should be regarded as an important driving force for economic development, and investment should be made in advance to achieve the best efficiency in economic development and planning.

More research is needed to investigate how rationally and effectively to allocate public resources in view of China's government among different types of factors related to logistics network, so get the improvement of economic in each regions.

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중국의 물류네트워크 및 경제발전

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국문요약

물류시스템은 점점 더 중국의 경제성장을 위한 중요한 원동력 중 하나로 인정받고 있습니다. 물류효과의 폭이 넓어의 범위와 중국의 물류인프라, 물류산업의 발전과 함께 급속한 발전을 이루었습니다.

이 논문은 중국에서 2003년부터 2012년까지 기간 동안 31 지방을 포함하는 데이터 집합을 사용하여, 물류 발전과 경제 성장 사이의 관계를 조사합니다. 요인분석은 국가경제성장의 물류의 발전에 미치는 영향을 정의물류함수의 전체평가를 얻기 위해 적용됩니다.

고정효과패널 데이터의 접근방식에 따르면, 중국의 경제성장에 물류발전의 중요하고 긍정적인 영향은 그사이에, 해안지방과 내장 지방 사이 의 경제발전에 대한비교분석 도 실시, 발견된다. 결과는 경제성장에 물류발전의 영향은 서부지역에 비해 동부지역에서 높은 것이 좋습니다.

주제어 : 물류네트워크, 경제성장, 고정패널데이터모델, 요인분석.