CSCanada
International Business and Management
Vol. 9, No. 2, 2014, pp. 8-16
DOI:10.3968/5791

ISSN 1923-841X [Print]
ISSN 1923-8428 [Online]
www.cscanada.net
www.cscanada.org

The Space Panel Econometric Study of Provincial Industrial Structure Rationalization in China

GAO Yuandong[a]; ZHANG Weiguo[b]; SUN Hanlin[c],*

[a] College of Economics and Management in Southwest University, Chongqing, China. Doctor of Economics jointly raised by China and Japan, the associate professor and the tutor of master for economic management college, mainly engages in industrial structure, agriculture, rural economy and spatial econometric study.
[b] College of Economics and Management in Southwest University, Chongqing, China. The professor and the tutor of Doctor of the economic management college, now is the President of Southwest University, and mainly engages in industrial economy and relating research.
[c] The master of the economic management college in Southwest University, Chongqing, China.
*Corresponding author.

Supported by the Major Program of National Social Science Foundation of China (12&ZD100), the National Social Science Foundation of China (14BJY125), the Social Science Foundation of Ministry of Education of China (12YJC790041), the China Postdoctoral Science Foundation (2013M540687), the Key Program of Humanities and Social Science Key Research Bases in Chongqing (13SKB020), the Key Program of Higher Education Teaching Reform Research in Chongqing (132061).

Received 22 August 2014; accepted 19 October 2014
Published online 30 November 2014

Abstract
The intensive study on the mechanism of rationalization of industrial structure has not been found in previous literature. And effects of influencing factors on rationalization of industrial structure have not been measured more fully. Therefore, this paper analyzes the mechanism of rationalization of industrial structure by presenting a theoretical model from a capital point of view, determines the factors influencing on rationalization of industrial structure and allocates index to them accordingly. In addition, we develop a spatial econometric model of the rationalization of industrial structure, which is estimated by utilizing Chinese provincial panel data over the periods 1992-2011. The results show, that the spatial interdependence of the rationalization of industrial structure between provinces is significant and positive, and promotion effects of per capita GDP, government consumption, domestic physical capital and FDI on the rationalization of industrial structure in this province are positive significantly, and so on.

Key words: Rationalization of industrial structure; Influencing factors; Spatial panel econometrics

Gao, Y. D., Zhang, W. G., & Sun, H. L. (2014). The Space Panel Econometric Study of Provincial Industrial Structure Rationalization in China. *International Business and Management, 9*(2), 8-16. Available from: http://www.cscanada.net/index.php/ibm/article/view/5791
DOI: http://dx.doi.org/10.3968/5791

INTRODUCTION
The previous studies of the optimization and upgrade for industrial structure both at domestic and abroad from the perspective of factors, which are mainly focused on three aspects as follows. First, analyzing the present situation and evolution trend of the industrial structure. Such as Guokesha (1999), from the time dimension, the international comparison and industry internal part, analyzes the characteristics and trend of changes in industrial structure in China, foresees the transformation trend of industrial structure, and puts forward some suggestions to problems; Lu (2002) analyzes the change trend of industrial structure in the west of China; Li (2012) compares and analyzes the coefficient of similarity for regional industrial structure, the convergence characteristics of the structure of traditional industry and of strategic emerging industries; Zhu et al. (2013) predict the evolution of Chinese industrial structure by applying Markov model, and etc.. Secondly, doing theoretical research or empirical analysis on some factors, which influence the optimization and upgrade of industrial structure. Such as, Clark (1938) and Kuznets (1961) find that the dominant industry is in the evolution with the increase of per capita income. Bergeron (1998), Malerba (2007) studied that technological innovation had an effect

on industrial structure. Fujita et al. (1999), Iammarino and McCann (2006) found that industrial clusters can promote the optimization and upgrade of industrial structure through the spread of trade and knowledge. Kim (2007) found that FDI plays an active role in the industrial structure upgrade. Chen et al. (2011) analyzed the mechanism of industrial innovation promoting industrial structure optimization, and did empirical research which based on the data of Fujian province, finally put forward suggestion about industrial innovation promoting industrial structure optimization. Zhou et al. (2001) studied the mutual relationship between technological innovation and upgrade of industrial structure in China; Dai and Bie (2006) study the relationship between human capital and industrial structure upgrade in developing countries by using the dynamic comparative model; Cai et al. (2011) quantitatively analyze effects of scale and structure of consumption on industrial structure optimization in China; Zhang and Gao (2012) study the effect of fiscal stimulus policy and tax policy on the adjustment of industrial structure by using general equilibrium model. Thirdly, study the factors influencing the evolution of industrial structure. Dong et al. (2011) comprehensively analyzes of the factors affecting the evolution of industrial structure in China, which includes GDP per capita, income gap between urban and rural areas, workforce, and so on. Zhang (2009), Wei (2008), Jiang (2006) and others discuss the various factors that affect industrial structure, but there is difference on the analysis of factors, and there is no specific quantitative indicators. Xu (2003), Huang et al. (2008) regard factors as a whole, quantitatively study the effect of factors on industrial structure optimization by intervention model, but fail to distinguish the concrete effect of factors on industrial structure. In addition, Feng (2012), Zhang (2013), from the perspective of different factors, using panel data, quantitatively analyze the effect of factors for the industrial structure changes in all domain and different area of China. In general, the existing research lack systematic analysis of the inner mechanism for industrial structure optimization, and there are some differences of the results for concrete factors on industrial structure optimization; more importantly, it fails to quantitatively measure the effect of factors on industrial structure optimization; in addition, the line is coarse, and it fails to further rationalization and upgrade till the reasonable and higher-class quantitative analysis of industrial structure.

Rationalization of industrial structure is one of the core for industrial structure optimization, is the basis of industrial structure upgrade, and is dynamic and changing. At present, there are many different definitions of industrial structure rationalization, based on the coordination of industrial structure, function and the allocation of resources and so on. Combining various ideas, it argues that industrial structure rationalization: first of all, refers to the output value proportion, resources possession ratio, and etc. within the industry of thrice industrial, they should be matched with the development of economy, should conform to the development goals of economic subject in certain period; the second one is the growth and development of industries should coordinate with each other; thirdly, the change of industrial departments should comply with the general laws of economic development. In the field of industrial structure rationalization, Wang et al. (2002) using input-output analysis method, put forward the model of quantitative analysis for industrial structure rationalization. Jiao et al. (2004) present a new method to define the connotation of rationalization of industrial structure, and discuss the relationship between rationalization and upgrade of industrial structure. Based on the theory that the rate of return on capital in each industry has a average trend, Wang and Cao (2009) establish the theoretical model, but they fail to make an empirical analysis. Wang and Mei (2011), Li (2013) mainly construct index system of industrial structure rationalization, and adopt different methods to measure the degree of industrial structure rationalization. Most of the existing analysis of industrial structure rationalization are qualitative analysis of industrial structure rationalization; there are theoretical models in some books, but the models don't work well, which are difficult to have empirical analysis, also they lack the analysis of internal mechanism for industrial structure rationalization.

In order to quantitatively study the influence of factors on industrial structure rationalization, from the view of capital, this article analyzes the internal mechanism of industrial structure rationalization, finds out the factors of industrial structure rationalization and its quantitative indicators, measures the level of industrial structure rationalization based on the concept of order degree; at the same time, consider the spatial effect of variables, build space panel econometric model, do the empirical analysis by using panel data of Chinese province from 1992 to 2011, and study the influence of factors on industrial structure rationalization and possible spatial spillover. Different from existing research, the innovation of this article is mainly two points: (1) Based on the view of capital, analyze the internal mechanism of industrial structure rationalization, provide scientific evidence for the selection of factors that influence the development of industrial structure rationalization; (2) propose spatial econometric model of industrial structure rationalization, apply the latest method of space measurement, and do empirical research based on the panel data of Chinese provinces.

1. THE INTERNAL MECHANISM OF INDUSTRIAL STRUCTURE RATIONALIZATION: BASED ON THE VIEW OF CAPITAL

In order to analyze the internal mechanism of industrial structure rationalization from the perspective of capital, we assume that: (1) The three industrial sectors (primary industry, secondary industry and tertiary industry) consist of national economy with clear responsibilities of their own; the different economic subjects, such as, family, enterprise and government, make a decision which type of industry to invest according to profit-driven capital. (2) The scale of economy is stable, market mechanisms are complete, the social system is full of elasticity, social resources can free flow between the various sectors, the combination of industrial capital and other factors, such as labor, always reach the optimal state. (3) Capital is homogeneous. Based on the above assumption, in certain conditions of resource constraints, the construction of national production function is as follows from the perspective of capital:

$$\begin{cases} Y = f(K_1, K_1, K_3) \\ s.t.\ \ K_1 + K_2 + K_3 = K \end{cases} \quad (1)$$

Y is on behalf of social gross output, K_1 on behalf of the capital invested into the first industry, K_2 on behalf of the capital invested into the secondary industry, K_3 on behalf of the capital invested into the tertiary industry, K on behalf of the total capital provided by three major industrial sectors is certain. Due to the scale of economy is stable, output function is a homogeneous function, so actual output function can be transformed into:

$$Y = K_1 * f(1, K_2/K_1, K_3/K_1) \quad (2)$$

$$\text{Namely } Y/K_1 = f(K_2/K_1, K_3/K_1) \quad (3)$$

If $y = Y/K_1$, $k_2 = K_2/K_1$, $k_3 = K_3/K_1$, The output function can be further transformed as:

$$Y = K_1 y = K_1 f(k_2, k_3) \quad (4)$$

If formula (4) makes a partial derivative to K_1, K_2, K_3 respectively, then:

$$Y'_{K_1} = f(k_2, k_3) - k_2 f'_1(k_2, k_3) - k_3 f'_2(k_2, k_3) \quad (5)$$

$$Y'_{K_2} = f'_1(k_2, k_3) \quad (6)$$

$$Y'_{K_3} = f'_2(k_2, k_3) \quad (7)$$

Obviously, the production function meets the form and nature of the new classical economic growth model put forward by Solow (1956). Therefore, according to above assumes, the actual output function must have the relationships and features as follows:

$$k'_2 = k_2(K'_2/K_2 - K'_1/K_1) = \sigma_2 f(k_2, k_3) - nk_2 \quad (8)$$

$$k'_3 = k_3(K'_3/K_3 - K'_1/K_1) = \sigma_3 f(k_2, k_3) - nk_3 \quad (9)$$

$$Y'/Y - n = \delta(k_2)(K'_2/K_2 - n) + \delta(k_3)(K'_3/K_3 - n) \quad (10)$$

Indeed, $\delta(k_2) = k_2 f'_1(k_2, k_3)/f(k_2, k_3)$ and $\delta(k_3) = k_3 f'_2(k_2, k_3)/f(k_2, k_3)$ are on behalf of the elasticity of capital output in the primary industry and secondary industry respectively, $n = K'_1/K_1$ on behalf of the growth rate of capital in primary industry, $\sigma_2 = K'_2/Y$, $\sigma_3 = K'_3/Y$ respectively on behalf of the invested capital increment ratio of actual output in the secondary industry and tertiary industry.

From formula (8), (9), if n, σ_2 and σ_3 remain constant, the whole economy is in a state of steady growth, the proportion of capital allocation in the primary industry, the secondary industry and the tertiary industry is desirable (when $k'_2 = k'_3 = 0$). From formula (8) - (10), if the proportion of K_2 and K_3 is desirable, then $Y'/Y = K'_2/K_2 = K'_3/K_3 = K'_1/K_1 = n$, namely, the actual output and the capital of three industry will grow at the same speed, at that time, the economic growth facilitates the growth of the stable equilibrium path. As Rostow (1962) mentioned, the evolution of industrial structure is the economic growth learns from the scientific and technological innovation, as well as the process of change in leading industry departments. As an important dimension of the industrial structure evolution, industrial structure rationalization has a strong stability with economic growth; steady economic growth matches the higher level of industrial structure rationalization (Gan et al., 2011). Believe it, when there is a table equilibrium path of economic growth, at the same time, industrial structure matches economic development well, and the level of industrial structure rationalization reaches a peak stage.

Chenery, *Robinson*, *Quinn* found, with the development of economy, the increase of income and the improvement of consumption structure will drive the upgrade of industrial structure, and the optimize and upgrade industrial structure fundamentally are caused by the change of consumption structure. As shown in Figure 1, capital achieves balanced allocation in the industrial sectors, and the industrial structure matching the economic development realizes the rationalization, which assumed as the state 1 of industrial structure rationalization. Along with economic development, the increase of income, the improvement and changes of consumption structure (including personal consumption structure, governmental consumption structure, and etc.), they all prompt the science and technology innovation of relating industry, and induce the change of profit margins in each industry department; and the change of the profit margins further causes the flow of capital in each industry department, directly promotes the changes of industrial structure rationalization, and ultimately achieves the balanced allocation of capital in various industry departments at equilibrium 2, reached a new state 2 of industrial structure rationalization. Thus, the effect of capital on industry and its adjustment process are endless, as long as there is science and technology innovation of consumption structure or certain industry department, profit margins are changed, the capital flow in each industry will be started up again, pushing the change of the state in industrial structure rationalization.

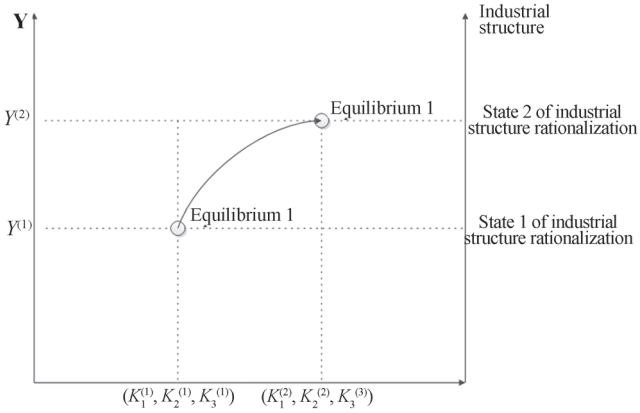

Figure 1
The Dynamic Change of Industrial Structure Rationalization Driven by Capital

2. THE MEASUREMENT OF DEGREE FOR INDUSTRIAL STRUCTURE RATIONALIZATION AND THE SELECTION OF INDICATORS OF FACTORS

2.1 The Calculation of Rationalization Level of Chinese Provincial Industrial Structure

To analyze factors of industrial structure rationalization and its effect on rationalization level, first of all, it is needed to measure the level of industrial structure rationalization. In this article, adapt the order degree of industrial structure method put forward by Liu (2004) and others to measure the order degree of Chinese provincial industrial structure from 1992 to 2009, reflecting the degree of the industrial structure rationalization. As shown in Figure 2, the average of order degree in provincial industrial structure of our country continues to rise. Among them, the order degree of industrial structure in eastern region during 1992-2002 continues to rise, and there is a downward trend afterward. In middle and western region, the order degree of industrial structure is keep rising after 1992, which fits the conclusion of Lu (2002) who studied the industrial structure of western region. Thus, comparing with western region, in our country, the degree of early industrial structure rationalization the western region is lower, but afterward, its adjustment speed is high. It also reflects the certain achievements that we gained from the implementation of western development, the middle and western industrial structure adjustment and other major strategies in our country.

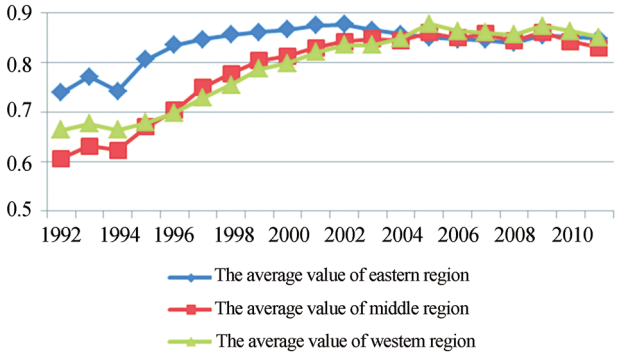

Figure 2
The Order Degree of Industrial Structure in Eastern, Middle and Western Region in our Country

2.2 The Selection of Indicators for Factors that Influence the Rationalization of Industrial Structure

Based on the analysis of internal mechanism for industrial structure rationalization, and the affection of the system during the process of industrial structure change (Jiang et al., 2006); in this article, we summarize the factors of the industrial structure rationalization into four categories, which are social needs, the innovation of science and technology, the supply of human resource, and the effect of system.

(1) Social needs. Social needs include consumer demand, demand for investment and export demand (because there is using the sampling data of Chinese province, export demand will not be considered). Among them, consumer demand includes personal consumer demand and public consumer demand. Personal consumer demand and public consumer demand match the individual income level; as the change of income level, the structure of personal consumption changes, which affects the development of the industry, then promotes the change of industrial structure. Therefore, in this article, the GDP per capita reflects consumer demand. In addition, the governmental consumption directly affects the consumer demand of residents; especially the governmental consumption related to the public service, which will directly affect the public consumer demand and consumer demand of residents. Therefore, the indicator that the ratio of government consumption in GDP is a supplementary indicator of per capita income, to reflect consumer demand. Demand for investment includes the demand of investment both in fixed assets and current assets, the demand of investment in fixed assets is the proximate cause of the change of industrial structure, and the material capital reflects the demand for investment. At the same time, except the assumption of

capital homogeneity in theoretical analysis, considering the heterogeneity of FDI (Foreign Direct Investment) different from the domestic capital, in addition to capital supply, also through the spread of technology to improve technology level, then promote the optimization of industrial structure. In this article, FDI is separated from the investment in fixed assets, studying its impact on the industrial structure rationalization separately.

(2) The innovation of science and technology. Technological innovation is the motivation of industrial structure upgrade. At present, there are three ways to indirectly measure the innovation of science and technology: the first one is input method, such as, R&D funds input method; the second one is output method, such as, the number of patents; the third one is the influence of technology, such as, TFP (Total Factor Productivity). In this article, according to the estimation of technological progress put forward by Li (2008), the per capita R&D spending is adapted.

(3) The supply of human resource. The amount of human resources will directly influence the development of industry, influence the process of industry rationalization, influence the change of industrial structure. In order to measure the influence of the quantity and quality of human resources on industrial structure respectively, there are the number of labor and the level of human capital to reflect the supply of human resource.

(4) The effect of system. System plays an important role in the evolution of industrial structure. First of all, system influences the allocation of resources. There are two kinds of methods for resource allocation, namely, market allocation and planned allocation. Market is the main means in market allocation, the evolution of industrial structure is in accordance with the change of market demand. Secondly, system affects the direction of upgrade for industrial structure. System is the major factor affecting the operation of macro economy, government uses economic, administrative and legal means to guide economic development according to the predicted direction, and the development of industrial structure is also along this direction. Besides, system affects the state of upgrade for industrial structure. In order to achieve the desired goals of economic development, making industrial policies, such as, license for entrance, to affect the evolution of industrial structure. At present, the measurement of system is still difficult, there are indicators for measurement, including index of marketization, the proportion of non-state-owned enterprises in gross industrial output value, the share of non-state-owned economy in the investment of fixed assets, or its composite index, and so on (Fu et al., 2006). Considering the important effect of the investment of fixed assets on industrial development and the availability of data, in this article, the quantitative index of system adapted, which is the proportion of non-state-owned economy in the investment of fixed assets around the whole society.

3. THE DESIGN OF MODEL FOR INDUSTRIAL STRUCTURE RATIONALIZATION AND EMPIRICAL RESEARCH

3.1 Sample Data and Variable

In this article, the samples of empirical analysis includes 28 provinces of China (municipalities directly under the Central Government, autonomous region), except for HongKong, Macao special administrative region, Taiwan, Qinghai province, Hainan province and Tibet autonomous region. All sample data are derived from *The New Chinese Statistical Data of 60 Years Assembly*, each relating journal of *Chinese Statistical Yearbook* during 1991-2012, the each relating journal of *Statistical Yearbook for Chinese Labor* during 1993-2012. Digital maps are from the website http://www.fas.harvard.edu/~chgis/, and adjust them according to needs.

The designs of variable are as follows: (1) The per capita GDP (PCGDP). It gained that the historical provincial GDP per capita is divided by GDP index. (2) GE is the government spending as a share of GDP. It is in the consumer spending of each province government as a share of GDP. (3) The domestic material capital (DK). Expressed as a domestic stock of fixed assets. In this article, the FDI is removed from the fixed investment of each year, after the adjustment of price index of investment in fixed assets, with the depreciation rate of 5% for allowance according to the perpetual inventory method. (4) The Foreign Direct Investment (FDI). According to the exchange rate of that year, in the province using dollars as the unit, actual use of the amount of the historical provincial FDI converts into RMB, according to the same domestic material capital calculation method. (5) R&D spending per capita (PCR&D). R&D spending in China mainly comes from the state financial input, therefore, in this article, the variable is gained that the science and technology spending of historical provincial fiscal expenditure is divided by provincial population. (6) The number of labor (L). It is showed by the number of the historical provincial workers. (7) The level of human capital (h). In this article, acquisition of education is the index to show the level of human capital (Barro & Lee, 2000; Yue et al., 2006), considering the health factor, then introduces the index of average future life of labor force to make an adjustment. The formula $h = E_i L_i A$, E_i shows the proportion of labor force that their education are i in the whole amount of labor force, L_i shows the fixed number of year in level of the education i, A shows the index

of average future life for provincial labor[1]. (8) System (INS). It is showed by the proportion of the investment for provincial non-state-owned economy in the investment of fixed assets of each province.

3.2 The Building of Spatial Econometric Model

With the order degree of industrial structure as explained variable, GDP per capita, domestic capital and FDI and other factors of the industrial structure rationalization as explanatory variables, build a linear logarithmic model, and the form is as follows:

$$\ln ORD_{it} = \alpha \ln PCGDP_{it} + \beta \ln DK_{it} + \varphi \ln FDI_{it} + \tau \ln PCR\&D_{it} + \mu \ln L_{it} + \nu \ln h_{it} + \theta GE_{it} + \sigma INS_{it} + \varepsilon_{it} \quad (15)$$

ORD_{it} shows the order degree period of province industrial structure, reflecting the rationalization of industrial structure. Equation (15) is the model of the industrial structure rationalization without considering the space effect of variable. According to the spatial panel data model of *j. Paul Elhorst* (2010), we build the spatial econometric model of industrial structure rationalization in the following steps.

Firstly, estimate the results of model (15) for the non-space industrial structure rationalization though *Lagrange multiplier* (LM) test, to determine if the spatial lag model should be used or spatial error model is more suitable, as shown in table 1. If there are not fixed-effect model and spatial fixed-effect model, the null hypothesis that model is for the non-space industrial structure rationalization is rejected at 5% significance; that is, the model should be spatial lag model or spatial error model or spatial doberman model. However, for time-fixed effect model and space-and-time-fixed effect model, they do not reject null hypothesis, namely, the non-space model should be used (15).

Table 1
Lagrange Multiplier (LM) Test

		LM value	*P* value
Pooled OLS	LM spatial lag	12.6245	0.000
	LM spatial error	28.0377	0.000
	Robust LM spatial lag	6.9457	0.008
	Robust LM spatial error	22.3589	0.000
Spatial fixed effects	LM spatial lag	41.1811	0.000
	LM spatial error	21.4628	0.000
	Robust LM spatial lag	33.3266	0.000
	Robust LM spatial error	13.6083	0.000
Time-period fixed effects	LM spatial lag	0.2182	0.640
	LM spatial error	1.9115	0.167
	Robust LM spatial lag	4.3665	0.037
	Robust LM spatial error	6.0597	0.014
Spatial and time-period fixed effects	LM spatial lag	1.5598	0.212
	LM spatial error	0.7537	0.385
	Robust LM spatial lag	1.4776	0.224
	Robust LM spatial error	0.6715	0.413

To be continued

Continued

Obviously, the determination of space or time fixed effect has an important influence on the selection of model. Therefore, it is necessary to further using *Likelihood the wire (LR)* test to determine the choices of fixed effects model. The results ($LR = 67.35$, $p < 0.01$) indicate that the spatial fixed effect of model is significant. Similarly, the hypothesis that the time-period fixed effects are not jointly significant must be received ($LR = 4.43$, $p = 4.43$). These test results justify that the model of space fixed effect should be adopted. Combing with the test result in Table 1, using space fixed effect, the hypothesis that model is for the non-space industrial structure rationalization is rejected at 1% significance,. Therefore, we should choose spatial Durbin model including the spatially lagged independent variable.

Secondly, we will test the random effect against the fixed effects model by running *Hausman* test. The results (*Hausman* = 106.51, $p < 0.01$) indicate that the hypothesis that the random effects model is more efficient must be rejected, namely, adopting the fixed effect is more appropriate for model .

Thirdly, we do *Wald* tests to detect whether the spatial Durbin model can be simplified as the spatial lag model or spatial error model, as shown in the estimated results (*Wald* = 156.18, $p < 0.01$; *Wald* = 191.76, $p < 0.01$), both hypothesis must be rejected. Thus, the spatial lag model or spatial error model must be rejected in favor of the spatial Durbin model. Based on the above tests, the model specification is as follows:

$$\ln ORD_{it} = \alpha \ln PCGDP_{it} + \beta \ln DK_{it} + \chi \ln FDI_{it} + \tau \ln PCR\&D_{it} + \mu \ln L_{it} + \nu \ln h_{it} + \theta GE_{it} + \sigma INS_{it} + \omega W \ln PCGDP_{it} + \varphi W \ln \mathrm{DK}_{it} + \phi W \ln FDI_{it} + \eta W \ln PCR\&D_{it} + \zeta W \ln L_{it} + \nu W \ln h_{it} + \pi WGE_{it} + \rho WINS_{it} + \rho W \ln ORD_{it} + s_i + \varepsilon_{it} \quad (16)$$

s_i stands for spacial fixed effect, ε_{it} stands for random error and W for spatial weight matrix. Model (16) is the final spatial econometric model of industrial structure rationalization.

The construction of spatial weight matrix W is to define the mutual relationship between spatial units, mainly can be constructed based on geographical relationship and social economy relationship. Because spatial weight matrix W constructed based on social and economic variables is likely to have multi-collinearity,

[1] The index A of the average future life for provincial labor, which gains through the average future life of provincial population is divided by the minimum of an area. Since there are censuses of population only 2 times after reform and opening, only provincial future life in 1990 and 2000, in order to achieve comparability between data, in the samples before 2000, the calculation of human capital level uses the index of future life in 1990; after 2000, the calculation of human capital level uses the index of future life in 2000.

therefore, in this article, we build W on the basis of geographical relationship. According to the method put forward by Anselin (1988), there are three building criterions: contiguity criterion, distance criterion and k - nearest criterion. This article is the spatial econometric study based on the provincial panel data in China. Because eastern provincial area of China is small, well developed, and the density of population is high; while the western area is vast, less developed, and the density of population is low; because of the unique geographical structure of China, so it is not reliable to build spatial weight matrix W based on distance and k-nearest criterion. Moreover, the use of k-nearest criterion, forcibly gives the number of k of the nearest neighbors for every spacial unit, also destroys the inherent geographical structure of space unit, and cannot accurately quantifies the relationship between space units. Therefore, we choose contiguity criterion to construct spatial weight matrix W, to build each element w_{ij} of W according to the following principles, and standardize W (Anselin, 1988).

$$w_{ij} = \begin{cases} 1 & Region(i)\ share\ a\ common\ side\ with\ region(j) \\ 0 & others \end{cases} \tag{17}$$

3.3 The Results of Estimation

Estimate the spatial econometric model of industrial structure rationalization, and the results are shown in Table 2. Per capita GDP, government spending, domestic capital and FDI, they all have significantly positive role in promoting the rationalization of industrial structure; among them, the impact of government consumption on industrial structure rationalization is biggest, reflecting the government consumption has a great influence on consumer demand, and ultimately improve the level of industrial structure rationalization. Besides, if the sum of estimated coefficient value of per capita GDP and government consumption is more than 0.5, which confirms the theoretical analysis that consumption demand is the fundamental factor to promote the industrial structure rationalization, and the change of consumption demand has a decisive influence on the development of industrial structure rationalization, pointing out the key way to improve Chinese industrial structure rationalization level, and this is consistent with the conclusion of Sun (2008) that the improvement of demand space can promote the optimization of industrial structure. In addition, it is shown in the spacial lagged coefficient estimation of per capita GDP and government consumption, the two indexes affecting consumer demand have significant positive spacial spillover, that is, the improvement of consumption level and structure in a province will effectively promote the degree of industrial structure rationalization in adjacent provinces.

The preferential structure of FDI increased the structural deviation of the industrial structure in China, and hinders the rationalization of industrial structure; at the same time, FDI significantly promotes the development of social services, deposits, post, telecommunications and other industries, and has a positive effect on the rationalization of industrial structure. As a result of two-way roles both positive and negative, the empirical results show that FDI has a positive role in promoting the rationalization of industrial structure, but the effect is small (the coefficient estimation is 0.0294). With the development of economy in our country, the orientation of foreign policy is more clearly, reasonable; through the reasonable norms and guidance to foreign capital, FDI has a positive effect on the adjustment and upgrade of industrial structure in China, and improves the structure of industries in our country (Zhou et al., 2008). At the same time, the contrast of spatial lagged coefficient estimate of domestic capital and that of FDI, the spatial spillover of domestic capital is not significant because of its inherent geopolitical relations; but as a result of the heterogeneity of capital for FDI, FDI often shows significant spatial spillover between regions (Zhong, 2010), it is in agreement with the paper estimation results. But on the contrary to expectations, the spacial spillover effect of FDI between provinces is negative. As the study of Jiang and Zhang (2008) shows, system has important effects on the play of FDI spillover effect. In this article, the empirical results show that the system has an insignificant impact on the rationalization of industrial structure. As a result, the imperfect of industrial policy and system, and the shortcomings within the structure of FDI investment in China and distribution structure, limit the spatial spillover effect of FDI between provinces.

In contrast to the expected results, technology innovation, labor and human capital doesn't play a positive role in promoting the industrial structure rationalization. As for the reasons, mainly due to the large number and poor quality of labor in our country; moreover, due to the complementarity between technical innovation and human resources, science and technology innovation is slow, as well as science and technology fail to serve for the industrial development, which cannot effectively play the role for the promotion of industrial structure rationalization (Zhang, 2010). At the same time, the low level of human capital also limits the relative advantage of product diversification and labor costs in China, restrict the development of industry in the low-end industrial chain, hinders the process of industrial structure rationalization of China (Dai et al., 2006). But, as a result of the diffusion of technology and the externality of knowledge, the technology innovation between provinces should have significant positive spatial spillover, it has been proved in this article (the spacial lagged variable estimation of technological innovation is 0.043 at 1% significance), which is consistent with the conclusion of Cai (2008). At the same time, the spatial

lagged value of labor number is significantly positive. It reflects that the rational flow and migration of labor force between the adjacent provinces have a positive role in the improvement of industrial structure rationalization in adjacent provinces. However, the spatial spillover effect of human capital is not significant. Besides the low level of human capital in China, this is also because the system environment of human capital, the healthiness degree of labor market and the security system of free migration are not perfect (Tian et al., 2006) .

As the results of estimation show, the spatial lagged estimate of industrial structure rationalization is 0.4430, which means it is correct to use spatial Durbin model, indicates the industrial structure rationalization has significant spatial dependence between provinces, namely, the improvement of industrial structure rationalization in a province can promote the level of industrial structure rationalization on the adjacent provinces. Therefore, the provinces with higher or lower degree of industrial structure rationalization gather in different blocks in China.

Table 2
Estimation Results of Spatial Econometric Model for Industrial Structure Rationalization

The dependent variable: lnORD			
	Coefficient	**Asymptotic Value *t***	***Z* Value**
lnPCGDP	0.0842	3.3449	0.0008
GE	0.4231	3.5108	0.0004
lnDK	0.0895	5.3586	0.0000
lnFDI	0.0294	4.9486	0.0000
lnPCR&D	- 0.0502	- 4.9620	0.0000
lnL	- 0.0824	- 4.9222	0.0000
Lnh	- 0.1420	- 3.0160	0.0026
INS	- 0.0584	- 1.6087	0.1077
WlnPCGDP	0.1309	4.1068	0.0000
WGE	0.9081	4.1707	0.0000
WlnDK	- 0.0319	- 1.4918	0.1358
WlnFDI	- 0.0596	- 6.2622	0.0000
WlnPCR&D	0.0430	2.8752	0.0040
WlnL	0.1609	8.3308	0.0000
Wlnh	0.0432	0.5749	0.5653
WINS	- 0.1523	- 2.4916	0.0127
WlnORD	0.4430	10.0017	0.0000
Adj R^2	0.6141	Log-likelihood	553.37195

CONCLUSION

Based on the analysis of the internal mechanism for industrial structure rationalization, we scientifically confirm the factors and indexes of industrial structure rationalization in the paper, construct the spatial econometric model of the rationalization of industrial structure, and do empirical analysis by using the panel data of 28 Chinese provinces during 1992-2011. The results show that: (1) The industrial structure rationalization between provinces has significant spatial dependence, namely, the improvement of industrial structure rationalization in a province can promote the level of industrial structure rationalization on the adjacent provinces. (2) The per capita GDP, government spending, domestic capital and foreign direct investment, they all have significantly positive role in promoting the industrial structure rationalization in the same province; among them, the effect of government spending and GDP per capita on provincial industrial structure rationalization is biggest, and both of them have positive spatial spillover between provinces, that is, the increase of GDP per capita and government spending in a province can promote the level of industrial structure rationalization on the adjacent provinces; however, the space spillover effect of FDI is negative. (3) So far, the innovation of technology, the level of labor and human capital doesn't have significant effect on industrial structure rationalization; however, both the innovation of technology and labor have significant positive spatial spillover between provinces.

REFERENCE

Anselin, L. (1988). *Spatial econometrics: Methods and models*. Dordrecht, Holland: Kluwer Academic Publishers.

Bergeron, S. (1998). Location of innovation activities, industrial structure and techno-industrial cluster in the French economy, 1985–1990: Evidence from US patenting. *Research Policy*, *26*(7), 8-18.

Cai, H., & zhang, Y. L. (2008). The Measurement of the regional spillover for knowledge stock between regions and its research of economic effect. *Journal of Management*, *5*(4), 568-575.

Cai, S. H., Mou, D. G., & Fang, M. X. (2011). Under the emissions of carbon dioxide, the study the driving force of the industrial structure optimization in China. *Journal of Management Science in China*, *4*, 167-173.

Chen, L., Xie, B. H., & Fang, R. X. (2011). Industrial innovation for structural optimization of industry: Case of Fujian Province. *Energy Procedia*, *5*, 638-642.

Clark, B. (1938). International comparison of national income. *Weltwirtschaftliches Archiv*, *47*(1), 51-76.

Dai, Q., & Bie, Z. X. (2006). Human capital, dynamic comparative advantage and the upgrade of industrial structure in developing countries. *Journal of World Economy*, *11*, 70-85.

Dong, X. B., Song, S. F., & Zhu, H. (2011). The Industrial structure and economic fluctuation—Evidence from China. *Journal of the Social Science Journal*, *48*, 468-477.

Elhorst, J. P. (2010). Matlab software for spatial panels. *Presneted at the Ivth World Conference of the Spatial Econometrics Association*. Chicago.

Feng, F. F. (2012). *Research to the factors of the optimization and upgrade for regional industrial structure, based on the quantile of panel data, its analysis and application*. Chongqing: Chongqing University.

Fu, X. X., & Wu, L. X. (2006). Technical efficiency, deepening of capital, and regional differences, based on random objective model, the analysis of regions in China. *Journal of Economic Studies*, *10*, 52-61.

Fujita, M., Krugman, P., & Venables, A. J. (1999). *The spatial economy*. Cambridge Mass: MIT Press.

Gan, C. H., Zheng, R. G., & Yu, D. F. (2011). The effect of industrial structure change on the fluctuation and growth of economy in China. *Journal of Economic Studies*, *5*, 4-15.

Gong, L. T., & Xie, D. Y. (2004). The analysis of the flow of element between provinces and the gap of marginal productivity in our country. *Journal of Economic Studies*, *1*, 67-69.

Guo, K. S. (1999). The study of the change trend for industrial structure and policy in China. *The Management of the World*, *5*, 73-83.

Huang, Y. P. (2008). The analysis of factors for industrial structure change and model design. *Chinese Statistics*, *9*, 49-50.

Jiang, D. C., & Zhang, Y. (2008). Economic transformation and the spillover effect of foreign direct investment. *Journal of Economic Studies*, *7*, 26-38.

Jiang, Z. H., & Bai, Y. (2006). The analysis of connotation and factors for the upgrade of industrial structure. *Journal of Contemporary Economic Studies*, *10*, 53-56.

Jiao, J. W., & Li, D. J. (2004). The standard of the industrial structure rationalization. *Journal of Economic Frame*, *4*, 88-91.

Kim, Y. H. (2007). Impacts of regional economic integration on industrial relocation through FDI in East Asia. *Journal of Policy Modelling*, *29*(1), 165-180.

Kuznets, S. (1961). Quantitative aspects of the economic growth of nations：: Long term trends in capital formation proportions. *Economic Development and Cultural Change*, *9*, 1-124.

Li, F. Q., Dong, Z. Q., & Wang, L. H. (2008). System domination, factor contribution and the classification of economic growth momentum in China. *Journal of Economic Studies*, *4*, 53-65.

Li, S. F., Tang, X. W., & Dang, Y. G. (2004). The study of the order degree for industrial structure. *Journal of Economics*, *5*, 53-57.

Li, Z. (2012). The institutional cause of regional industrial structure convergence and the selection of strategy. *Journal of monetary economics*, *12*, 63-68.

Lu, Z. Y. (2002). The change trend of industrial structure, the change of environmental and the adjustment of idea in the western region. *Journal of economic studies*, *3*, 83-96.

Malerba, F. (2007). *Perspectives on innovation*. Cambridge: Cambridge University Press.

Sun, J. (2008). Demand factor, the innovation of technology and industrial structure evolution. *Nankai Economic Research*, *5*, 58-71.

Tian, Y. P., He, C., & Yu, Y. F. (2006). The reaearch research of soft environment for human capital: Based on the perspective of social security system and the segmentation of labor market. *Chinese Population*, *5*, 103-107.

Wang, C. X., & Liu, D. R. (2002). The model of quantitative analysis for the industrial structure rationalization. *Journal of Technology Economy*, *4*, 51-53.

Wang, T., & Cao, Y. X. (2009). The theory of the rationalization of industrial structure. *Productivity research*, *14*, 19-22.

Wei, X. C. (2008). The factors of the optimization and upgrade of regional industrial structure. *Journal of Economic Aspect*, *10*, 22-24.

Xu, C. Y., & Du, J. (2003). The analysis of factors for industrial structure change and model design. *Industrial Technology Economy*, *2*, 83-84.

Yue, S. J., & Liu, C. M. (2006). The analysis of human capital and the productivity of total factors in the region. *Journal of economic studies*, *4*, 90-96.

Zhang, G. (2013). *The research of factors for industrial structure change of different regions in China*. Nanjing: Nanjing University.

Zhang, R. X. (2010). The human capital, technology adoption and the upgrade of industrial structure. *Science of Finance and Economics*, *2*, 66-74.

Zhang, T. B., & Gao, T. M. (2012). Tax incentive policy, the development of high and new technology industries and the adjustment of industrial structure. *Journal of economic studies*, *5*, 58-70.

Zhang, W., Sun, L. Y., & He, Z. (2009). The analysis of factors for the evolution of Chinese industrial structure. *The Research of Science and Technology Management*, *6*, 373-375.

Zhong, C. B. (2010). The study of spillover effect between regions with foreign direct investment. *Journal of economic studies*, *1*, 80-89.

Zhou, S. L., & Wang, W. G. (2001). Science and technology innovation and the upgrade of the industrial structure. *The Management of World*, *5*, 70-78.

Zhou, Y., & Wang, C. Y. (2008). The analysis of industrial structure transformation with foreign direct investment in our country. *Chinese Soft Science*, *3*, 148-152.

Zhu, Y. B., Liu, C. X., Wang, Z., & Shi, Y. J. (2013). Trend of our country industrial structure evolution and its potential analysis of reduction and emission. *Chinese soft science*, *2*, 35-42.

