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Government Expenditure and Upgrading of the Industrial Structure: An Empirical Analysis of Dynamic Spatial Model

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Abstract:
Based on panel data covering the period from 2000 to 2014 in China's 31 provinces, we introduce spatial weight matrixes that reflect regional similarity into the dynamic spatial panel model, thus empirically testing the influence of government expenditure scale and structure (government investment expenditure, government welfare expenditure and government consumption expenditure) on upgrading of the industrial structure. The research results reveal that upgrading of the industrial structure is characterized by spatial heterogeneity and dynamic adjustability. With respect to government expenditure aggregate, the increasing overall government expenditure can positively influence upgrading of the industrial structure but in an insignificant way; structurally, the government investment expenditure and welfare expenditure are significantly conducive to upgrading of the industrial structure while the government consumption expenditure has an inhibiting effect on upgrading of the industrial structure.

Keywords: *Government expenditure scale, government expenditure structure, upgrading of the industrial structure, spatial heterogeneity, dynamic spatial effect*

1. Introduction

Since reform and opening up, the market-oriented economic system reform has greatly boosted industrial structure adjustment and transformation in China. Upgrading of the industrial structure is becoming an effective approach to optimize resource allocation, enhance regional innovation ability and cultivate new driving force for economic growth. Government expenditure, as an important means of improving market economy mechanism, plays a paramount role in boosting the course of upgrading of the industrial structure in China. According to its mechanism of action, on the basis of giving full play to market mechanism and following the principle of "make good omissions and deficiencies", it encourages or restricts the flow of production factors to certain industries through direct or indirect government expenditure policies and promote the hi-tech, knowledge-oriented, capital-intensive and value-added development of industrial structure through the rational allocation of production factors among different industries, thus further influencing the demand structure of main players in micro-market and materializing the optimization and upgrading of industrial structure. Considering the fact that government expenditure policy serves as one of the major means of macro-control in the course of the industrial structure adjustment in a certain country, its thinking on macro-control, policy design and implementation mode will directly impact the adjustment effect of industrial structure. For one thing, great achievements have been made in the development pattern, in which, the government expenditure policies can promote the allocation, flow, diffusion and spillover effect of various resource elements between different industries and regions and further advance the upgrading of regional industrial structure by means of the arrangement of government expenditure policies and "location directional-induction" effect of policy tools on industrial structural adjustment; for another, the changes in government expenditure scale and structure will impact the public financial resource adequacy of local governments and the acts of local governments. Excessive or inappropriate local government intervention will result in the loss of the dominant position of enterprise innovation, assimilation of regional industrial layout, worsening vicious competition and the widening gap of industrial transformation speed and course in different regions. The trans-departmental and trans-industrial flow of capitals, labor force and technologies has contributed to the obvious clustering and competition of inter-regional industrial development and structural adjustment, which means that the industrial development in geographically adjacent regions or economically similar regions are not completely independent. At present, it is of both theoretical and realistic significance to establish a reasonable and effective \industrial-regional" common interest community and form a development pattern featuring the integration of government, market, industry and enterprises against the backdrop of the new normal of economy. Therefore, reviewing the effect of government expenditure on regional industrial structure adjustment and transformation development and accelerating the industrial transformation and advancing the balanced development of regional industries through the optimization of government expenditure are crucial to the coordinated development of regional economy.

Currently, the fact that the developed regions in eastern China are leading the country in industrial structural adjustment and transformation upgrading while the less developed regions in central and western China are in a stage of industrial structural upgrading testifies to the imbalance between different regions in industrial structural upgrading level. The global competitiveness of a country's industry and technologies hinges on not only the industrial structural upgrading level of the developed regions, but also the overall level of industrial structural optimization and upgrading. For this reason, how to narrow the gap of industrial structural optimization abilities between developed regions and less developed regions is a realistic issue facing governments of all levels. From the perspectives of industrial development and structural upgrading, it is a key project of paramount realistic significance to study whether government expenditure can boost or inhibit upgrading of the industrial structure. In light of the strong dynamics and continuity of industrial development and structural upgrading and the fact that the strategic competition and "free-riding" caused by the overflowing of government expenditure policies have further enhanced the spatial correlation of industrial development, we think that it is necessary to integrate the inter-regional interaction and dependence relationship into spatial econometrics analysis framework from the angle of spatial heterogeneity and dynamic adjustment of industrial structure as well as the local effect and spatial externality of government expenditure and empirically test the dynamic and spatial spillover effects of government expenditure on upgrading of the industrial structure, or the relationship between regional industrial development, competition, transformation and agglomeration under the government expenditure policies by establishing the dynamic spatial econometric model describing the influence of government expenditure on upgrading of the industrial structure.

From a general survey of relevant research, it is not difficult to find that people pay close attention to research regarding the government expenditure and upgrading of the industrial structure in terms of the relationship, mechanism, effect, and so on [6, 7, 9, 13, 20]. On one hand, a large number of scholars have investigated the impact of one kind or several kinds of government expenditure on the adjustment of industrial structure [1, 4, 5, 8, 16, 18, 19]. On the other hand, Yu and Hu [21], Chu and Jian [3], Shang and Tao [15], Wang et al. [17] and other scholars also studied the impact of government expenditure on the adjustment of industrial structure from the perspective of total amount and structure.

Due to differences in objectives, thinking, and methodology, scholars have failed to reach a consensus regarding the impact of government expenditure on upgrading of the industrial structure. We briefly discuss some shortcomings in the previous literature below. First, most scholars used static panel models, which cannot present the dynamic adjustment characteristics of upgrading of the industrial structure. Second, most of the existing studies usually employed the traditional panel model to analyze the relationship between government expenditure and upgrading of the industrial structure, while the introduction of spatial econometric methods is rarely studied.

For the aforementioned reasons, we attempt to set up the unified analysis framework for government expenditure scale, government expenditure structure and upgrading of the industrial structure from the institutional perspective and introduces the spatial weight matrixes that reflects regional similarity into dynamic spatial econometric model so as to empirically test the impact of government expenditure gross and structure on industrial adjustment.

In this fashion, we hope to make the following two key contributions to the literature.

- Different from the previous studies that simply found the differences in inter-regional industrial structural upgrading speed and level, this paper starts with the institutional origin for the interactive relationship of industrial development in different regions and integrates government expenditure, a policy factor, and industrial structural upgrading into the unified analysis framework, thus providing a more detailed research perspective for the spatial differences of inter-regional industrial structural upgrading in China.
- The dynamic spatial model is utilized to investigate the influence of government expenditure scale and structure on upgrading of the industrial structure and offer a scientific identification of the influence path from the angles of dynamic effect and spatial spillover effect.

The remainder of this paper is structured as follows. Section 2 establishes dynamic spatial econometric models for government expenditure scale, government expenditure structure and upgrading of the industrial structure, in addition to addressing the selection of variables; Section 3 provides a result analysis of the dynamic spatial estimation of government expenditure scale and structure on upgrading of the industrial structure; Section 4 presents conclusions and policy recommendations.

2. Model Specification and Variable Selection

2.1. Model Specification

In light of the geographical proximity of spatial dimension and the dynamics of time dimension, the impact of government expenditure scale and structure on upgrading of the industrial structure is measured by analyzing the spatial distribution and dynamic change of upgrading of the industrial structure in 31 Chinese provinces by means of dynamic spatial panel data model in this paper. The establishment of dynamic spatial panel model that contains lagged variables of upgrading of the industrial structure can, for one thing, introduce spatial factors to reflect the spatial correlation and spatial spillover effect of regional upgrading of the industrial structure, and for another, introduce the lagged interpreted variables into the model as independent variables to test the influence of potential factors that are not listed in the measurement model on upgrading of the industrial structure and overcome the deficiency of inadequate estimation accuracy of static spatial panel model.

According to the different impact modes of the spatial correlation of observed values, spatial econometric model falls into spatial autocorrelation model (SAR) and spatial error model (SEM). Among which, SAR assumes that the spatial

correlation is derived from the interpreted variables, measuring the impact of upgrading of the industrial structure in adjacent regions on the industrial development of local region;

SEM assumes that the spatial correlation stems from the error impact of dependent variables in adjacent regions, measuring the influence of spillover effect caused by the errors of interpreted variables in adjacent regions on the locally observed values. The specific models are set as:

The dynamic spatial autocorrelation model is set as:

$$ITU_{it} = \varphi ITU_{it-1} + \rho W_{ij} ITU_{it} + \beta_i X_{it} + \mu_i + \varepsilon_{it} \quad (1)$$

Among which, $\varepsilon_{it} \sim N(0, \ \delta_{it}^2)$

The dynamic spatial error model is set as:

$$ITU_{it} = \varphi ITU_{it-1} + \beta_i X_{it} + \mu_i + \varepsilon_{it} \quad (2)$$

$\varepsilon_{it} = \lambda W_{ij} \times \varepsilon_{it} + \xi_{it}$, among which, $\xi_{it} \sim N(0, \ \delta_{it}^2)$

In Equation (1) and (2), is as the spatial autocorrelation coefficient, reflects the influence orientation and degree of upgrading of the industrial structure in adjacent regions on the industrial development of local region. is the spatial weight matrix, while and represent region and year , respectively; is a regional disturbance that cannot be observed; and for spatial error coefficient. refers to the upgrading of the industrial structure, to the first lagged upgrading of the industrial structure and to the explanatory variables, including government expenditure scale, government expenditure structure (government investment expenditure, government consumption expenditure and government welfare expenditure) and other control variables.

2.2. Variables Selection

In view of data availability and sample unanimity, we take the 31 provinces (cities) in China as the research samples, and the research period covers the years from 2000 to 2014. With all the data from China Statistical Yearbook, China City Statistical Yearbook and China Statistical Yearbook for Regional Economy as well as the statistical yearbook of each province and city from 2001 to 2015. The missing data were partially obtained by interpolation. To weaken the influence of heteroskedasticity, outliers and anomalous terms on the stability of the data, all the data were processed by a logarithm. The selection and definition of the variables are provided in Table 1.

Besides, to avoid model setting deviation and spurious regression, this paper adopts LLC and Fisher-ADF methods of unit root testing on the relevant variables before the spatial econometric regression is conducted. Stationarity test results of panel data indicate that all the variables refuse the null hypothesis of existence of roots of unity at the significant level of at least 5%. Therefore, the panel data are possessed of stationarity and model regression results are of remarkable reliability.

3. Empirical Methodology

3.1. Estimated Results of Dynamic Spatial Panel Model

The dynamic spatial panel model is adopted to empirically test the influence of government expenditure scale and structure on upgrading of industrial structure. At the same time, the decision rule proposed by Anselin and Florax [2] is consulted to determine whether SAR or SEM is used. The empirical test indicates that LM Lag statistics of dynamic SAR model is significant but that of SEM model is not. For this reason, the estimated results of dynamic SAR model are adopted for analysis. Table 2 introduces the estimated results of dynamic spatial panel model based on mixed weight matrix.

Index		Variables	Definition and Measurement
Upgrading of Industrial Structure		ITU	$ITU = \sum_{j=1}^{n} Q(j) * j$, $Q(j)$ is the proportion of the third industry accounts for local GDP of region j, $n = 3$, and the value of the index ranges from 1 to 3.
Government Expenditure Scale		GE	It is measured by the proportion of government expenditure of the year in GDP.
Fiscal Expendi-ture structure	Government Investment Expenditure	GIE	Government investment expenditure refers to the government expenditure in infrastructure construction, major basic industries, regional development, scientific and technological innovation and hi-tech industrial development with a view to vigorously developing economy. We used the proportion of government investment expenditure in GDP for characterization.
	Government Consumption Expenditure	GCE	Government consumption expenditure refers to the government expenditure in national defense, public security and public administration with a view to maintaining national security and the normal running of public administration institutions. We used the proportion of government consumption expenditure in GDP for characterization.

	Government Welfare Expenditure	GWE	Government welfare expenditure refers to the government expenditure in education, social insurance and employment, medical health and agricultural support and the transfer expenditure for backward areas with a view to providing basic social insurance for the public, especially the low-income groups. It possesses the function of the redistribution of social wealth. We used the proportion of government welfare expenditure in GDP for characterization.
Human Capital		HC	The human capital index is constructed as: $HC=\sum(\frac{mid}{pop}\times 9+\frac{hig}{pop}\times 12+\frac{sec}{pop}\times 12+\frac{col}{pop}\times 16)$, mid stands for the number of students enrolling at middle school, hig for the number of students enrolling at senior high school, sec for the number of students enrolling at secondary vocational schools, col to the number of students enrolling at colleges and universities and pop for the total population.
Urbanization		URBAN	The measurement formula for urbanization is: $URBAN = POP_{urban} / POP_{total}$, POP_{urban} and POP_{total} represent the urban population and the local population respectively.
Opening up Level		OPEN	The proportion of total volume of import and export trade in GDP is used to measure the opening up degree in each region.
Fixed Asset Investment		IFA	Fixed-asset investment acts upon the industrial structural adjustment and transformation development through scale, structure and technical effect. We used the proportion of the real fixed assets formation in GDP for measurement.
Economic Development		PGDP	The enhancement of economic development level is conducive to the industrial structural adjustment and transformation development. The per capital GDP is utilized for measurement in this paper.
Technological Innovation		TEC	The total number of annual authorizations of the three patents, namely, invention, utility model and appearance design, is adopted to measure the technical innovation level.
Spatial Weight Matrix		W_{ij}	This paper adopts adjacent weight matrix ($W_{0\text{-}1}$), geographical weight matrix (W_{geo}), economic weight matrix (W_{eco}) and mixed weight matrix ($W_{geo-eco}$) to set the spatial measurement weight. $W_{0\text{-}1}$ is constructed as: if two regions are geographically adjacent, $W_{0-1}=1$ or 0; W_{geo} is constructed as: $W_{geo}=\begin{cases}\frac{1}{D_{ij}^{\ 2}} & i\neq j\\ 0 & i=j\end{cases}$, D_{ij} refers to the geographical distance between region i and j calculated by the longitude and latitude data of the regional administration center; W_{eco} is constructed as: $W_{eco}=\begin{cases}\frac{1}{\left\|GDP_i-GDP_j\right\|} & i\neq j\\ 0 & i=j\end{cases}$, GDP_i and GDP_j represent the per capital GDP in region i and j; Strategic competition tends to occur in the regions with the similar level of economic development, simultaneously the concentration effect will gradually decay with the geographical distance [14].In order to comprehensively reflect the spatial effects of geographical and economic characteristics, and accurately measure the spatial correlation among regions, we will construct the mixed geography-economy weighting matrix. The concrete form of $W_{geo-eco}$ is: $W_{geo-eco}=W_{geo}\times W_{eco}$. In the process of estimation, the four types of spatial weight matrixes are subjected to standardized treatment to ensure that the sum of elements in each line of the spatial weight matrix is 1.

Table 1: Selection and Definition of the Variables

Model Variable	Government Expenditure Scale	Government Expenditure Structure		
	model（1）	model（2）	model（3）	model（4）
$LnITU_{-1}$	0.771***（24.01）	0.719***（20.52）	0.730***（27.13）	0.754***（18.61）
LnGE	0.002（0.34）			
LnGIE		0.005***（3.05）		
LnGCE			-0.002*（1.72）	
LnGWE				0.006*（1.82）
LnHC	-0.004***（-9.71）	-0.007***（-19.36）	-0.007***（-19.10）	-0.002***（-6.39）
LnURBAN	0.009***（2.73）	0.003***（8.26）	0.003***（8.47）	0.004（1.09）
LnOPEN	-0.001（-0.72）	-0.005***（-2.74）	-0.003（-1.62）	-0.001（-0.58）
LnIFA	-0.003***（-11.44）	-0.007***（-21.74）	-0.006***（-21.50）	-0.002***（-8.81）
LnPGDP	0.003***（11.59）	0.005***（20.00）	0.005***（18.61）	0.002***（8.00）
LnTEC	-0.009***（-5.81）	-0.002***（-12.30）	-0.002***（-12.96）	-0.005***（-3.13）
ρ	0.363***（8.28）	0.375***（14.32）	0.378***（13.34）	0.353***（16.06）
R^2	0.772	0.731	0.738	0.738
Log L	1439.521	1439.742	1440.671	1441.632
observations	434	434	434	434

Table 2: Estimated Results of Dynamic Spatial Panel (Based on Mixed Weight Matrix)

The numerical values within the brackets under the coefficient refer to the t statistics of the corresponding coefficient while ***, ** and * represent the significant level at 1%, 5% and 10%, respectively. Model (1)-(4) stand for the estimated results of the impact of government expenditure scale, government investment expenditure, government consumption expenditure and government welfare expenditure on upgrading of industrial structure.

The estimated results of Table 2 show that the overall spatial-correlation coefficient of all the samples under the four models are all positive values and all pass 1% significance test level, a fact showing that there is positive spatial dependence (positive spatial spillover effect) between upgrading of industrial structure in local region and upgrading of industrial structure in the adjacent regions. It means that the economic activities in adjacent regions have obvious spillover effect on the upgrading of industrial structure in local region, which will further trigger the imitations and strategic competition by inter-regional industrial development. Besides, the lagged variable coefficients of upgrading of industrial structure in all models are positive values that fluctuate between 0.667-0.746 and all pass the 1% significance level test, which indicate that the accumulation of industrial structural adjustment at the primary stage will act upon the upgrading of industrial structure level of the later stages (or multi-phases). In line with the research conclusions of D. Chu and K. Jian [3], it is believed by this paper that the upgrading of industrial structure is a dynamic system process with obvious adjustment inertia; what's more, such adjustment inertia also possesses "two-sided" features. To be more specific, in provinces with high level of upgrading of industrial structure, such adjustment inertia will be conducive to industrial structural optimization and upgrading in this region, or it will hinder the industrial structural adjustment and transformation upgrading of the region.

Table 2 shows that the estimation coefficient of government expenditure scale (LnGE) on upgrading of industrial structure is positive but fails to pass the significance test, which indicates that the government expenditure scale does not have an obvious effect in promoting the industrial structural adjustment and transformation development. It is worth-noticing that the government expenditure policy has both "positive effect" and "negative effect" on upgrading of industrial structure. The positive effect is evidenced by the ability of government expenditure policy to change the investment decisions and production behaviors of various main market players and guide capitals and factors to flow to departments that pursue the objective of high grade and rationalization of industrial structure. However, as the result of decision-making misplay, policy time lag and inconsistent policy objectives, government expenditure policy will also exert "negative effect" on upgrading of industrial structure, thus further deteriorating the twist and unbalance of industrial structural adjustment. Specifically, first, government and market are the major means of resource allocation. The excessively large government expenditure scale means stronger governmental ability of resource allocation, which, to some extent, will weaken the dominant role of market in resource allocation and guarantee GDP growth at the cost of the rationalization of industrial structure. Second, the action of government expenditure on upgrading of industrial structure is a process of implementing "signal sending-signal transmission-signal reception -signal feedback". Against the backdrop of the imperfect market economy system in China, the distortion or mistakes in the process of policy signal transmission will result in wrong production strategies in enterprises, thus leading to the mismatching and waste of capitals, labors and technologies among industries.

In terms of government expenditure structure, the estimated values of government investment expenditure (LnGIE) and government welfare expenditure (LnGWE) are significantly positive at least at the 10% confidence level, which demonstrates that these two kinds of expenditure can positively promote the upgrading of industrial structure. According to the research conclusions of this paper, which is consistent with that of Zhang [22], the government investment has long-term positive impact on industrial structure, a view that is also held by Luo [12], Yang and Sun [19] and Lu et al. [11]. For one thing, direct government investment, as the indicator of regional industrial development, can

effectively guide the rational flow and allocation of various private investment, private capitals and social capitals among and within different industries, thus advancing the coordination, optimization and upgrading of these industries; for another, governmental investment in infrastructure and public products, such as energies, telecommunications and transportation can also boost industrial structural optimization and upgrading by evidently improving the regional market economy environment, reducing the transaction costs of main market players, attracting the inflow of capitals, talents, information and technologies and forming highly technology-focused, informationalized and capital-intensive agglomeration effect.

The facilitating effect of government welfare expenditure (LnGWE) on upgrading of industrial structure is noticeably demonstrated by: firstly, the government welfare expenditure is conducive to balancing the increasingly complicated interest relationship between urban and rural areas, different regions, different industries, different enterprises and residents and creating a benign, steady and sustainable economic and social environment for industrial development and structural adjustment; secondly, after their needs for basic livelihood, such as education, medical care and social insurance have been fulfilled, residents and enterprises will have higher demands for products and services, which will hasten the flow of factor resources to the industries that meet the needs of the main market players and force the industrial structural adjustment and upgrading; at last, as one of the important factors advancing industrial structural optimization and upgrading, the quality of labor forces is intimately related to government expenditure in education. Among government welfare expenditure, the increasing proportion of education spending will enormously enhance the quality and effectiveness of human capitals.

The estimated value of government consumption expenditure (LnGCE) is significantly negative at the 10% confidence level, a fact shows that the increase in government consumption expenditure is not favorable to industrial structural adjustment and transformation development. Government consumption expenditure, essentially as the non-productive and socially exhaustive expenditure, refers to the consumption of social wealth and public fund. On the one hand, excessive government consumption expenditure will increase the cost of government administrative management and occupy government investment expenditure and welfare expenditure, thus, to some extent, weakening the fiscal macro-control ability and hindering the industrial structural adjustment and optimization. On the other, under the circumstances of limited governmental fiscal capacity and less-standardized income system, the rising government consumption expenditure will add more tax and fee burdens to enterprises and undermine the governmental fiscal support for enterprise technological innovation, research and development, which will give rise to the insufficient funding in internal research and development and hinder the speed and course of industrial structural optimization and upgrading [3].

3.2. Robustness Test Results

To guarantee the robustness and reliability of the test results, we calculate spatial lagged terms with adjacent weight matrix, geographic weight matrix and economic weight matrix and take the upgrading of industrial structure as explained variables for measurement regression in order to analyze the impact difference of estimated results under different weight setting. The robustness test results that take adjacent weigh matrix as spatial weight matrix are shown in Table 3. The robustness test results that take geographic weight matrix as spatial weight matrix are shown in Table 4. The robustness test results that take economic weight matrix as spatial weight matrix are shown in Table 5.

The estimated results of Table 3, 4 and 5 show that the regression coefficients of government expenditure scale and structure (government investment expenditure, government consumption expenditure and government welfare expenditure) are consistent with the coefficients of the corresponding variables of the models in Table 2. At the same time, the regression results of model basically accord with the conclusions of Table 2. A comparison of the estimated results of four weight matrixes shows that there are certain differences in the influential coefficients of government expenditure scale and government expenditure structure; it also reveals that the gap of inter-regional economic development level will also influence the effect of government expenditure scale and structure on upgrading of industrial structure. To begin with, due to the heterogeneity of regional economic development under the fiscal decentralization system, different local governments vary from each other in terms of their matching capacity and degree of fiscal revenue and expenditure and fiscal pressure, which determines their different intervention degree of regional market environment and lead to the regional differences of upgrading of industrial structure. Furthermore, the upgrading of industrial structure is dependent on the supporting conditions provided by economic foundations. Different economic and social environment will result in the increasing concentration of industrial structural transformation and upgrading in regions with regional advantages and cause the unbalanced speed of upgrading of industrial structure between different regions. Under the evaluation mode featuring GDP as the major performance indicator, the local governments will take into consideration the policy behaviors of the adjacent areas under administration as well as that of regions with similar economic development level. Besides, regions with similar economic development level are prone to trans-regional knowledge distribution, technological spillovers and flow of human capitals, which will bring the inter-regional industrial communication and relationship closer. It also demonstrates that in the process of investigating the dynamic spatial influence of government expenditure scale and structure on upgrading of industrial structure, it is essential to take into account of the influence of geographic distance and economic distance.

Model Variable	Government Expenditure Scale	Government Expenditure Structure		
	model（5）	model（6）	model（7）	model（8）
$LnITU_{-1}$	0.702***（22.79）	0.710***（23.06）	0.711***（23.20）	0.686***（22.33）
LnGE	0.006（1.24）			
LnGIE		0.003*（1.70）		
LnGCE			-0.005**（-2.38）	
LnGWE				0.007**（2.41）
LnHC	-0.005（-1.24）	-0.005（-1.41）	-0.005 （-1.48）	-0.004 （-1.01）
LnURBAN	0.010***（3.02）	0.010***（3.03）	0.010***（3.19）	0.010***（3.01）
LnOPEN	-0.004**（-2.34）	-0.004**（-2.29）	-0.003**（-2.06）	-0.004***（-2.58）
LnIFA	-0.005*（-1.72）	-0.006*（-1.87）	-0.003（-0.97）	-0.004*（-1.67）
LnPGDP	0.002（0.82）	0.002（0.91）	0.002（0.70）	0.002（0.76）
LnTEC	-0.002（-1.60）	-0.002（-1.49）	-0.002（-1.30）	-0.003*（-1.88）
ρ	0.368***(8.14)	0.377***（8.35）	0.380***（8.44）	0.365***（8.07）
R^2	0.738	0.737	0.741	0.744
Log L	1452.320	1453.054	1454.436	1454.113
observations	434	434	434	434

Table 3: Estimated Results of Dynamic Spatial Panel (Based on Adjacent Weight Matrix)

The numerical values within the brackets under the coefficient refer to the t statistics of the corresponding coefficient while ***, ** and * represent the significant level at 1%, 5% and 10%, respectively. Model (5)-(8) stand for the estimated results of the impact of government expenditure scale, government investment expenditure, government consumption expenditure and government welfare expenditure on upgrading of industrial structure.

Model Variable	Government Expenditure Scale	Government Expenditure Structure		
	model（9）	model（10）	model（11）	model（12）
$LnITU_{-1}$	0.632***（20.68）	0.637***（20.31）	0.634***（20.26）	0.800***（25.52）
LnGE	0.003（0.66）			
LnGIE		0.003*（1.77）		
LnGCE			-0.005**（-2.32）	
LnGWE				0.007**（2.12）
LnHC	-0.004***（-10.75）	-0.004（-1.20）	-0.005（-1.24）	-0.008**（-2.02）
LnURBAN	0.010***（2.96）	0.008**（2.46）	0.009***（2.61）	0.010***（3.14）
LnOPEN	-0.005***（-3.96）	-0.004**（-2.11）	-0.003*（-1.87）	-0.005***（-2.58）
LnIFA	-0.004***（-2.91）	-0.006**（-2.07）	-0.003（-1.19）	-0.006（-0.27）
LnPGDP	0.003（1.54）	0.004*（1.67）	0.004（1.51）	0.004（0.19）
LnTEC	-0.005***（-9.59）	-0.002（-1.62）	-0.002（-1.39）	-0.004***（-2.88）
ρ	0.375***（7.25）	0.385***（7.45）	0.386***（7.49）	0.369***（7.13）
R^2	0.711	0.743	0.747	0.737
Log L	1447.535	1444.015	1444.850	1445.760
observations	434	434	434	434

Table 4: Estimated Results of Dynamic Spatial Panel (Based on Geographic Weight Matrix)

The numerical values within the brackets under the coefficient refer to the t statistics of the corresponding coefficient while ***, ** and * represent the significant level at 1%, 5% and 10%, respectively. Model (9)-(12) stand for the estimated results of the impact of government expenditure scale, government investment expenditure, government consumption expenditure and government welfare expenditure on upgrading of industrial structure.

Model Variable	Government Expenditure Scale	Government Expenditure Structure		
	model（13）	model（14）	model（15）	model（16）
LnITU-1	0.502***（18.75）	0.547***（17.91）	0.546***（14.79）	0.546***（24.50）
LnGE	0.003（1.27）			
LnGIE		0.003**（1.97）		
LnGCE			-0.006***（-2.94）	
LnGWE				0.007**（2.26）
LnHC	-0.004***（-6.21）	-0.001（-0.30）	-0.010***（-2.79）	-0.003（-0.79）
LnURBAN	0.006***（7.55）	0.009***（2.77）	0.005（1.46）	0.012***（3.59）
LnOPEN	-0.004**（-2.11）	-0.004**（-2.41）	-0.003（-1.60）	-0.005***（-2.93）
LnIFA	-0.004***（-2.48）	-0.009***（-3.03）	-0.001***（-5.48）	-0.002（-0.91）
LnPGDP	0.004（1.23）	0.005*（1.81）	0.012（4.62）	0.003（1.02）
LnTEC	-0.005（-1.19）	-0.002（-1.22）	-0.002（-1.34）	-0.004***（-2.76）
ρ	0.442***（8.82）	0.450***（8.99）	0.447***（8.95）	0.437***（8.71）
R^2	0.696	0.732	0.625	0.730
Log L	1457.478	1443.485	1296.770	1458.045
observations	434	434	434	434

Table 5: Estimated Results of Dynamic Spatial Panel (Based on Economic Weight Matrix)

The numerical values within the brackets under the coefficient refer to the t statistics of the corresponding coefficient while ***, ** and * represent the significant level at 1%, 5% and 10%, respectively. Model (13)-(16) stand for the estimated results of the impact of government expenditure scale, government investment expenditure, government consumption expenditure and government welfare expenditure on upgrading of industrial structure.

4. Conclusions and Enlightenments

Based on the spatial heterogeneity and dynamic adjustment characteristics of upgrading of industrial structure, this paper adopts the panel data of 31 provinces and cities from 2000 to 2014 and introduces the spatial weight matrixes that reflect regional similarities into dynamic spatial panel models, thus empirically testing the influence of government expenditure scale and fiscal expenditure structure on upgrading of industrial structure and the induced strategic industrial development competition. Based on the results of previous empirical analyses, we can draw the following conclusions and recommendations:

First, the upgrading of industrial structure of China has significant spatial heterogeneity and dynamic adjustment of industrial structural upgrading. The industrial development of regions, especially the adjacent regions, is not independent; instead, significant spatial spillover exists between them, which means that the upgrading of industrial structure of the local region will also be subjected to the significant influence of the industrial development and other economic and social factors in adjacent regions. This conclusion indicates the fact that local government's responsibility of advancing industrial structural adjustment and transformation development is obscurely divided. What's more, under the fiscal decentralization system, local government's scramble for resource elements will trigger industrial chain effect among the adjacent regions. Therefore, different regions should make full use of their advantages in resource endowment, spatial location and policy environment so as to save the cost of industrial transformation and upgrading. At the meantime, it is of prime importance to coordinate different policy means and reduce the negative externality effect caused by unbalanced regional economic development.

Second, government expenditure can noticeably influence upgrading of industrial structure and determine the resource allocation and industrial layout of technological innovation. This conclusion also sends out the signal that it is paramount to guarantee the government expenditure behaviors of local governments conform to the interests of residents and industrial development needs. What's more, it should also boost the long-term and sustainable growth of regional economy, strengthen the role of local government behaviors in guiding the industrial structural adjustment, help government investments withdraw from the competitive production fields and nurture the development of emerging industries. In addition, it is also important to give play to fiscal system's well-targeted function in industrial structural adjustment and transformation development and its role in promoting the efficient flow and reasonable allocation of resource factors between different regions, boosting the balanced regional industrial development and enhancing upgrading of industrial structure. Eventually, the adjusting and controlling pattern that ensures the directional flow of resource factors through fiscal induction is formed so as to play its role in regulating industry regulation, development, adjustment and transformation upgrading in an all-rounded manner.

Third, the influence of government expenditure scale and government expenditure structure on upgrading of industrial structure displays significant spatial spillover effect; the degree of which is closely related to spatial weight matrix that reflects regional similarities and economic attribute similarities. With respect to aggregate, the increasing overall government expenditure can positively influence the upgrading of industrial structure but in an insignificant way; structurally, the government investment expenditure and welfare expenditure are significantly conducive to upgrading of industrial structure while the government consumption expenditure has an inhibiting effect on upgrading of industrial

structure. It is shown from this conclusion that first, it is necessary to reduce fiscal burdens caused by the mismatching between the fiscal capacity of local governments and expenditure, guarantee the balance between government expenditure scale and structure and weaken the negative intervention of local governments in industrial structural adjustment and enterprise operational development; second, according to the empirical evidence of local governmental expenditure's differential influence on upgrading of industrial structure and spatial dependence, well-targeted and directional control policies should be formulated to guide the reasonable flow of resource factors between policy "depressions" and policy "highlands". At last, it is also of prime importance to clarify the role positioning of government and market, central government and local government and government of different levels in upgrading of industrial structure and enterprise innovation in accordance with the hierarchy of spatial effect and spillover effect degree [10] in order to materialize the organic integration between fiscal decentralization system characterized by inter-governmental gaming competition and industrial policies featuring industrial structure optimized by market competition.

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Notes on contributor(s)

All authors conceived and designed the research; Weijia Chen collected and processed the data; Xiaomei Hu analyzed the data and interpreted the results; All authors were also involved in writing the manuscript and have all proved the submitted form.

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