Local Governments' Tax Competition, Industrial Structure Adjustment and Regional Green Development in China

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Based on the inter-provincial panel data from 2000 to 2014 in China, this paper applies the spatial panel simultaneousequations model to test the impact of local governments' tax competition and industrial structure adjustment on the regional green development in China. The conclusions are as follows. Local governments' tax competition and industrial development have a negative impact on green development. Tax competition and industrialization in the neighboring regions will also suppress local green development through the negative incentives of "race to the bottom". Evidently, regulating the tax competition behavior of the local government and rationally guiding the upgrading of local industrial structure have important policy implications for the high-quality growth of China's regional economy and the green, coordinated development between regions in the new era.

Keywords: local governments' tax competition, industrial structure adjustment, regional green development

1.Introduction

Since the reform and opening up, along with the reform of the fiscal and tax system involving the central and local relations, such as fiscal responsibility system and tax sharing, local governments have launched a fierce "competition for growth" among the regions in order to obtain more fiscal surplus rights and the economic performance of the promotion at the local officials level, which is considered to be an important driver of China's sustained and rapid economic development over the past 40 years (Zhang, 2005). However, in the local "competition for growth", tax competition policy and industrial structure adjustment, as an important means of local government competition

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(An and Wang, 2012), while actively guiding the cross-regional flow of resources, generate significant pressures on green development in various regions through the "race-to-the-bottom" effect of environmental regulation.[1] Moreover, with the strengthening of local tax competition and the migration of factors in different sectors and regions, the regional industrial structure and industrial policy will be adjusted (Kong *et al.*, 2017), which will also have a significant impact on the green development of local and neighboring regions (Han *et al.*, 2015). Therefore, the reality of China's rapid economic development and increasing environmental pollution for a long time has made the problem of regional green development approached from the perspective of local tax competition and industrial structure adjustment an academic focus (Yuan and Xie, 2014).

In the context of China's economic entry into the new normal, as local governments have more urgent needs to stabilize the demand for economic growth through tax competition and industrial restructuring, the impact of the two on the regional green development will be more significant. This has produced a series of questions worth thinking about: Do the intensified tax competition and industrial restructuring between local governments deviate from the concept of green development proposed by the 13th Five-Year Plan? Through what mechanism do inter-regional tax competition and industrial restructuring affect green development? Can we achieve the coordinated development of regional tax policy, industrial structure and green development through some kind of mechanism design? This paper intends to carry on the in-depth study into these problems. Under the background of the deepening reform of local fiscal and tax system, the urgent upgrading of domestic industrial structure and the comprehensive campaign of pollution prevention and control, it is of great significance to integrate local government tax competition, industrial structure adjustment and regional green development into a holistic framework study to realize high-quality economic growth and green coordinated development in China in the new era.

2. Literature Review

Welfare economics holds that the government, as the "night-watchman", can "internalize" the external cost of pollution by taxing sewage enterprises, and use the "Pigovian tax" to correct the damage to the environment caused by market failure, which can be regarded as the beginning of the study on the impact of tax policy on environmental pollution. Most research on the impact of local government tax

[1] The so-called "race-to-the-bottom" effect of environmental regulation refers to the behavior of local governments actively reducing regional environmental regulation via competitive fiscal and tax policies and industrial policy adjustments to attract more foreign liquidity factors by way of "race to the bottom" to maintain the rapid growth of the region's economy relative to the adjacent areas, and to stand out in the fiscal and even political competition. (Zhu *et al*., 2011).

competition on green development focuses on the impact of tax competition on local government environmental regulation. For example, Rauscher (2005) believes that local governments will gain an advantage in economic competition, broaden the tax base and increase tax revenue by adopting lax environmental control, thus giving up the maximization of regional social welfare. Fredriksson and Millimet (2002) point out that tax competition among local governments leads to lax standards of environmental regulation and governance, leading to damaging effect of "race to the bottom". Other scholars have discussed it from the perspective of fiscal decentralization, for example, Li and Zhou (2005) hold that under the fiscal decentralization system of central and local governments, local officials are more likely to gain a tax competitive advantage by investing more in infrastructure, and investment in public services will weaken, which aggravates local environmental pollution to a certain extent; Zhang *et al.* (2015) and He *et al*. (2016) further explore the impact of tax competition on local environmental quality through different fiscal decentralization channels. In addition, there are some studies analyzing the impact of tax competition on environmental pollution from other angles. For example, Chirinko and Wilson (2010) and Cui and Liu (2010) find that, because local governments usually implement the "riding seesaw" strategy in environmental governance, there are significant differences in the impact of local government tax competition on different pollutants. On the whole, the existing research has made some discussion, but also needs to be improved. For example, local government tax competition will have a significant impact on industrial policy, industrial structure, but the existing research does not include such impact in the scope of analysis. In the empirical study, most of them use different pollutant emission to measure the environmental quality, and the difference of physical properties and statistical sources of different pollutants will cause some errors in the estimation; meanwhile, in studies into the effect of local tax competition on environmental pollution, insufficient attention has been paid to the endogenous errors that the causal relationship between the two may produce.

In terms of the research on the relationship between industrial structure adjustment and green development, the classical studies of Grossman and Krueger (1995) break down the influence of economic development on environmental pollution into scale effect, structural effect and technical effect. Among them, the structural effect mainly refers to the impact of the economic structure and industrial structure adjustment changes on environmental pollution. Most scholars use the framework of the Environmental Kuznets Curve (EKC) by Grossman and Krueger (1995) to investigate the impact of industrial structure adjustment on environmental pollution. Jalil and Feridum (2011), find that the optimization and upgrading of industrial structure can promote the green development of the region to a certain extent, while studies by Bruvoll and Medin (2003) and Levinson (2009) show that industrial structure adjustment has not played a key role in the improvement of regional environmental

quality, and the improvement of technological progress on regional environmental quality is more prominent. Other scholars argue that the relationship between industrial restructuring and environmental quality is not a simple one-way link (Yuan and Xie, 2014), and that changes in regional environmental policies (or environmental quality) can also have a certain "inversion" impact on local industrial policies and industrial structures (Porter and Linde, 1995). On the whole, the existing research has been fruitful. However, the existing literatures mostly regard industrial structure and green development as one-way effects, and with little investigation into reciprocal causation, it is difficult to control the endogeneity between the two; the empirical investigation between the two is also limited to the direct impact of the local industrial structure, relatively little research has been done on the spillover effect of industrial restructuring in surrounding areas.

In view of this, taking the 30 provinces of China in 2000—2014 as the research object, this paper systematically investigates the complex impact of local tax competition and industrial structure adjustment on regional green development through the construction and estimation of spatial simultaneous equations. The main contribution of this paper is as follows. In terms of the research framework, this paper incorporates the local government tax competition, industrial structure adjustment, and regional green development into one integrated framework. Through the introduction of impact path of local tax competition–industrial structure adjustment–regional green development, this paper systematically examines the differences in the impacts of tax competition and industrial structure adjustment on regional green development through different channels.

3. Mechanism, Model and Data Description

3.1. A Brief Review of the Mechanism

The focus of this paper is to investigate the impact of local governments' tax competition and industrial structure adjustment on regional green development. Based on the brief review of the existing literatures, the impact of local governments' tax competition on the local green development is mainly reflected in two aspects. First, it is the impact of local tax competition on local green development. Under the competition model dominated by "competition for growth", local governments tend to compete for tax in two ways, such as directly lowering statutory tax rates and reducing the degree of tax enforcement, and the latter (reducing tax oversight) is more hidden and difficult to be supervised by higher governments and is often used by local governments (Fan and Tian, 2013). Local governments compete for the inflow of cross-regional capital (including environmentally backward production capacity factors) by means of tax competition (Li and Zhao, 2017). Although it may

be beneficial to the short-term stability of the local economy, it is not conducive to the transformation and upgrading of the local industrial structure, also it has a certain impact on local resource consumption patterns and actual pollution emissions. At the same time, local governments will be more keen on infrastructure investment to stimulate economic growth and obtain more local tax share (He *et al.*, 2016), which will lead to overlapping projects of fixed assets, excess capacity and other real economic problems, which will promote the development of the local heavy chemical industry through the industrial correlation effect but will also bring air pollution, environmental problems such as the destruction of water resources (Pi *et al.*, 2014). Moreover, the intensification of government tax competition will also bring about the lack of supply of public goods such as education and environmental protection (Zhang *et al.*, 2015), which is not conducive to promoting local environmental protection concepts and increasing investment in environmental governance (Li, 2016), nor to the local sustainable green development. Second, there is the impact of tax competition in neighboring areas on local green development. Under the background of economic development as the main competition target of local government, horizontal tax competition in neighboring areas will directly lead to the outflow of local liquidity factors to the surrounding areas, bringing about the pressure of local economic downturn, and under the "competition for growth" system of local governments, local governments will adopt the "race to the bottom" of tax and industrial structure as the countermeasure (Guo and Li, 2009; Huang *et al.*, 2012), that is, to increase attractiveness to liquidity factors through lower actual tax rates or the easing of tax administration, and to expand the scale of local "extensive" industrial production in order to stabilize local economic growth; and such tax competition will also curb local green development through increased environmentally backward production capacity, strengthened local infrastructure investment, and inadequate channels of public goods.

The impact of regional industrial structure adjustment on local green development is mainly realized through the following two aspects. First, there is the impact of local industrial restructuring on local green development. As mentioned above, different types of industry dominance models lead to significant differences in pollution emission intensity, pollution control patterns, and so on (Grossman and krueger,1995; Huang *et al.*, 2012), and local industrialization dominance development models usually lead to higher levels of pollution emissions in the region, which will also have a direct negative impact on local green development. Second, there is the impact of industrial restructuring in neighboring areas on local green development. First of all, under the background of local governments' tax competition, in the process of undertaking industrial transfer in various regions, the regional industrial structure tends to "imitate" the industrial structure of the adjacent areas, and there is a "race to the bottom" in the industrial structure (Huang *et al.*,

2012), and industrialization in neighboring areas will affect local green development by stimulating the development of local strategic industrialization. Next, due to the existence of regional industrial association and industrial agglomeration, the adjustment of industrial structure in neighboring areas will also have the same correlation influence on the process of advanced and rational local industrial structure. Therefore, if the neighboring areas neglect environmental governance to promote local industrial agglomeration, or slow down the optimization and upgrading of the industrial structure for short-term economic growth, this will adversely affect the inflow of local cleaner production factors and environmental technology spillover through industrial agglomeration and industrial linkages (Yan *et al.*, 2011; Han *et al.*, 2015), which is not conducive to local green development. Finally, the adjustment of industrial structure in neighboring areas will have a direct impact on the environmental quality of adjacent areas, and because of the externality of environmental protection and the existence of spatial spillover of environmental quality, there will also be a direct impact on the local green development level. Therefore, if the neighboring region adopts the "extensive" industrial development model, it will directly lead to the rise of local environmental pollution level, which will also reduce the local green development level through the negative externality of environmental pollution.

3.2. Models and Methods

On the basis of reviewing the theoretical mechanism and drawing on the research framework of Liu and Li (2013) and Li *et al.* (2014), this paper puts the local governments' tax competition, industrial structure adjustment and China's regional green development into a unified analysis framework, and establishes the spatial panel simultaneous equations model, which is set as follows.

$$sect_{it} = \psi_i + \pi_t + \alpha_1 \ln pgdp_{it} + \alpha_2 tax_{it} + \alpha_3 Wtax_{it} + \alpha_4 eco-eff_{it} + \alpha_5 X_{it} + \mu_{1it} \tag{1}$$

$$\begin{aligned} \mu_{1it} &= \rho_1 \sum_{j=1}^{n} w_{ij}\mu_{1it} + \varepsilon_{1it} \\ \ln pgdp_{it} &= \theta_i + \varphi_t + \beta_1 sect_{it} + \beta_2 Wsect_{it} + \beta_3 eco-eff_{it} + \beta_4 Z_{it} + \mu_{2it} \end{aligned} \tag{2}$$

$$\begin{aligned} \mu_{2it} &= \rho_2 \sum_{j=1}^{n} w_{ij}\mu_{2it} + \varepsilon_{2it}s \\ eco-eff_{it} &= \delta_i + \gamma_t + \eta_1 pgdp_{it} + \eta_2 pgdp_{it}^{\ 2} + \eta_3 sect_{it} + \eta_4 Wsect_{it} + \eta_5 tax_{it} + \eta_6 C_{it} + \mu_{3it} \end{aligned} \tag{3}$$

$$\mu_{3it} = \rho_3 \sum_{j=1}^{n} w_{ij}\mu_{3it} + \varepsilon_{3it}$$

$$\Phi = Var\begin{pmatrix}\varepsilon_{1it}\\ \varepsilon_{2it}\\ \varepsilon_{3it}\end{pmatrix} = E\begin{pmatrix}\varepsilon_{1it}^2 & \varepsilon_{1it}\varepsilon_{2it} & \varepsilon_{1it}\varepsilon_{3it}\\ \varepsilon_{2it}\varepsilon_{1it} & \varepsilon_{2it}^2 & \varepsilon_{2it}\varepsilon_{3it}\\ \varepsilon_{3it}\varepsilon_{1it} & \varepsilon_{3it}\varepsilon_{2it} & \varepsilon_{3it}^2\end{pmatrix} = \begin{pmatrix}\sigma_{11} & \sigma_{12} & \sigma_{13}\\ \sigma_{21} & \sigma_{22} & \sigma_{23}\\ \sigma_{31} & \sigma_{32} & \sigma_{33}\end{pmatrix} \quad (4)$$

where i represents the region, t represents the year, ψ_i and π_t, θ_i and φ_t, δ_i and γ_t, respectively, represent the individual effect and the time effect, and ε_{it} and μ_{it} are the random error item. *sect*, ln*pgdp*, *eco−eff*, and *tax* represent industrial structure adjustment, economic growth, green development and local governments' tax competition index respectively. W is the $N\times N$ dimensional spatial weighted matrix, contains three kinds of weight, such as geography, economy and mix. Geographical weight matrix $W_d=1/d_{ab}^2$, $a\neq b$, otherwise 0; economic weight $W_e=1/|gdp_a-gdp_b|$, $a\neq b$, otherwise 0; mixed spatial weight matrix $W_m=W_d\bullet W_e$. *Wtax* and *Wsect* are the spatial lag of local government tax and industrial structure respectively, and *X, Z*, and *C* are the control variables representing industrial structure equation, economic growth equation and green development equation respectively.

The interaction between industrial structure variables and green development variables leads to the endogeneity between variables and error items, and non-conformance or non-effective estimation of the estimation value of spatial panel simultaneous equation model (Zhang and Wang, 2014). In order to overcome the problems in the estimation of the spatial panel simultaneous equation model, the fixed effect estimation method in the general spatial three-stage least squares (GS3SLS) of the generalized space is used to measure and analyze the model.

3.3. Variables and Data Descriptions

In this paper, 30 provinces in China (not including Tibet and Hong Kong, Macao and Taiwan) were selected as samples of the study, and the data originated from *Procuratorial Yearbook of China*, *China City Statistical Yearbook*, *China Statistical Yearbook for Regional Economy*, *China Energy Statistical Yearbook, China's Environmental Yearbook, China Labor Statistical Yearbook*, and provincial statistical yearbooks, as well as the website of the National Bureau of Statistics and the official websites of the provincial People's Procuratorates. In order to eliminate the heterogeneity between the variables, all absolute amount variables were log-transformed, and all the indicators containing price factors were treated with the fixed-base price index of 2000 as the base period in order to remove the influence of price factors. Table 1 shows the index meaning and statistical description of the main variables.

Table 1. Statistical Description of Major Variables

Variable	Index meaning	Number of samples	Mean	Standard deviation	Minimum	Maximum
eco-eff	Green development (calculated index)	450	0.539	0.330	0.515	1.000
sect	Industrial structure (%)	450	0.403	0.082	0.131	0.565
pgdp	Economic development (log)	450	9.161	0.530	7.901	10.367
tax	Local governments' tax competition (%)	450	0.067	0.028	0.035	0.176
urban	Urbanization (%)	450	0.461	0.204	0.192	0.900
market	Marketization (%)	450	0.474	0.204	0.107	0.873
consume	Resident consumption (log)	450	8.581	0.531	7.530	10.070
decent	Fiscal decentralization (%)	450	0.764	0.089	0.541	0.933
capital	Fixed capital (log)	450	4.598	3.663	0.695	21.347
human	Human capital (calculated index)	450	0.927	0.165	0.491	1.312
poprate	Population growth rate (%)	450	5.432	2.921	−1.350	12.620
techno	Technological progress (1/100)	450	1.082	2.240	0.007	19.981
open	Openness (%)	450	0.388	0.493	0.041	2.145
cor	Rent-seeking corruption (cases/ million people)	450	29.780	11.747	9.180	139.020
reg	Environmental regulation (cases/ person)	450	0.529	0.589	0.010	4.080
popden	Population density (population/ area)	450	3.966	4.950	0.040	37.230

The explained variables include industrial structure (*sect*), economic development (*pgdp*) and green development (*eco-eff*). Since the reform and opening up, China's industrial structure has transited from the primary industry to the second industry, leading to the deterioration of environmental pollution; at present, China's industrial structure is undergoing the transition from the second industry to the tertiary sector, and with the decline in the proportion of the second industry and the rise in the proportion of the tertiary sector, the total environmental pollution emissions have declined. Therefore, this paper uses the proportion of output value of the second industry in each region in GDP to measure the industrial structure (*sect*). The level of economic development (*pgdp*) is expressed by GDP per capita. Green development (*eco-eff*) uses the ecological efficiency measured as the agent variable of regional green development in China. The main explanatory variable is local governments' tax competition (*tax*): the local governments have a direct impact on the environment

through tax competition of regulating tax burden and relaxing tax enforcement, and have an indirect impact on the environment by affecting industrial structure with tax policy. Based on the practice of Ren *et al.* (2014), the ratio of macro tax burden in the region to the average macroscopic tax burden in neighboring areas is used to describe the degree of local governments' tax competition.

Control variables (*X*) affecting industrial structure. (1) The level of urbanization *(urban)=*pop_{urban}/pop_{total}, pop_{urban} and pop_{total} represent the urban population and the local population in various regions respectively. (2) The level of marketization, (*market)=*$market_{domestic}/market_{total}$, $market_{domestic}$and $market_{total}$ represent respectively industrial output of state-owned enterprises and total industrial output in various regions. (3) Resident consumption (*consume*): expressed in the per capita consumption of regional residents in China. (4) Fiscal decentralization (*decent*): expressed in the decentralization of regional fiscal expenditure. (5) Industrial structure of the adjacent areas (*Wsect*), adding spatial lag *Wsect* to the industrial structure equation to study the impact of industrial structure adjustment in the neighboring areas on the industrial structure of the region. (6) Meanwhile, in order to measure the influence of tax competition in the neighboring areas on local industrial structure and green development, in this paper, spatial lag *Wtax* is added to the industrial structure equation(Shao *et al.*, 2015).

Control variables (*Z*) affecting economic growth. (1) Fixed capital (*capital*): expressed in the per capita fixed asset stock in all regions of China. (2) Human capital (*human*): expressed by the number of post-secondary level schooling years per capita in all areas of China. (3) Population growth rate (*poprate*): expressed in the year-end population growth rate in various regions of China. (4) Technological progress (*techno*): measured by the number of annual authorizations for three patents for inventions, utility models and designs. (5) Openness (*open*): expressed in the proportion of total import and export trade in GDP in various regions. (6) Output agglomeration effect (*Wpgdp*): this paper adds spatial lag *Wpgdp* to the output equation to study the effect of economic growth in neighboring areas on local economic growth, and to verify the agglomeration effect in spatial distribution of regional economic growth (Zhang and Wang, 2014).

Control variables (*C*) affecting green development. (1) Square of GDP per capita ($pgdp^2$): to verify the existence of EKC curves. (2) Rent-seeking corruption (*cor*): expressed by the number of cases of corruption and bribery in each million people in each region. (3) Environmental Regulation (*reg*): represented by the number of environmental administrative penalties enforced by each environmental worker in each region. (4) Population density (*popden*): expressed by dividing the total population of each region by the area of the region. (5) Green development cluster (*Weco-eff*): in this paper, the spatial lag *Weco-eff* is added to the green development equation to study the impact of green development in the adjacent areas on the local green development, and

to verify the agglomeration effect in spatial distribution of green development (Li *et al.,* 2014).

4. Empirical Results and Analysis

4.1. Estimation Analysis of Fundamental Panel Simultaneous Equation

In order to solve the problem of variable selection and heteroscedasticity of different equations in panel simultaneous equations, the parameter estimation is carried out by using three-stage least squares (3SLS) in this paper. Moreover, compared with 2SLS estimation, 3SLS estimation results are more effective when the metering equation is correct and the rank constraint is satisfied. Meanwhile, 2SLS is used to test the robustness of the model estimation (the results are shown in Table 2). The estimation results of 3SLS and 2SLS in Table 2 show that the regression coefficient of 3SLS in the model is slightly higher than that of 2SLS. Therefore, this paper mainly uses 3SLS to analyze the estimation results of the simultaneous equation.

Based on the estimated results of industrial structure equation in 3SLS estimation in Table 2, local governments' tax competition (*tax*) passed the test by the industrial structure at the significance level of 10%. This shows that in order to solidify existing tax revenues or expand the tax base, local governments tend to choose industrial enterprises with large output and high profits and taxes as the main pillar industries in the area (Afonso and Furceri, 2010). Green development (*eco-eff*) passed the test of industrial structure at the significance level of 1%, and the estimation coefficient is negative. This shows that in recent years, local governments have begun to pay attention to the coordinated development of environmental protection and economy, and the implementation of various environmental protection policies and measures has begun to promote the transformation and upgrading of regional industrial structure. The impact of green development (*eco-eff*) on economic growth has not passed the significance test at 10%. At present, regional economic development is still dominated by extensive growth, and rapid economic growth has brought more serious resource consumption and environmental degradation, which is the reason why regional green development has no obvious effect on economic growth (Wang *et al.*, 2014). Local industrial restructuring (*sect*) passed the test of green development at 5%, and the coefficient is negative. This shows that although industrial development is an important link between economic behavior and ecological environment, in order to compete for liquidity factors and economic advantages, the local governments are more inclined to adopt the "riding the seesaw" strategy and ignore the environmental costs of industrial policy, distorting the distribution of factors (Cui and Liu, 2014), and the externality of environmental pollution will

even lead to the "tragedy of the commons" of environmental pollution, thus bringing greater negative pressure to the local green development. Local governments' tax competition (*tax*) passed the test of green development at the level of 10%, and the coefficient is negative. This suggests that local governments, in order to gain a tax competitive advantage, adopt competitive strategies that reduce their tax burden and reduce the degree of tax enforcement in order to chase the scale of capital inflows, which directly increase emissions of industrial output and pollutants (Li and Zhao, 2017), while low tax burdens further lead to increased marginal external costs of environmental pollution, thus it is difficult to correct the negative externality of local governments' tax competition to environmental pollution (Shao *et al.*, 2015). On the other hand, the use of tax competition by local governments to reduce the inflow threshold of factors of production will inevitably lead to industrial policy "race to the bottom", indirectly reducing the level of green development in the region (Zeng and Zhao, 2009).

Table 2. Estimated Results of 2SLS and 3SLS

2SLS						3SLS					
sect		*pgdp*		*eco-eff*		*sect*		*pgdp*		*eco-eff*	
C	0.415***	*C*	0.713***	*C*	0.925*	*C*	0.674***	*C*	0.814***	*C*	0.973**
	(4.62)		(9.12)		(1.77)		(4.20)		(12.44)		(2.03)
pgdp	−0.850***	*sect*	0.820***	*pgdp*	0.807*	*pgdp*	−1.243***	*sect*	1.023***	*pgdp*	1.007*
	(−3.20)		(4.80)		(−1.85)		(−3.01)		(8.06)		(−1.94)
tax	0.652*	*eco-eff*	−0.110	*pgdp2*	0.035*	*tax*	0.534*	*eco-eff*	−0.094	*pgdp2*	0.039**
	(1.72)		(−1.35)		(1.75)		(1.75)		(−1.41)		(2.21)
eco-eff	−1.824**	*capital*	0.122***	*sect*	0.419**	*eco-eff*	−2.202***	*capital*	0.221***	*sect*	0.581**
	(−2.19)		(13.72)		(−1.97)		(−3.34)		(15.70)		(−2.55)
urban	0.003	*human*	1.044***	*tax*	−0.010*	*urban*	0.074	*human*	1.088***	*tax*	−0.013*
	(0.09)		(12.06)		(−1.67)		(0.35)		(13.79)		(−1.69)
market	−0.867	*poprate*	−0.012**	*cor*	−0.008***	*market*	−0.633	*poprate*	−0.075**	*cor*	−0.015***
	(−1.28)		(−2.35)		(−5.14)		(−0.82)		(−2.44)		(−5.70)
consume	0.651	*techno*	0.001***	*reg*	0.045*	*consume*	0.546	*techno*	0.004***	*reg*	0.053*
	(1.49)		(5.81)		(1.69)		(1.05)		(6.16)		(1.87)
decent	1.029*	*open*	0.254***	*popden*	−0.019***	*decent*	1.433**	*open*	0.314***	*popden*	−0.023***
	(1.79)		(7.33)		(−3.91)		(2.31)		(8.13)		(−4.11)
R^2	0.472	R^2	0.736	R^2	0.482	R^2	0.493	R^2	0.815	R^2	0.543

Note: ***, ** and * represent significance at levels 1%, 5% and 10%, respectively. In parentheses is *T* value. Similarly hereinafter.

4.2. Analysis of Measurement Estimation Considering Spatial Spillover Effect

Because of the spatial spillover of regional public policy and the"free-rider" in environmental protection between regions, inter-regional green development is bound to be affected by economic policy and green development in neighboring areas. In this paper, the model is estimated by GS3SLS (the results are shown in Table 3). According to Table 3, the tax competition in neighboring areas (*Wtax*) has passed the test of industrial structure at the significance level of 1%, and the influence coefficient of the estimated value relative to the local tax competition is more significant. Local governments, as coordinators of national economic development and social order, compete with each other for the pursuit of more economic resources, stimulating local governments to develop industry-led industries in exchange for short-term economic benefits (Brajer *et al.*, 2011). The influence coefficient of industrial structure adjustment in neighboring areas (*Wsect*) on local industrial structure is positive, that is, the enhancement of secondary industry in neighboring areas will improve the development of local secondary industries. Under the current performance appraisal system which mainly takes GDP as the core, the local governments can improve the spillover and diffusion of industrial structure through agglomeration or "gathering", and the industrial structure setting of each region often displays the characteristics of "imitating" the industrial development of the neighboring areas (Huang *et al.*, 2012). The coefficient of output agglomeration (*Wpgdp*) is significantly positive, that is, the increase in output in adjacent areas will increase the level of local output. The inter-regional game behavior of competition and dependence and the scale effect in space will lead to the cross-region flow of production factors, thus economic development has a strong spatial spillover effect (Yan *et al.*, 2011). The estimation coefficient of industrial structure adjustment in neighboring areas (*Wsect*) to green development is positive, but it has not passed the significance test, which shows that the "race to the bottom" of local governments' industry development is hardly effective for local environmental pollution control. The coefficient of green development cluster (*Weco-eff*) to local green development is significantly positive, that is, the increase of green development in neighboring areas will improve the local green development. The green development of neighboring areas will have diffusion effect and demonstration effect, the "positive externality" of environmental protection leads to the proximity of green development level to neighboring areas in the region, generating the incentive of regional green development, and the green development mode of "block" has a "positive" effect on regional environmental protection, as the adoption of "follower" behavior has promoted the local green development (Cui and Liu, 2010).

Table 3. GS3SLS Estimated Results

Geographical weigh						Economic weight						Mixed weight					
sect		*pgdp*		*eco-eff*		*sect*		*pgdp*		*eco-eff*		*sect*		*pgdp*		*eco-eff*	
C	5.568***	*C*	12.820***	*C*	4.709***	*C*	7.106***	*C*	11.255***	*C*	6.255***	*C*	6.106***	*C*	12.541***	*C*	6.106***
	(5.25)		(8.72)		(3.25)		(5.83)		(6.23)		(3.63)		(5.20)		(6.43)		(3.20)
pgdp	−0.415***	*sect*	1.228***	*pgdp*	1.181***	*pgdp*	−0.410***	*sect*	1.564***	*pgdp*	−1.438***	*pgdp*	−0.321***	*sect*	1.672***	*pgdp*	−1.624***
	(−3.86)		(3.21)		(−3.11)		(−4.03)		(3.40)		(−3.68)		(−3.11)		(3.87)		(−3.82)
tax	0.124**	*Wsect*	−1.827***	*pgdp2*	0.048***	*tax*	0.102*	*Wsect*	−2.152***	*pgdp2*	0.063***	*tax*	0.133**	*Wsect*	−2.335***	*pgdp2*	0.071***
	(2.18)		(−4.10)		(2.78)		(1.84)		(−4.32)		(2.93)		(2.24)		(−4.87)		(3.30)
Wtax	1.822***	*eco-eff*	−3.378***	*sect*	−0.126*	*Wtax*	2.029***	*eco-eff*	−2.665**	*sect*	−0.146**	*Wtax*	2.017***	*eco-eff*	−2.262**	*sect*	−0.265**
	(2.67)		(−3.32)		(−1.92)		(3.20)		(−2.21)		(−2.07)		(2.84)		(−2.07)		(−2.18)
eco-eff	−0.837*	*capital*	0.044***	*Wsect*	0.007	*eco-eff*	−0.829*	*capital*	0.155***	*Wsect*	0.065	*eco-eff*	−0.924*	*capital*	0.255**	*Wsect*	0.075
	(−1.70)		(3.24)		(0.21)		(−1.69)		(4.12)		(0.52)		(−1.72)		(5.01)		(0.96)
urban	0.432	*human*	0.198***	*tax*	−0.060*	*urban*	0.389	*human*	0.168***	*tax*	−0.072*	*urban*	0.552	*human*	1.770***	*tax*	−0.078*
	(0.55)		(4.07)		(−1.69)		(0.53)		(3.39)		(−1.78)		(0.66)		(3.58)		(−1.82)
market	−1.018	*poprate*	−0.322*	*cor*	−0.078**	*market*	−1.833	*poprate*	−0.751**	*cor*	−0.064*	*market*	−1.644	*poprate*	−0.574**	*cor*	−0.074*
	(−0.75)		(−1.94)		(−1.99)		(−0.94)		(−2.01)		(−1.91)		(−0.83)		(−1.98)		(−1.95)
consume	1.210	*techno*	0.040*	*reg*	0.032*	*consume*	0.855	*techno*	0.076*	*reg*	0.036*	*consume*	1.156	*techno*	0.166**	*reg*	0.047*
	(1.12)		(1.85)		(1.69)		(1.12)		(1.95)		(1.72)		(1.22)		(2.18)		(1.92)
decent	2.429**	*open*	0.052*	*popden*	−0.178*	*decent*	2.152*	*open*	0.094*	*popden*	−0.152*	*decent*	2.756**	*open*	0.097**	*popden*	−0.175*
	(2.13)		(1.74)		(−1.79)		(1.95)		(1.90)		(−1.69)		(2.42)		(2.06)		(−1.78)
Wsect	0.088*	*Wpgdp*	0.247***	*Weco-eff*	0.058*	*Wsect*	0.067*	*Wpgdp*	0.267***	*Weco-eff*	0.055*	*Wsect*	0.082*	*Wpgdp*	0.325***	*Weco-eff*	0.065*
	(1.93)		(9.10)		(1.89)		(1.85)		(10.65)		(1.68)		(1.93)		(10.94)		(1.91)
R^2	0.412	R^2	0.469	R^2	0.820	R^2	0.377	R^2	0.436	R^2	0.517	R^2	0.477	R^2	0.436	R^2	0.575

Among other variables affecting local green development (*eco-eff*), the per capita gross domestic product (GDP) coefficient is significantly negative, with a significantly positive quadratic term coefficient ($pgdp^2$). There is a positive U-shape relationship between economic growth and green development, that is, in the low level of economic development, the performance appraisal mechanism with economic growth as the core will "spur on"the local governments to pursue short-term economic benefits in investment, to support the production and operation of enterprises and lower factor prices, to intervene in the environmental assessment and approval of construction and projects, and to reduce entry threshold and neglect environmental protection, resulting in environmental pollution (Huang *et al.*, 2014). And when the economy develops to a certain critical point, the degree of green development increases with the growth of GDP per capita. With the expansion of economic scale and the maturity of industrial development, the structural and technological effects of economic growth play a role, and industrial structure and technological development will enhance the level of green development in the region. Rent-seeking corruption (*cor*) passed the test of green development at the level of 10%, and the coefficient is negative. The complicity between the enterprise and the government has an "anti-driving effect" on the green development by lowering environmental standards and relaxing environmental regulations (Li and Liu, 2013). The influence coefficient of environmental regulation (*reg*) to green development is positive and has passed the test at least at 10%. This shows that with the rising status of "energy saving and emission reduction" and other environmental indicators in the local assessment system and the popularity of "scientific outlook on development" and other concepts, the strengthening of local government environmental regulation has indeed brought about an increase in the level of green development. The population density (*popden*) has a negative impact on green development and has passed the significance test. In areas with high population density, the level of green development is relatively low; this shows that the environmental pollution pressure caused by population growth at the current stage exceeds its contribution to environmental protection.

4.3. Analysis of Differences in the Impact of Different Channels

This paper focuses on the impact tax competition and industrial structure adjustment on regional green development. Because of the significant spatial spillover effects of inter-regional tax competition and industrial restructuring, Table 4 gives the effect of local and adjacent tax competition and industrial restructuring on local green development based on the estimation results of Table 3. As can be seen from Table 4, (1) Local tax competition (*tax*) has a certain negative impact on the local green development directly or through the industrial structure adjustment; at the same time, local tax competition will also lead to local industrial structure focus

on the industrial sector, hindering the promotion of local green development; taken together, tax competition will lead to a significant decline in local green development. (2) Tax competition in neighboring areas (*Wtax*) will hinder the upgrading of local industrial structure through the "race to the bottom" of industrial structure, which inhibits the local green development to a certain extent, and the development of local industrial structure in favour of industrialization will pose more difficulties for the transformation of local production mode, further inhibiting the improvement of regional green development; overall, tax competition in neighboring areas has had a significant negative impact on local green development. (3) There is the impact of local industrial restructuring (*sect*). Local industrialization-oriented industrial development will directly bring about increased local pollution and increased pressure on green development; in addition, similar to the analysis of previous two channels, such a biased industrial structure will also increase environmental pressure by stimulating extensive growth; overall, the negative impact of the development of local industrialization on green development is quite significant. (4) There is the impact of industrial restructuring in neighboring areas (*Wsect*). Because the direct impact of industrial restructuring in neighboring areas on local green development of is not significant, the impact results are no longer shown in the table; however, the industrial restructuring of neighboring areas in favour of industrialization will inhibit the improvement of local green development level through the spillover effect and correlation effect of industrial structure, coupled with the negative impact of economic growth channels, The industrial structure of neighboring areas biased towards industrialization will result in a significant negative spillover to the local green development. Therefore, in addition to having a direct negative impact on local green development, local tax competition and industrial restructuring in favour of industrialization will also reduce the level of local green development through industrial structure or economic growth channels, and if the negative spillover impact of relevant tax competition and industrial policies on the green development of neighboring areas is taken into account, tax competition among local governments and industrial competition in favuor of industrialization are a kind of lose-lose competition in the aspect of regional green development, which is harmful to others as well as to oneself.

Table 4. Differences in the Impact of Tax Competition and Industrial Restructuring on Green Development through Different Channels

Factors	Channels	Geographical weight	Economic weight	Mixed weight
Local tax competition (*tax*)	Direct impact (*tax-eco*)	−0.060	−0.072	−0.078
	Industrial structure (*tax-sect-eco*)	−0.016	−0.015	−0.035
	Industrial structure-economic growth (*tax-sect-pgdp-eco*)	−0.046	−0.046	−0.072
	Comprehensive impact	−0.122	−0.133	−0.185

Factors	Channels	Geographical weight	Economic weight	Mixed weight
Tax competition in neighboring areas (*Wtax*)	Industrial structure (*wtax-sect-eco*)	−0.230	−0.296	−0.535
	Industrial structure-economic growth (*wtax-sect-pgdp-eco*)	−0.675	−0.900	−1.090
	Comprehensive impact	−0.905	−1.196	−1.625
Local industrial restructuring (*sect*)	Direct impact (*sect-eco*)	−0.126	−0.146	−0.265
	Industrial structure-economic growth (*sect-pgdp-eco*)	−0.303	−0.444	−0.540
	Comprehensive impact	−0.429	−0.590	−0.805
Industrial restructuring in neighboring areas (*Wsect*)	Industrial structure (*wsect-sect-eco*)	−0.011	−0.009	−0.022
	Industrial structure-economic growth (*wsect-sect-pgdp-eco*)	−0.026	0.029	0.044
	Comprehensive impact	−0.037	0.038	−0.066

Note: Estimations of impact in this table, the level of economic growth (ln*pgdp*) is assumed to be 9.161, the sample mean.

5. Conclusions and Policy Implications

Based on the provincial data from 2000 to 2014 in China, this paper constructs a spatial panel model which includes local governments' tax competition, industrial structure adjustment and regional green development equation. Analysis of the impact of local governments' tax competition and industrial structure adjustment shows that the tax competition of local governments and the industrialization of industrial structure will have a direct negative impact on the local green development, and the tax competition and industrialization development in the neighboring areas will also inhibit the local green development directly through the negative incentive of "race to the bottom".

Based on the conclusion of this paper, the policy implications are as follows. First, regions need to build green development policies based on regional functional characteristics. Because of the different regional ecological capacity in China, local governments need to consider their local ecological capacity in planning and construction, and formulate regional development strategy and environmental protection policy according to their regional positioning to promote the equilibrium of green development between regions. At the same time, the weight of green development evaluation in local performance assessment should be effectively increased, preventing local governments from ignoring ecological environmental protection and excessively pursuing economic growth, thus effectively promoting the new development model of coordinated regional economic growth and social and environmental protection. Second, local governments' tax competition behavior should be standardized. We should deepen the reform of local fiscal and tax system and strengthen the central government's supervision over the implementation of

local tax policies and tax collection and administration. At present, along with the unified legislation by the central government, in order to reflect regional differences, local governments are granted the initiative to formulate appropriate collection standards and management methods within the prescribed range, but it is necessary to strengthen supervision and carry out the filing approval system. At the same time, implementation of environmental tax collection should be strengthened and the environmental constraints of capital flow across regions should be increased to eliminate the possibility of local governments attracting backward production capacity through tax competition. Third, local governments should reasonably determine the appropriate industrial structure development strategy. With the help of the "anti-driving mechanism" of the industrial development strategy, we should give full play to the "innovation compensation" effect in the Porter hypothesis, weaken the negative effect of the protection barrier on the local governments' environmental function, change the "free-rider" behavior in local government environmental protection, develop the cross-regional collaboration between production factors and services, give full play to the benign competitive effect of local government and the positive spatial spillover effect of inter-regional industry, and promote the green transformation of regional industry.

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