


## Article

# Do Local Fiscal Expenditures Promote the Growth of Profit-Seeking Enterprise Numbers in Neighboring Areas?

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**Abstract:** In order to allocate resources and formulate policies effectively, governments and enterprises often need accurate geographical information on profit-seeking enterprises. This study explores the impact of local fiscal expenditure and environmental regulation on the number of profit-seeking enterprises in Taiwan's counties and cities from the perspective of spatial econometrics, and analyzes data from 2001 to 2019. After comparing the explanatory power differences of various spatial econometric models, the spatial Durbin model, with spatial and time fixed effects, was used to explore the direct effect on the number of local profit-seeking enterprises, and the spillover effect of the number of local profit-seeking enterprises in different geographical locations on neighboring regions, especially the spatial spillover effect of local fiscal expenditure and labor and environmental regulations. This paper discusses the decision-making choices of local government regarding the competition strategy of environmental regulation, and finally provides the policy implications for the government as a reference.

**Keywords:** spillover effect; fiscal expenditure; spatial autocorrelation; spatial Durbin model



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## 1. Introduction

The establishment of a profit-seeking enterprise can affect the economic development of the place where the enterprise is located. To attract companies and manufacturers to invest and set up factories, local governments often introduce many preferential policies and investment promotion measures. Tiebout (1956) proposed the “vote by feet” theory, suggesting that, under normal circumstances, there would be more population inflow in places that can effectively provide public goods and services that meet their consumption preferences; on the contrary, places that cannot effectively provide these products and services would face population outflow. The “vote by feet” theory revises the traditional notion that public finance leads to market failure and introduces the spatial concept into the financial theory. In this view, population mobility is affected not only by public expenditure, but also by the burden of rents and taxes.

It is worth discussing whether enterprises will invest and set up factories in the right places to drive economic growth, as part of the migration described by the “vote by feet” theory. This study attempts to explore the growth in the number of profit-seeking enterprises in various regions from the perspective of the spatial effect of fiscal expenditure, which has been seldom discussed in past studies. First, the relationship between fiscal expenditure and economic growth has been the focus of many scholars (Barro 1990; East-erly and Rebelo 1993; Helms 1985; Lin and Song 2002). For example, Arrow and Kurz (2011) discussed the relationship between fiscal expenditure and economic growth in the framework of neoclassical growth theory and, subsequently, this research topic attracted

the attention of many scholars. Barro (1990) was the first to introduce fiscal expenditure into the production function. In this way, economic growth not only depends on the changes of production factors, such as capital accumulation and labor input, but also fiscal expenditure, which is regarded as an accumulative input of production factors. Boarnet (1998) suggested that the more complete a region's infrastructure is, the more attractive it will be to neighboring regions' capital, labor, and other factors of production. Through empirical analysis, Pereirã and Roca-Sagalés (2003) and Cohen and Morrison Paul (2004) found that public expenditure in a region, especially infrastructure construction, would have a positive spatial spillover effect on the economic growth of neighboring regions. Therefore, as a reflection of local fiscal capacity, local fiscal expenditure not only has a direct or indirect impact on the endowment and flow of production factors, such as labor, capital, technology, and information, but also has an important external effect on the operating environment of enterprises. This will naturally affect the growth in the number of profit-seeking enterprises.

Second, as far as the spatial dependence of the place of business of profit-seeking enterprises is concerned, the business or establishment behavior or phenomenon in the spatial geographical location does not exist independently, but has some spatial correlation with the phenomenon in the adjacent spatial geographical location. The distribution of profit-seeking enterprises has certain spatial rules, and the number of profit-seeking enterprises in different spatial geographical locations is affected by the local and neighborhood effect. Since the 1990s, spatial characteristics in the process of economic growth have been gradually examined by scholars. Bernat (1996) pointed out that there are spatial correlation and spatial spillover effects in the process of economic growth, and he was one of the early scholars who focused on spatial dependence in economic development. Rey and Montouri (1999) tested the spatial dependence, spatial heterogeneity and spatial convergence of economic development from the perspective of the neoclassical research, and found that ignoring the spatial effect of regional economic development would lead to the deviation of empirical results. This is because an important premise of traditional econometric models is to assume that the research objects are independent of each other, which is obviously inconsistent with reality. Traditional econometric models assume that spatial items are uncorrelated and homogenous, and model estimates are mostly made with the ordinary least squares (OLS) method. Ignoring spatial effects causes the biases commonly seen in these models. As a result, the estimations and inferences are not adequately robust, and hence fall short of the required explanatory power (LeSage and Pace 2009). The traditional econometric model has limitations in the analysis of spatial relations and numerical values; that is, it lacks the viewpoint of spatial effects, and it is difficult to reflect the distribution and change in the establishment of profit-seeking enterprises in different regions.

The spatial distribution pattern of the number of profit-seeking enterprises is the basis for studying the spatial structure of regional economic development, while the number of profit-seeking enterprises in different regions may have spatial autocorrelation. However, there are relatively few studies on spatial measurement on this topic. This study will bridge the gap between previous studies. The research objectives of this paper are as follows. (1) As Taiwan's economy has grown steadily, the number of profit-seeking enterprises has been on a gradual rise. This study examined the spatial autocorrelation and distribution of profit-seeking enterprises in different the cities and counties of Taiwan, and the subsequent findings can serve as a reference for the establishment, operation, and investment of companies or manufacturers. (2) A comparison was performed on the explanatory power of multiple quantitative spatial econometric models, including the spatial autoregressive model (SAR), spatial error model (SEM), and spatial Durbin model (SDM). This study conducted its analysis by using the best model. (3) The fiscal spending factors that influence the number of profit-seeking enterprises include general government expenditures, economic development expenditures, expenditures on education, science, and culture, and expenditures on community development and environmental protection. The environmental condition factors that influence the number of profit-seeking enterprises

include the net amount of tax collected, labor force participation rates, the number of lighting users, the proportion of employees with a junior college or higher education, and the percentage of employees aged from 25 to 44. This study examined the direct impact of the fiscal spending and environmental conditions in local cities and counties on the number of local profit-seeking enterprises. It also explored the spatial spillovers effects of the fiscal spending and environmental conditions in local cities and counties on the number of profit-seeking enterprises in adjacent cities and counties. (4) Different types of environmental conditions, as competitive strategies by local city/county governments, were also explored. The findings provide a reference for policymaking for local city/county governments.

## 2. Literature Review

[Tobler \(1970\)](#) proposed the First Law of Geography (Tobler's First Law or Tobler's First Law of Geography (TFL)): everything is related to everything else, but near things are more related than distant things. The First Law of Geography is concerned with the correlation of variables in different spatial geographies. This phenomenon is called spatial dependency or spatial autocorrelation.

[Cliff and Ord \(1973\)](#) mentioned the measurement of spatial autocorrelation, which mainly measures the values represented by adjacent spatial units (such as counties or states). If the values are similar, it means that there is spatial autocorrelation. [Goodchild \(1987\)](#) indicated that spatial autocorrelation quantifies the potential spatial dependence of geographical phenomena and describes the similarity between the phenomena in the region and other neighboring regions to identify the spatial aggregation. [Sokal et al. \(1988\)](#) proposed that spatial autocorrelation means to test the spatial differences between spatial unit variables and adjacent spatial variables. According to [Anselin \(1988\)](#), spatial autocorrelation refers to the potential spatial dependence of geographical phenomena, and it describes the spatial similarity between the region of a particular phenomenon and other neighboring regions by means of quantization, so as to identify the spatial aggregation characteristics. Therefore, the essence of spatial autocorrelation is to discuss the correlation between "local area" and "adjacent area"; that is, to discuss the influence degree of the "neighborhood effect", and to explore the possible influence mechanism of producing a spatial neighborhood effect ([Anselin 2003](#); [Goodchild et al. 2000](#); [Morenoff and Sampson 1997](#)).

Phenomena in space are not independent. Due to the similarity of the economic conditions and the social and cultural conditions between neighboring regions, the economic radiation of population transfer, industrial development, resource accumulation, and factor flow leads to the obvious spatial agglomeration of neighboring regions. When the observed area has a high degree of similarity with its neighboring regions, it is likely to have a contagion or diffusion effect, which is called a spatial overflow effect. The development of regional economy is influenced by spatial factors, and spatial spillover is an important part of regional economic development.

Previous studies used the spatial econometric model for fiscal expenditure ([Carruthers and Úlfarsson 2008](#); [De Siano and D'Uva 2017](#); [He et al. 2018](#); [Jiang et al. 2020](#); [Oyun 2017](#); [Pan et al. 2020](#); [Que et al. 2018](#); [Tyrrell and Johnston 2009](#); [Wang et al. 2021](#); [Wu and Zhu 2021](#); [Zhang et al. 2019](#)). For example, [Tyrrell and Johnston \(2009\)](#) studied the impact of tourism growth on municipal income and expenditure in 21 cities under the jurisdiction of New London County, Connecticut, from 1993 to 2002. [Oyun \(2017\)](#) explored the interstate spillover effects of Medicaid expenditures in 50 states on home- and community-based services (HCBS) from 2000 to 2010, and examined the relationship between fiscal decentralization and public expenditures. [De Siano and D'Uva \(2017\)](#) studied the spillover effect of fiscal decentralization and the public expenditure of local governments in Italy from 1996 to 2010. [Que et al. \(2018\)](#) discussed the spillover effect of fiscal decentralization on local public goods supply in 31 provinces of China from 1994 to 2013. [He et al. \(2018\)](#) used a spatial econometric model to study the determinants of company productivity and spatial spillover effects in China's electric apparatus industry from 1999 to 2007, in which public expenditure was an important factor. In the past, the

spatial econometric model was used to explore the theory of “vote by feet”. For example, Cheng and Pu (2017) studied the stable relationship between the effective tax rate and China’s economic growth from the perspective of spatial econometrics through the panel data of 31 Chinese provinces from 2007 to 2013. There are also studies on the factors influencing the employment growth of high-tech SMEs (Fingleton et al. 2004).

### 3. Methodology

#### 3.1. Setting of the Spatial Econometric Model

The definitions and descriptions of dependent and independent variables in the empirical models are as follows:

Number of profit-seeking enterprises ( $NPSE_{i(j),t}$ ): This refers to the number of profit-seeking enterprises in the county (or city)  $i$  ( $j$ ) in Taiwan in the  $t$ -th year. It is the number of companies registered for profit enterprise tax registration according to Article 28, Chapter 5 of the Value-added Tax and Non-value-added Tax Law.

General government expenditure (TWD million; New Taiwan Dollars) ( $GGE_{it}$ ): This refers to the general government expenditure of the  $i$ th county or city in Taiwan in the  $t$ th year. It is the expenditure of the county or city on the exercise of government power, administration, civil affairs, and finance (excluding police expenditure).

Economic development expenditure (TWD million) ( $EDE_{it}$ ): This refers to the economic development expenditure of the  $i$ th county or city in Taiwan in the  $t$ th year. It is the expenditure of the county or city on agriculture, industry, transportation, and other economic services.

Expenditure on education, science, and culture (TWD million) ( $EESC_{it}$ ): This refers to the education, science, and culture expenditure of the  $i$ th county or city in Taiwan in the  $t$ th year. It is the expenditure on education, science, and culture, and other undertakings and subsidies.

Expenditure on community development and environmental protection (TWD million) ( $ECDEP_{it}$ ): This refers to the expenditure for community development and environmental protection of the  $i$ th county or city in Taiwan in the  $t$ th year. It is the expenditure of a county or city for community development, environmental protection, and other undertakings and subsidies.

Net amount of tax collected (TWD thousand) ( $NATC_{it}$ ): This refers to the net amount of tax collected of the  $i$ th county or city in Taiwan in the  $t$ th year. The net amount of tax collected refers to the amount of tax collected in the current year minus the amount of tax refunds. The current year or previous years are included.

Number of lighting users ( $NLU_{it}$ ): This refers to the number of lighting users of the  $i$ th county or city in Taiwan in the  $t$ th year. It is the number of users of electricity for flat-rate lighting and metered lighting (including business and non-business users) of the Taiwan Power Company.

Labor force participation rate (%) ( $LFPR_{it}$ ): This refers to the percentage of the labor force of the  $i$ th county or city in Taiwan in the  $t$ th year in the population over 15 years old. Labor force refers to the working population over the age of 15, including the employed and the unemployed. The formula is (number of labor force/number of population over 15 years old)  $\times 100$ .

Proportion of employees with a junior college or higher education (%) ( $PEE_{it}$ ): This refers to the percentage of the employees with a junior college or higher education of the  $i$ th county or city in Taiwan in the  $t$ th year in the total employment. The formula is (the number of the employees with a junior college or higher education/the total number of the employed people)  $\times 100$ .

Percentage of employees aged 25 to 44 (%) ( $PEA_{it}$ ): This refers to the percentage of employees aged 25 to 44 in total employment in the first year of the  $i$ th county and city of Taiwan. The formula is (number of employees aged 25–44/total number of employees)  $\times 100$ .

Panel data analysis can control the differences between cross-sectional individuals, reduce the collinearity among variables, adjust the autocorrelation of variables in time

series analysis, and reduce the risk of bias derived from the measurement model. All kinds of economic activities are related in spatial geography, and with the development of the economy, they are more closely related in space. For simplification purposes, the intercept term is included in the matrix of independent variables, and the model in this study is written in matrix form. The empirical model in this study is as follows:

$$\begin{aligned} \mathbf{Y} &= \rho \cdot \mathbf{W}\mathbf{Y} + \mathbf{X} \cdot \boldsymbol{\beta} + \mathbf{W}\mathbf{X} \cdot \boldsymbol{\theta} + \boldsymbol{\varepsilon} \\ \boldsymbol{\varepsilon} &\sim N(0, \varepsilon^2 \mathbf{I}) \\ & \quad i \neq j \end{aligned}$$

where  $\mathbf{Y} = Y_{i,j,t}$  denotes  $NPSE_{i(j),t}$ , while  $\mathbf{W}$  is the spatial weighting matrix used to measure spatial correlation between geographical counties (cities), and  $\rho$  is the vector of spatial lag coefficient and the spatial autocorrelation coefficient of the dependent variable. It reflects the direction and degree of the influence of the dependent variable ( $Y_{jt}$ ) in the neighboring region on the dependent variable ( $Y_{it}$ ) of the region; that is, the influence of the dependent variable ( $Y_{jt}$ ) of the region with spatial correlation on the dependent variable ( $Y_{it}$ ) of the region. By verifying the spatial lag coefficient ( $\rho$ ), we can further explore the spillover effect of the neighboring region on this region. When  $\rho$  significantly differs from zero, this means that there is indeed a spatial relation with the neighboring region. The value of  $\rho$  reflects the degree of interaction between regions, such as spatial diffusion or spatial spillover;  $\mathbf{W}\mathbf{Y}$  is the spatial autocorrelation matrix of the dependent variable, which is an endogenous variable. It represents the influence of  $NPSE_{jt}$  in region  $j$  adjacent to region  $i$  on  $NPSE_{it}$  in region  $i$ .

$\boldsymbol{\beta}$  is the vector of coefficients to be estimated, which represents the original effect of the independent variable vector  $\mathbf{X}$ , which consists of  $GGE_{it}$ ,  $EDE_{it}$ ,  $EESC_{it}$ ,  $ECDEP_{it}$ ,  $NATC_{it}$ ,  $LFPR_{it}$ ,  $NLU_{it}$ ,  $PEE_{it}$ , and  $PEA_{it}$ . Therefore, our independent vector is  $\mathbf{X} = [GGE_{it}, EDE_{it}, EESC_{it}, ECDEP_{it}, NATC_{it}, LFPR_{it}, NLU_{it}, PEE_{it}, PEA_{it}]$ .

$\mathbf{X} \cdot \boldsymbol{\beta}$  reflects the original influence of each independent variable on  $NPSE_{it}$ , and  $\boldsymbol{\theta}$  is the coefficient vector to be estimated, which is the spatial autocorrelation coefficient of the independent variable. It reflects the influence of all the independent variables in the neighboring regions on  $NPSE_{it}$  in the region. A positive  $\boldsymbol{\theta}$  indicates that the neighborhood effect has a positive effect on the dependent variable ( $NPSE_{it}$ ), and that there is spillover effect between the neighboring regions, while a negative  $\boldsymbol{\theta}$  represents that there is a competition effect among the neighboring regions.  $\mathbf{W}\mathbf{X}$  is the matrix of the spatial autocorrelation terms of the independent variables, which represents the spatial effect of all independent variables and shows the influence of all independent variables in the neighboring areas on  $NPSE_{it}$  in region  $i$ .  $\mu_i$  is the spatial (individual) effect, which is the individual effect of county (city)  $i$ , and  $\varepsilon_{it}$  is an independent and identically distributed random error term and a spatial autocorrelation error term.

In order to address the problem of inflation, this study takes the deflated consumer price index (CPI) as a real variable in each nominal variable of fiscal expenditures, excluding the impact of inflation on fiscal expenditure measurement. Among the variables, general government expenditure ( $GGE_{it}$ ), economic development expenditure ( $EDE_{it}$ ), expenditure on education, science, and culture ( $EESC_{it}$ ), expenditure on community development and environmental protection ( $ECDEP_{it}$ ), the net amount of tax collected ( $NATC_{it}$ ), and other nominal variables are deflated according to the CPI to remove the impact of inflation factors. For example:  $\text{Nominal General Government Expenditure} \div \text{CPI} \times 100 = \text{Real General Government Expenditure}$ .

### 3.2. Data and Sample

This paper takes the data of 22 counties and cities in Taiwan for 19 years from 2001 to 2019 as samples. The codes and names of counties and cities in Taiwan are shown in Table 1. The data are mainly from the Key Statistical Index Inquiry System on Counties and Cities, under the National Statistics Website of the Republic of China.

**Table 1.** Codes and names of 22 counties and cities in Taiwan.

No.	Name	No.	Name	No.	Name	No.	Name
1	Lienchiang County	7	Keelung City	13	Taoyuan City	18	Kinmen County
2	Yilan County	8	Hsinchu City	14	Miaoli County	19	Kaohsiung City
3	Changhua County	9	Taipei City	15	Hsinchu County	20	Taitung County
4	Nantou County	10	New Taipei City	16	Chiayi City	21	Hualien County
5	Yunlin County	11	Taichung City	17	Chiayi County	22	Penghu County
6	Pingtung County	12	Tainan City				

### 3.3. Spatial Weight Matrix

The spatial weight matrix needs to be considered before constructing the spatial econometric model. The spatial weight matrix is the premise and foundation of spatial econometric analysis using exploratory spatial data analysis (ESDA). A binary symmetrical spatial weight matrix  $W_{n \times n}$  is usually defined to express the spatial neighborhood relation of  $n$  locations.

$$W_{ij} = \mathbf{W} = \begin{bmatrix} w_{11} & w_{12} & \cdots & w_{1n} \\ w_{21} & w_{22} & \cdots & w_{2n} \\ \vdots & \vdots & \cdots & \vdots \\ w_{ni} & w_{n2} & \cdots & w_{nn} \end{bmatrix}$$

There are three methods to identify the adjacency of spatial units: rook contiguity, bishop contiguity, and queen contiguity. Rook contiguity refers to the contact between two spatial boundaries, bishop contiguity refers to the diagonal contiguity, and queen contiguity refers to contacts on the edge or diagonal (Sawada 2004). This research used the queen contiguity to define spatial adjacencies.

There are various rules for establishing a spatial weight matrix. Among them, a binary adjacency space weight matrix based on adjacency rules and distance rules is commonly used. This study used adjacency rules, which were defined as:

$$W_{ij} = \begin{cases} 1, & \text{regions } i \text{ and } j \text{ are neighboring regions} \\ 0, & \text{regions } i \text{ and } j \text{ are not neighboring regions} \end{cases}$$

There are three island counties in Taiwan, and there is no adjacency relationship between these island counties and other counties; therefore, they exhibited a value of 0.

## 4. Results

### 4.1. Descriptive Statistics

Table 2 shows the variables in the model of this study. Table 3 shows the results of the correlation analysis.

**Table 2.** Summary of descriptive statistics.

Variables	Obs.	Mean	Std. Dev.	Min.	25th Percentile	Median	75th Percentile	Max.
NPSE	418	56,699.16	63,026.64	813	17,353	24,413	86,319	235,828
GGE	418	4689.37	4995.12	314.69	1831.48	2417.02	5771.08	30,812.48
EDE	418	7194.08	7441.14	881.11	2596.07	4359.20	8333.14	47,178.08
EESC	418	15,098.66	16,282.09	463.52	4959.05	4959.04	19,860.31	65,587.43
ECDEP	418	2369.52	3710.74	88.11	310.10	683.84	2026.77	16,149.67
NATC	418	80,633,469.67	140,544,536.26	91,613.62	8,530,115	26,300,000	104,000,000	789,241,887.60
NLU	418	557,416.83	540,259.25	3635	174,403	174,403	174,403	2,058,119
LFPR	418	57.92	3.99	46	56.3	57.9	59.3	74.90
PEE	418	37.38	12.81	9.74	28.81	36.01	44.49	81.05
PEA	418	54.69	4.90	37.49	51.86	55.16	57.93	63.97

**Note:** NPSE: Number of profit-seeking enterprises; GGE: General government expenditure (TWD million); EDE: Economic development expenditure (TWD million); EESC: Expenditure on education, science, and culture (TWD million); ECDEP: Expenditure on community development and environmental protection (TWD million); NATC: Net amount of tax collected (TWD thousand); LFPR: Labor force participation rate (%); NLU: Number of lighting users; PEE: Proportion of employees with junior college or higher education (%); PEA: Percentage of employees aged 25 to 44 (%).

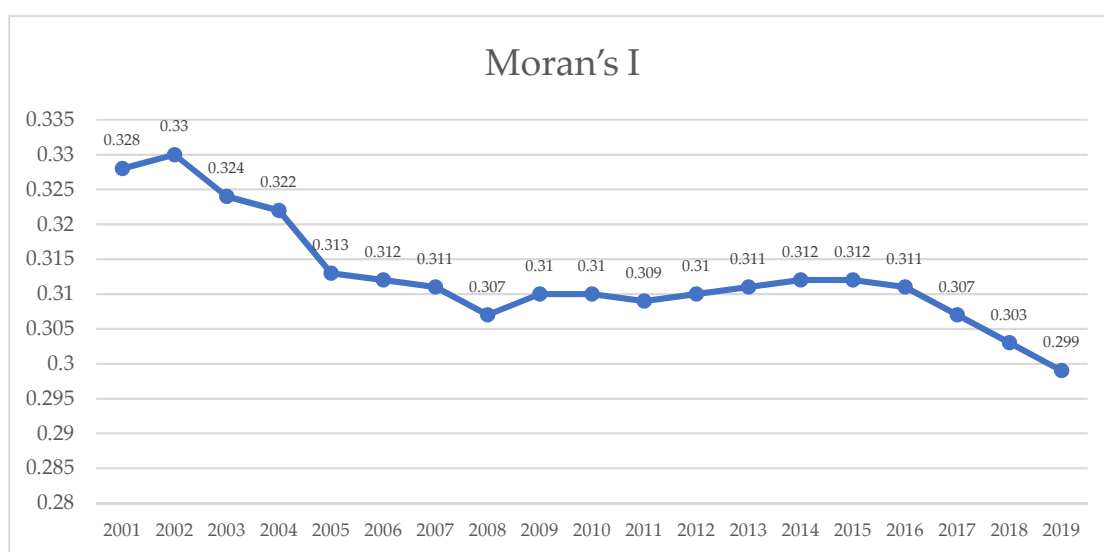
**Table 3.** Pearson correlation analysis.

	NPSE	GGE	EDE	ECE	CEE	ACN	LFP	LU	ESE	AEP
NPSE	1									
GGE	0.865 ***	1								
EDE	0.869 ***	0.837 ***	1							
EESC	0.971 ***	0.885 ***	0.892 ***	1						
ECDEP	0.911 ***	0.866 ***	0.859 ***	0.930 ***	1					
NATC	0.794 ***	0.690 ***	0.738 ***	0.855 ***	0.815 ***	1				
LFPR	0.934 ***	0.831 ***	0.798 ***	0.883 ***	0.801 ***	0.579 ***	1			
NLU	0.050	0.066	0.031	0.043	0.018	0.005	0.103 *	1		
PEE	0.491 ***	0.493 ***	0.452 ***	0.536 ***	0.563 ***	0.647 ***	0.321 ***	0.127 **	1	
PEA	0.225 ***	0.072	0.093	0.177 ***	0.157 **	0.144 **	0.236 ***	0.094	0.080	1

Note: \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

#### 4.2. Test of Spatial Autocorrelation

Before spatial econometric analysis, it is necessary to test whether the dependent variable has spatial autocorrelation. If the dependent variable has spatial autocorrelation, it is reasonable to add spatial geography factors. The detection of spatial autocorrelation can definitely analyze spatial relations (concentration, random, and dispersion). Spatial autocorrelation mainly includes global spatial autocorrelation and regional spatial autocorrelation. Among the various spatial autocorrelation indicators, Moran’s statistical power is the best (Walter 1992), thus making it the most widely used spatial autocorrelation indicator (Cliff and Ord 1973, 1981). The closer the value of Moran’s I approaches 1, the more it indicates that the positive spatial autocorrelation degree is stronger, and the closer the value approaches  $-1$ , the stronger the negative spatial autocorrelation degree is. According to Table 4, all the values of Moran’s I reach the significance level of 0.05, indicating that the number of profit-seeking enterprises in all counties and cities from 2001 to 2019 has a significant positive spatial autocorrelation. It is therefore suitable to use the spatial econometric model in this study. The trend chart of spatial autocorrelation is shown in Figure 1. Moran’s I in the past 19 years has roughly shown a decreasing trend year by year, indicating that the distribution of the number of profit-seeking enterprises in Taiwan’s counties and cities is less and less concentrated.

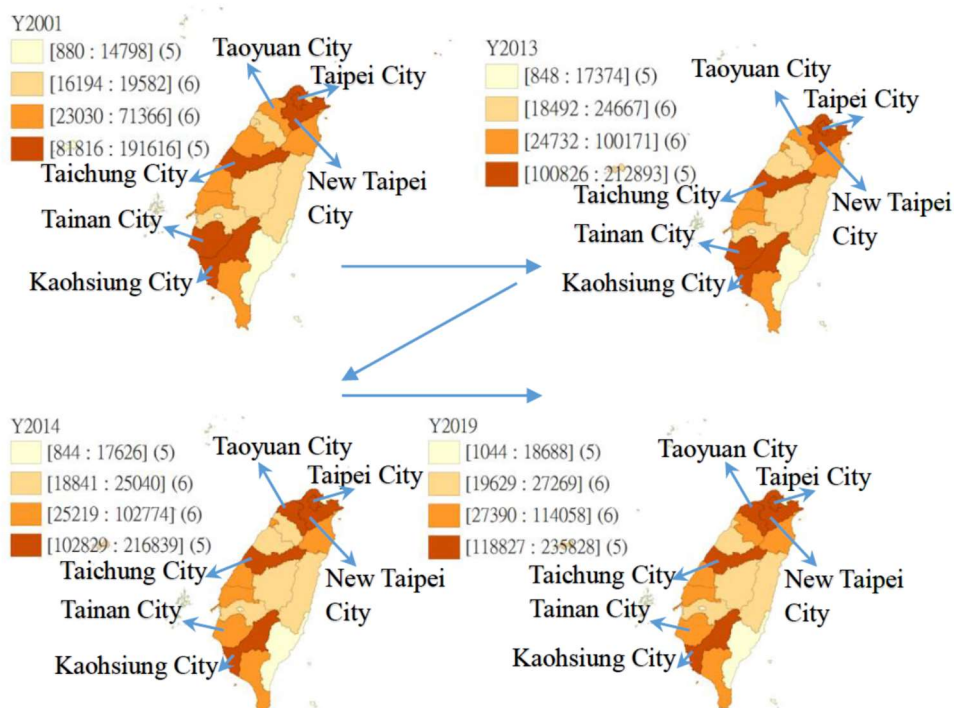


**Figure 1.** Graph of global Moran’s I of Taiwan’s profit-seeking enterprises from 2001 to 2019.

**Table 4.** Spatial autocorrelation statistics from 2001 to 2019.

Year	Moran's I		Year	Moran's I	
	I	p-Value		I	p-Value
2001	0.328	0.025	2011	0.309	0.036
2002	0.330	0.025	2012	0.310	0.035
2003	0.324	0.028	2013	0.311	0.035
2004	0.322	0.029	2014	0.312	0.035
2005	0.313	0.033	2015	0.312	0.035
2006	0.312	0.034	2016	0.311	0.035
2007	0.311	0.035	2017	0.307	0.038
2008	0.307	0.037	2018	0.303	0.040
2009	0.310	0.035	2019	0.299	0.042
2010	0.310	0.036			

In this study, GeoDa, the spatial statistics software, was used to map the spatial distribution of the number of profit-seeking enterprises. Figure 2 shows the distribution of the number of profit-seeking enterprises in Taiwan's counties and cities from 2001 to 2019. The darker the color, the higher the number of profit-seeking enterprises. The five municipalities, Taipei City, New Taipei City, Taichung City, Tainan City, and Kaohsiung City, maintained the highest number of profit-seeking enterprises at Level 1 from 2001 to 2013. From 2014, Taipei City, New Taipei City, Taoyuan City, Taichung City, and Kaohsiung City maintained the highest number of profit-seeking enterprises, among which Tainan City fell to Level 2 after 2014. In 2014, Taoyuan City was newly established as a municipality directly under the central government. The number of its profit-seeking enterprises rose to the first level, which shows the devotion and investment of Taoyuan City in investment promotion.



**Figure 2.** Spatial distribution of Taiwan's profit-seeking enterprises from 2001 to 2019.

In terms of the distribution of profit-seeking enterprises in Taiwan, after Taoyuan City was upgraded to a municipality directly under the central government, the overall funds allocated by the central government to the local government and the tax revenue increased, resulting in an increase in the local fiscal expenditure budget. As a result, many profit-



seeking enterprises have chosen to invest in Taoyuan City, as in Tiebout’s “vote by feet” model, where residents can choose a residential community based on their preference for public goods. During the same period, the number of profit-seeking enterprises in Tainan City continued to increase, but the increase in the number of profit-seeking enterprises in Taoyuan City was higher than that of Tainan City. This study suggests that the reason is not that the government of Tainan City performed inferiorly to Taoyuan City, but that Taoyuan City’s growth in attracting investment exceeds Tainan City.

#### 4.3. Selection of the Spatial Econometric Model

Table 5 shows the results of the analysis and the comparison of three SAR models. The Hausman test, proposed by Hausman (1978), can be adopted to determine whether it is suitable to use the model of random effects or the model of fixed effects. Model 1 is the SAR with spatial fixed effects, Model 2 is the SAR with spatial and time fixed effects, and Model 3 is the SAR with random effects. Between Model 1 and Model 3, the Hausman test indicates  $\chi^2 = 6.61, p > 0.05$ . The results of the Hausman test show that the null hypothesis (random effects model) is not rejected. Therefore, Model 3 is more suitable for analysis than Model 1. Between Model 2 and Model 3, the Hausman test indicates  $\chi^2 = 483.42, p < 0.001$ . The results of the Hausman test show that the null hypothesis (random effects model) is rejected. Therefore, Model 2 is more suitable for analysis than Model 3.

**Table 5.** Estimation results of fixed effects and random effects of spatial autoregressive model (SAR).

Spatial Autoregressive Model (SAR):						
$Y = \rho \cdot WY + X \cdot \beta + \varepsilon$						
$\varepsilon \sim N(0, \sigma^2 I)$						
where Y is an n-dimensional dependent variable; $\rho$ is the vector of the spatial autoregressive coefficient; W is the spatial weight matrix; $\beta$ is a p-dimensional slope to be estimated; X is an n * p matrix of regressors; $\varepsilon$ is an n-dimensional vector of i,i,d disturbances following multiple normal distributions with zero mean and finite variances.						
Variables	Model 1		Model 2		Model 3	
	SAR with Spatial Fixed Effects		SAR with Spatial and Time Fixed Effects		SAR with Random Effects	
	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value
GGE	0.448 ***	0.000	0.558 ***	0.000	0.416 ***	0.000
EDE	0.035	0.365	0.066	0.060	0.038	0.334
EESC	0.148 *	0.033	0.063	0.312	0.178 *	0.012
ECDEP	0.449 **	0.002	0.415 **	0.001	0.445 **	0.002
NATC	0.000 ***	0.000	0.000 ***	0.000	0.000 ***	0.000
NLU	0.082 ***	0.000	0.085 ***	0.000	0.082 ***	0.000
LFPR	257.466 *	0.017	336.785 **	0.001	256.833 *	0.019
PEE	−108.494 *	0.019	501.005 ***	0.000	−106.946 *	0.020
PEA	65.021	0.403	76.645	0.372	82.816	0.297
Constant					−17,516.800	0.077
n		418		418		418
Spatial $\rho$	0.070 *	0.031	0.032	0.334	0.078 *	0.013
within R <sup>2</sup>		0.913		0.834		0.912
between R <sup>2</sup>		0.933		0.950		0.937
overall R <sup>2</sup>		0.933		0.943		0.937
Log-likelihood		−3848.553		−3809.588		−3934.340
AIC		7715.106		7637.175		7890.68
BIC		7751.425		7673.495		7935.07
Hausman $\chi^2$		6.61		483.42		
Hausman p-value	0.470		0.000			
Wald test	$H_0 : \theta = 0$ $\chi^2 = 179.78$ p-value = 0.0000		$H_0 : \theta = 0$ $\chi^2 = 132.24$ p-value = 0.0000		$H_0 : \theta = 0$ $\chi^2 = 159.79$ p-value = 0.0000	
	(1)		LR $\chi^2 = 128.14$ p-value = 0.0000		LR $\chi^2 = 131.78$ p-value = 0.0000	

Note: \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

Table 6 shows the results of the analysis and the comparison of the three SEM models. Model 4 is the SEM with spatial fixed effects, Model 5 is the SEN with spatial and time fixed effects, and Model 6 is SEM with random effects. Between Model 4 and Model 6, the Hausman test indicates  $\chi^2 = 4.62, p > 0.05$ . The results of the Hausman test show that the null hypothesis (random effects model) is not rejected. Therefore, Model 6 is more suitable for analysis than Model 4. Between Model 5 and Model 6, the Hausman test indicates  $\chi^2 = 379.02, p < 0.001$ . The results of the Hausman test show that the null hypothesis (random effects model) is rejected. Therefore, Model 5 is more suitable for analysis than Model 6.

**Table 6.** Estimation results of fixed effects and random effects of spatial error model (SEM).

Spatial Error Model (SEM):  
 $Y = X\beta + \zeta$   
 $\zeta = \lambda W\zeta + \varepsilon$   
 $\varepsilon \sim N(0, \sigma^2 I)$   
 where  $Y$  is an  $n$ -dimensional dependent variable;  $\beta$  is a  $p$ -dimensional slope to be estimated;  $X$  is the independent variable;  $\lambda$  is the spatial autocorrelation coefficient of the error lag  $W\zeta$ ;  $\varepsilon$  is an i.i.d noise.

Variables	Model 4 SEM with Spatial Fixed Effects		Model 5 SEM with Spatial and Time Fixed Effects		Model 6 SEM with Random Effects	
	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value
GGE	0.397 ***	0.000	0.569 ***	0.000	0.369 ***	0.000
EDE	0.023	0.500	0.063	0.081	0.026	0.465
EESC	0.035	0.592	0.067	0.310	0.061	0.362
ECDEP	0.417 **	0.002	0.429 **	0.001	0.423 **	0.002
NATC	0.000 ***	0.000	0.000 ***	0.000	0.000 ***	0.000
NLU	0.091 ***	0.000	0.084 ***	0.000	0.090 ***	0.000
LFPR	177.136	0.098	387.871 ***	0.000	169.164	0.124
PEE	-9.416	0.863	544.884 ***	0.000	3.033	0.958
PEA	82.254	0.320	64.136	0.477	98.888	0.242
Constant					-15,627.800	0.111
n		418		418		418
Spatial $\lambda$	0.406 ***	0.000	0.010	0.898	0.410 ***	0.000
within R <sup>2</sup>		0.909		0.830		0.910
between R <sup>2</sup>		0.922		0.951		0.926
overall R <sup>2</sup>		0.922		0.943		0.926
Log-likelihood		-3839.559		-3810.908		-3927.159
AIC		7697.118		7639.815		7876.317
BIC		7733.438		7676.135		7920.708
Hausman $\chi^2$		4.62		379.02		
Hausman p-value		0.707		0.000		
Wald test	$H_0 : \theta + \rho\beta = 0$ $\chi^2 = 132.09$ p-value = 0.0000		$H_0 : \theta = 0$ $\chi^2 = 112.36$ p-value = 0.0000		$H_0 : \theta + \rho\beta = 0$ $\chi^2 = 114.74$ p-value = 0.0000	
Likelihood-ratio test	LR $\chi^2 = 128.19$ p-value = 0.0000		LR $\chi^2 = 130.78$ p-value = 0.0000		LR $\chi^2 = 117.42$ p-value = 0.0000	

Note: \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

As shown in the Hausman test results of the SAR and SEM models, the model with spatial and time fixed effects is more suitable for analysis. LeSage and Pace (2009) and Elhorst (2010, 2001) argue that the SDM can be simplified to the SAR or SEM. The model is thus selected by verifying the following hypotheses.  $H_0: \theta = 0$ , if the original hypothesis is rejected, then the SDM cannot be simplified to the SAR, and so it is more rational to select the SDM.  $H_0: \theta + \rho\beta = 0$ , if the original hypothesis is rejected, then the SDM cannot be simplified to the SEM, and so it is more rational to select the SDM. In Table 5, between the SAR with spatial fixed effects and the SDM with spatial fixed effects, the Wald test shows  $\chi^2 = 179.78, p < 0.001$ , the likelihood-ratio test shows  $\chi^2 = 146.18, p < 0.001$ , and so it is more rational to select the SDM with spatial fixed effects. Between the SAR with spatial and time fixed effects and the SDM with spatial and time fixed effects, the Wald test indicates  $\chi^2 = 132.24, p < 0.001$ , the likelihood-ratio test indicates  $\chi^2 = 128.14, p < 0.001$ , and so it is

more reasonable to select the SDM with spatial and time fixed effects. Between the SAR with random effects and the SDM with random effects, the Wald test shows  $x^2 = 159.79$ ,  $p < 0.001$ , the likelihood-ratio test shows  $x^2 = 131.78$ ,  $p < 0.001$ , and so it is more rational to select SDM with random effects.

In Table 6, between the SEM with spatial fixed effects and the SDM with spatial fixed effects, the Wald test indicates  $x^2 = 132.09$ ,  $p < 0.001$ , the likelihood-ratio test indicates  $x^2 = 128.19$ ,  $p < 0.001$ , and so it is more reasonable to choose the SDM with spatial fixed effects. Between the SEM with spatial and time fixed effects and the SDM with spatial and time fixed effects, the Wald test shows  $x^2 = 112.36$ ,  $p < 0.001$ , the likelihood-ratio test shows  $x^2 = 130.78$ ,  $p < 0.001$ , and so it is more rational to select the SDM with spatial and time fixed effects. Between the SEM with random effects and the SDM with random effects, the Wald test shows  $x^2 = 114.74$ ,  $p < 0.001$ , the likelihood-ratio test shows  $x^2 = 117.42$ ,  $p < 0.001$ , and so it is more reasonable to choose the SDM with random effects.

The analysis results of the Wald test and likelihood-ratio test between the three models of SAR, SEM, and SDM show that the SDM is the most suitable for the analysis. As for which model of the SDMs is more suitable, we will analyze that in the next section.

#### 4.4. Estimation Results of Various SDMs

Table 7 shows the comparison results of the SDM with spatial fixed effects and the SDM with random effects. Akaike (1973) proposed the Akaike Information Criterion (AIC) based on the Kullback–Leibler driver. Since the model with a minimum MSE (mean squared error) is selected as the adaptive model, it is more effective and sensitive. The method of AIC is to find the model that best interprets the data and contains the least free parameters. The smaller the estimated value is, the higher the goodness of fit is. Schwarz (1978) proposed the Schwartz Bayesian Information Criterion (SBC or BIC), whose lag length, corresponding to the minimum value, is the optimal lag length. This method is used to select an optimal lag term that can minimize the final prediction error. With a large number of observations, the number of parameters obtained by the BIC is less than that by the AIC. As with the AIC, when it is used for model selection, the smaller the value, the higher the model fit. The BIC is a consistent model selection method. When the sample size is large enough, the BIC selects the smallest correct model.

As far as the overall goodness of fit is concerned, the spatial econometric model uses the maximum likelihood estimation (MLE), so the maximum similar and nonlinear verification value can be obtained in the model and its coefficient can be maximized. Only the fitness test of Log-likelihood (LIK), AIC, and BIC based on the nonlinear principle can be used as the indicator of the goodness of fit. The model with the largest LIK value or the smallest AIC value and BIC value is the best model. When the AIC and BIC values are used to evaluate the goodness of fit of the model, the smaller the value, the higher the goodness of fit of the model.

Between Model 7 and Model 9, the Hausman test indicates  $x^2 = 0.28$ ,  $p > 0.05$ . The results of the Hausman test show that the null hypothesis (random effects model) is not rejected. Therefore, Model 9 is more suitable for analysis than Model 7. Between Model 8 and Model 9, the Hausman test indicates  $x^2 = 39.67$ ,  $p < 0.001$ . The results of the Hausman test show that the null hypothesis (random effects model) is rejected. Therefore, Model 8 is more suitable for analysis than Model 9. In addition, in terms of the values of Log-likelihood (LIK), AIC, and BIC for Model 8, the AIC and BIC values of Model 8 are both lower than those of Model 7 and Model 9, and the Log-likelihood (LIK) value of Model 8 is higher than that of both Model 7 and Model 9. Thus, the model fit index of Model 8 is better than that of Model 7 and Model 9. The spatial lag coefficient of Model 8 reaches a significant level ( $\rho = 0.182$ ,  $p < 0.05$ ), indicating significant spatial autocorrelation of the distribution in the number of profit-seeking enterprises in counties and cities, and confirming once again the rationality of incorporating the spatial effects into the econometric model. Therefore, the SDM with spatial and time fixed effects is finally selected by this study as the basis for analysis.

**Table 7.** Estimation results of fixed effects and random effects of spatial Durbin model (SDM).

Spatial Durbin Model (SDM):  
 $Y = \rho \cdot WY + X \cdot \beta + W \cdot X \cdot \theta + \zeta$   
 $\zeta = \lambda W \zeta + \varepsilon$   
 $\varepsilon \sim N(0, \sigma^2 I)$   
 where  $Y = Y_{it}$   
 is an n-dimensional dependent variable;  $Y$  is the dependent variable, and the subscript  $i$  denotes the region ( $i = 1, 2, \dots, N$ );  $t$  is the year ( $t = 1, 2, \dots, T$ );  $T$  is the total number of periods;  $\rho$  is the spatial lag coefficient;  $W$  is the non-negative  $N \times N$  spatial weight matrix, which reflects the degree of interdependence between spatial individuals;  $WY$  is the degree of interdependence and correlation between the region and its neighboring regions;  $\alpha$  is a constant;  $\beta$  is the regression coefficient;  $X$  is the independent variable;  $WX$  is the exogenous interaction between the region and its neighboring regions;  $\theta$  is a reflection parameter of the exogenous interaction;  $\varepsilon$  is the independent and identically distributed random error term;  $\lambda$  is the autocorrelation coefficient of the spatial error;  $\zeta$  is the error term of the spatial autocorrelation.

Variables	Model 7		Model 8		Model 9	
	SDM with Spatial Fixed Effects		SDM with Spatial and Time Fixed Effects		SDM with Random Effects	
	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value
GGE	0.202 *	0.011	0.337 ***	0.000	0.218 **	0.007
EDE	0.098 **	0.003	0.087 **	0.007	0.100 **	0.003
EESC	0.134 *	0.027	0.147 *	0.013	0.144 *	0.021
ECDEP	0.256 *	0.037	0.228	0.057	0.258 *	0.042
NATC	0.000 ***	0.000	0.000 ***	0.000	0.000 ***	0.000
NLU	0.093 ***	0.000	0.089 ***	0.000	0.092 ***	0.000
LFPR	41.294	0.665	127.183	0.197	26.286	0.789
PEE	213.426 ***	0.000	249.263 *	0.017	233.193 ***	0.000
PEA	139.467	0.060	178.889 *	0.026	148.154 *	0.046
W×GGE	0.266*	0.010	0.625 ***	0.000	0.200	0.061
W×EDE	−0.072	0.157	−0.072	0.169	−0.086	0.095
W×EESC	0.450 ***	0.000	0.482 ***	0.000	0.382 ***	0.000
W×ECDEP	0.030	0.841	0.034	0.825	0.058	0.710
W×NATC	0.000 **	0.004	0.000	0.092	0.000 **	0.003
W×NLU	−0.072 ***	0.000	−0.072 ***	0.000	−0.057 ***	0.000
W×LFPR	88.822	0.674	294.051	0.207	182.973	0.195
W×PEE	−162.803	0.050	158.341	0.120	−252.968 **	0.003
W×PEA	−84.484	0.520	267.261	0.152	−18.823	0.846
Constant					−13019	0.259
n		418		418		418
Spatial $\rho$	0.324 ***	0.000	0.182 *	0.046	0.312 ***	0.000
within R <sup>2</sup>		0.934		0.916		0.934
between R <sup>2</sup>		0.885		0.823		0.918
overall R <sup>2</sup>		0.886		0.824		0.918
Log-likelihood		−3775.465		−3745.520		−3868.450
AIC		7582.93		7523.039		7772.9
BIC		7647.498		7587.607		7845.539
Hausman $\chi^2$		0.28		39.67		
Hausman p-value		0.100		0.000		

Note: \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

LeSage and Pace (2009) pointed out that in the SDM, considering the spatial interaction effects, if the regression results of the spatial estimation parameters were directly used to judge whether there is a spatial spillover effect, the feedback effects (FE) may lead to incorrect conclusions. Since the independent variables and dependent variables with spatial lag are included in the model, the estimated results cannot directly reflect their marginal effect, and it is also difficult to accurately measure the direct impact of independent variables on dependent variables (Elhorst 2010).

4.5. Decomposition Results of Direct Effects and Spillover Effects Based on SDM with Random Effects

LeSage and Pace (2009) pointed out that due to the spatial correlation between variables, it is necessary to decompose the influence of independent variables on dependent variables. They suggested that the results obtained by testing spatial spillover effects using point estimation were biased. Therefore, they proposed a partial differentiation method of the spatial regression model, which decomposes the total effect (TE) into the direct effect (DE) and indirect effect (IE). This method can better capture and explain the marginal effect

of independent variables in the presence of spatial interaction. The direct effect refers to the influence of independent variables on dependent variables in the region, and the direct effects include initial effects and feedback effects. Initial effects indicate that the change to the independent variable causes the change to the dependent variable in this region. Feedback effects indicate that the change to the independent variables in this region causes the change to the dependent variables in neighboring regions, which in turn causes the change to the dependent variables in this region. In terms of numerical values, the direct effect is equal to the sum of the  $\beta$  regression coefficient and the feedback effect of the SDM. The indirect effect, also known as the spatial spillover effect, is used to measure the influence of an independent variable in a neighboring region on the dependent variable of the region. The total effect is equal to the sum of the direct effect and the indirect effect; that is,  $TE = DE + IE$ . It can be interpreted as the average effect of the change to an independent variable in this region on the dependent variable in all regions. Table 8 shows the results of the SDM decomposition based on fixed effects.

**Table 8.** Direct, indirect, and total effects of SDM with spatial and time fixed effects.

Variables	LR_Direct Effect		LR_Indirect Effect		LR_Total Effect	
	Coefficient	<i>p</i> -Value	Coefficient	<i>p</i> -Value	Coefficient	<i>p</i> -Value
<i>GGE</i>	0.370 ***	0.000	0.709 ***	0.000	1.079 ***	0.000
<i>EDE</i>	0.083 **	0.009	−0.059	0.276	0.024	0.731
<i>EESC</i>	0.174 **	0.004	0.529 ***	0.000	0.704 ***	0.000
<i>ECDEP</i>	0.225	0.052	0.064	0.683	0.289	0.194
<i>NATC</i>	0.000 ***	0.000	0.000 *	0.012	0.000 ***	0.000
<i>NLU</i>	0.086 ***	0.000	−0.058 ***	0.000	0.028 *	0.021
<i>LFPR</i>	142.947	0.177	323.182	0.199	466.129	0.123
<i>PEE</i>	255.002 *	0.014	220.974	0.068	475.976 **	0.004
<i>PEA</i>	197.346 *	0.014	316.581	0.108	513.927 *	0.020

Note: LR\_Direct Effect = Coefficient of SDM + feedback effect; LR\_Indirect Effect = Spatial spillover effect; LR\_Total Effect = Direct effect + indirect effect. \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

The following is an analysis of the spatial effects of economic development expenditure. (1) Direct effects: The growth of economic development expenditure will drive the growth in the number of profit-seeking enterprises in the region. For every 1% increase in economic development expenditure, the number of profit-seeking enterprises in the region increases by 0.083%. (2) Indirect effects: The growth of economic development expenditure has no significant effect on the number of profit-seeking enterprises in the neighboring regions. (3) Total effects: The accumulation of direct and indirect effects of economic development expenditure has no significant effect on the average number of profit-seeking enterprises in all counties and cities in Taiwan.

The following is an analysis of the spatial effect of education, science, and culture expenditure. (1) Direct effects: The growth of education, science, and culture expenditure will drive the growth in the number of profit-seeking enterprises in this region. For every 1% increase in expenditure on education, science, and culture, the number of profit-seeking enterprises in the region increased by 0.174%. (2) Indirect effects: The growth of education, science, and culture expenditure has a positive spatial spillover effect on the number of profit-seeking enterprises in neighboring regions. For every 1% increase in expenditure on education, science, and culture in neighboring regions, the number of profit-seeking enterprises in the region increases by 0.529%. The increase in expenditure on education, science, and culture in the neighboring regions has a positive effect on the number of profit-seeking enterprises in the region. (3) Total effects: The accumulation of direct and indirect effects of education, science, and culture expenditure has a positive effect on the average number of profit-seeking enterprises in all counties and cities in Taiwan. Changes in expenditure on education, science, and culture increase the total effect of the number of profit-seeking enterprises by 0.704%.

The following is an analysis of the spatial effect of the number of lighting users. (1) Direct effects: An increase in the number of lighting users prompts an increase in the number of profit-seeking enterprises in this region. Each 1% increase in the number of lighting users adds 0.086% to the number of profit-seeking enterprises in this region. (2) Indirect effects: An increase in the number of lighting users has a negative spillover effect on the number of profit-seeking enterprises in adjacent regions. Each 1% increase in the number of lighting users in the adjacent region reduces the number of profit-seeking enterprises by 0.058% in this region. (3) Total effects: The combination of the direct and indirect effects from the number of lighting users creates positive effects on the average number of profit-seeking enterprises in the cities and counties of Taiwan. The change in the number of lighting users has total effect of increasing the number of profit-seeking enterprises by 0.028%.

The following is an analysis of the spatial effect of the proportion of employees with a junior college or higher education. (1) Direct effects: An increase in the proportion of employees with a junior college or higher education prompts growth in the number of profit-seeking enterprises in this region. Each 1% increase in the proportion of employees with a junior college or higher education corresponds to a 255.002% increase in the number of profit-seeking enterprises in this region. (2) Indirect effects: An increase in the proportion of employees with a junior college or higher education has no spatial diffusion effect on adjacent regions. (3) Total effects: The aggregation of the direct and indirect effects from the proportion of employees with a junior college or higher education creates a positive impact on the average number of profit-seeking enterprises in the cities and counties of Taiwan. The change in the proportion of employees with a junior college or higher education spurs the total effect by increasing the number of profit-seeking enterprises by 475.976%.

The following is an analysis of the spatial effect of the percentage of employees aged from 25 to 44. (1) Direct effects: An increase in the percentage of employees aged between 25 and 44 prompts growth in the number of profit-seeking enterprises in this region. Each 1% increase in the percentage of employees aged from 25 to 44 leads to a 197.346% increase in the number of profit-seeking enterprises in this region. (2) Indirect effects: An increase in the percentage of employees aged between 25 and 44 has no spatial diffusion effect on adjacent regions. (3) Total effects: The combination of the direct and indirect effects of the percentage of employees aged from 25 to 44 shows a positive influence on the average number of profit-seeking enterprises in the cities and counties of Taiwan. The change in the percentage of employees aged between 25 and 44 exhibits a total effect of a 513.927% increase in the number of profit-seeking enterprises.

In terms of model selection, this study analyzed the SAR, SEM and SDM. After various tests, the SDM with spatial and time fixed effects was selected as the basis for the analysis, and the estimated results were decomposed into direct effects, indirect effects, and total effects. First, the increase in general government expenditure, economic development expenditure, expenditure on education, science, and culture, the net amount of tax collected, the number of electric lamp users, the proportion of employees with a junior college or higher education, and the percentage of employees aged 25 to 44 will increase the number of local profit-seeking enterprises, which has a positive direct effect on the number of local profit-seeking enterprises. Second, as far as the spatial dependence of the number of profit-seeking enterprises is concerned, the number of profit-seeking enterprises in different spatial locations is affected by the neighborhood effect. The increase in general government expenditure, expenditure on education, science, and culture, and the net amount of tax collected continues to spread to the neighboring regions, thus bringing the positive spatial spillover effect on the number of profit-seeking enterprises in neighboring regions. Third, the fiscal expenditure and environmental regulations with positive total effects on the average number of profit-seeking enterprises in Taiwan's counties and cities are the general government expenditure, the expenditure on education, science, and culture, the net amount of tax collected, the number of electric lamp users, the proportion of employees with a junior college or higher education, and the percentage of employees aged 25 to 44.

#### 4.6. Competitive Strategy of Environmental Regulation

In this study, the SDM was used to explore the impact of fiscal expenditure and environmental regulation on the number of profit-seeking enterprises in various local counties and cities, and the competitive strategies of environmental regulation adopted by local governments can be further explored. On the basis of the SDM with random effects, different types of environmental regulation competitive strategies were identified by the parameters and the direction of signs (see Table 9).

**Table 9.** Competitive strategy of environmental regulation.

Coefficient	$\beta > 0$	$\beta < 0$
$\theta > 0$	<p>The stronger the environmental regulation, the higher the number of local profit-seeking enterprises, and local governments adopt the strategy of yardstick competition in environmental regulation.</p> <p>The yardstick competition strategy shows that the interactive behavior pattern of environmental regulation between local governments is “you are strong and I am strong”.</p> <p>→ General government expenditure → Expenditure on education, science and culture</p>	<p>The stronger the environmental regulation, the lower the number of local profit-seeking enterprises, and local governments adopt the strategy of differentiated competition in environmental regulation.</p> <p>The differentiated competition strategy shows that the interactive behavior pattern of environmental regulation among local governments is “you are strong and I am weak”.</p>
$\theta < 0$	<p>The stronger the environmental regulation, the higher the number of local profit-seeking enterprises, and local governments adopt the strategy of differentiated competition in environmental regulation.</p> <p>The differentiated competition strategy shows that the interactive behavior pattern of environmental regulation among local governments is “you are weak and I am strong”.</p> <p>→ Number of lighting users</p>	<p>The stronger the environmental regulation, the lower the number of local profit-seeking enterprises, and local governments adopt the strategy of racing to the bottom in environmental regulation.</p> <p>The “race to the bottom” competition strategy indicates that the interactive behavior pattern of environmental regulation among local governments is “you are weak and I am weak”.</p>

In the table,  $\beta > 0$  indicates that the intensity of environmental regulation is positively correlated with the number of profit-seeking enterprises in the region. In terms of the expenditure on community development and environmental protection and the ratio of the age range of employees from 25 to 44 years old, local governments adopt yardstick competition strategies for environmental regulation ( $\beta > 0, \theta > 0$ ). Local strengthening of environmental regulations, such as increasing the expenditure on community development and environmental protection or increasing the age range (25 to 44 years old) of employees, will lead to the same strengthening of environmental regulations in neighboring regions, which promotes the increase in the number of profit-seeking enterprises in neighboring regions, indicating that there is a positive spatial spillover effect of environmental regulation.

## 5. Conclusions

### 5.1. Conclusions and Policy Implications

Past spatial econometric models seldomly discussed Taiwan’s fiscal expenditures, labor and environmental regulations, and the economic development of profit-seeking enterprises. First, from the Moran’s I analysis on the number of profit-seeking enterprises in Taiwan, this study finds that the distribution of the number of profit-seeking enterprises in Taiwan’s counties and cities has become less and less spatially clustered in the past 19 years. This means that the spatial pattern of the distributions of profit-seeking enterprises has gradually shown a trend toward random distribution and away from clustering. It can be inferred from this phenomenon that the increase in fiscal expenditures of local governments and the improvement of labor and environmental regulations are the main reasons that have contributed to the rapid growth in the number of business operators of various counties and cities. Large numbers of profit-seeking business operators have not

excessively concentrated in certain counties and cities. Therefore, Taiwan has gradually developed into an area with multiple core zones of urban development.

The preference of the government to the allocation of financial resources can be shown by the structure of fiscal expenditure, which also reflects the functions and roles of the government in the economic society. Fiscal expenditure directly supports the development of profit-seeking enterprise-related industries. The investment of local fiscal expenditure in infrastructure and other aspects will attract the investment of profit-seeking enterprises and the inflow of talents, thereby creating a spatial spillover effect on neighboring regions. Investment by local governments in economic development and education, science, and culture can promote the growth in the number of profit-seeking enterprises in the region, and the investment in economic development can also promote the growth in the number of profit-seeking enterprises in neighboring regions through the cross-border dissemination of population movement and business contacts. In other words, fiscal expenditure is an effective means of supporting the development of profit-making undertakings in various counties and cities.

As far as labor and environmental regulation is concerned, the youth group of 25 to 44 years old and the educated intellectuals with a junior college degree or above are a major driving force to invigorate the economy. Fiscal expenditure creates and lays the external developmental environment and foundation for profit-seeking enterprises, promotes the accumulation of human capital, and promotes the growth in the number of profit-seeking enterprises. Local governments should introduce policies to attract young people and intellectuals in order to increase the labor participation rate and invigorate the local market economy.

### 5.2. Limitations and Future Directions

This study is limited to the sample of a few independent variables where multicollinearity exists. Variable transformation was applied in the analysis, but the results were not satisfying. This study has noted that fiscal expenditures among the 22 cities and counties in Taiwan are inherently highly correlated. Furthermore, cities are divided into six municipalities and 16 non-municipalities based on the provisions of the Local Government Act of Taiwan. Taiwan's economic development shows regional imbalance, since most of the resources and appropriations are allotted to the municipalities. The number of residents in these municipalities account for 69.45% of the total population of Taiwan. Although the fiscal expenditures of municipalities are highly correlated, dropping variables or using other variables as proxies for fiscal expenditures may influence the estimated effect of other variables on the variable of interest's coefficient and lower the economic implications. The analysis is still based on the original fiscal expenditure variables that included samples for the period 2001 to 2019, and we ran a spatial regression with the original model specification. The results of this study thus call for future research to focus on looking at other empirical approaches for better estimates. Second, there may exist other environmental regulations that affect the growth of profit-seeking enterprises. Future researchers may consider incorporating different environmental regulatory factors into the model to investigate different environmental regulatory effects on profit-seeking enterprise numbers. Third, this study is limited to analyzing and comparing three models: the spatial autoregressive model (SAR), the spatial error model (SEM), and the spatial Durbin model (SDM). However, when spatial difference and spatial dependence coexist, traditional econometric methods are no longer applicable. Future studies may employ other analyses using different models, such as spatial dependence and spatial heterogeneity models, to explore whether the issue of spatial heterogeneity exist.

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