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The Spatial Effect Analysis of Private Medical Care on Private Health Insurance Development in China

Guangsheng WAN[1], Bomin LIU[2]

Abstract

In recent years, China's private health insurance has achieved rapid development. The determinants of the development of private health insurance in China are still uncertain. This study investigated the impact of private medical care on the development of private health insurance, and particularly focused on its spillover effect. Based on the panel data of 31 provinces in China from 2007 to 2017, a Spatial Durbin Model was performed to explore the relationship between private medical care and private health insurance development. The results show that: the development of private health insurance has the spillover effects and it promotes the development of private health insurance in adjacent areas; private medical care is associates with the development of private health insurance, and it impacts both density and depth of private health insurance; at the same time, private medical care has a significant spatial spillover effect on the density of private health insurance in neighboring regions.

Keywords: private medical care, private health insurance, SDM, spatial spillover effect, social health insurance.

Introduction

In the last decade, with the widespread coverage of public social health insurance, the private health insurance market has had a rapid development. In 2018, the premium income of China's private health insurance was 544.813 billion

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RMB yuan, with 24.12% annual growth since 2017. Private health insurance had the largest growth speed among all insurance plans. However, the expenditure of health insurance compensation accounts for less than 3% of the total health expenditure, indicating a massive space for the development of China's private health insurance. So, how to promote the development of the private health insurance market becomes the social focus.

Many studies focused on the development of health insurance, and mainly discussed which factors would influence the private health insurance market. For instance, some studies investigate the influencing factors from the perspective of population structure, and some from public social health insurance competition (Qi, Xu & Hu, 2018; Peng, Zhang & Guo, 2017). However, we cannot ignore the critical fact that Chinese medical service supply system is dominated by public medical care sectors, which will affect the development of private health insurance. Under the current medical service market environment, does the private medical service affect the development of private health insurance? It is an interesting question worth studying.

In this paper, we studied the impact of private medical care, which was provided by non-public hospitals, on the development of private health insurance in China. We not only discussed the direct effect of this impacting, but also analyzed the indirect effect. Therefore, the spatial econometric model was used for data analysis. We mainly focused on two questions: (1) Does private medical care affect the development of private health insurance in China? (2) If there is an effect, is there a spatial spillover effect?

Literature review

Public social health insurance and private health insurance

Many scholars studied the relationship between social health insurance and private health insurance in different economies, and found that social insurance had a significant crowding effect on the demand for private health insurance (Zhao, 2017; Zhang, Su, Liu & Zhang, 2018). However, it might not be such a simple relationship in the context of China. Private health insurance and public health insurance did not directly compete in the urban areas in China, while private health insurance only played a supplementary role in the health care system (Hou & Zhang, 2017). Administrative data analysis showed that public social medical insurance played a significant role in promoting the development of private health insurance in China; however, the spatial autocorrelation of public social medical insurance might hinder its role in promoting private health insurance in neighboring provinces (Jiang, 2019). The development level of public social

health insurance moderated the relationship between them (Peng, Zhang & Guo, 2017). That is to say, the relationship between public social health insurance and private health insurance may vary in different dimensions.

Factors influencing the development of private health insurance

Many factors influence the development of the private health insurance market. From the perspective of regional imbalance in health insurance, it was found that per capita income, life expectancy, urban population ratio, fiscal expenditure had a significant impact on private health insurance (Yang & Jiang, 2018). Based on the demographic structure research, it was found that old-age dependency ratio, dependency ratio of children and adolescents, family size, the change in the proportion of the population with spouse and education level had a significant impact on the demand of private health insurance (Qi, Xu & Hu, 2018). Besides, urban per capita disposable income, per capita urban employee basic medical insurance fund income, and capita outpatient expenses significantly influenced the private health insurance demand (Ni & Feng, 2018). Investigating on consumption factors indicated that individuals' health insurance literacy, perception, and beliefs decided their preference to invest private health insurance or not (Mathur, Das & Gupta, 2018).

Private health insurance and medical care service

Private health insurance impacts the use of health care services. It was found that private health insurance increased the probability of hospital admission by 5-6 percentage points in Australia (Doiron & Kettlewell, 2018). In Denmark, private health insurance influenced people's prescription medicine, chiropractic care, and dental care (Kiil & Arendt, 2017). People with private health insurance tended to use the public health system less (Cantarero-Prieto, Pascual-Sáez, & Gonzalez-Prieto, 2017). Thus, the private health insurance promotes more meaningful use of non-public health care services.

Methodology

Variables and Measurements

The objective of this paper is to assess the influence of private medical care on the development of private health insurance. We used the following variables, and the definition information was also shown in *Table 1*.

(1) *Explained variables*. Private health insurance density (*des_HI*) and private health insurance depth (*dep_HI*) are the explained variables, and they were

calculated from private health insurance premium income (*private_HI*). The calculation methods were listed in *Table 1*.

(2) *Explanatory variables*. Private medical care is the key explanatory, and it was measured by the following variables, including number of diagnosis and treatment patients in private hospitals (*diagnosis*), number of health checkups in private hospitals (*H_check*), number of inpatients in private hospitals (*inhospital*) and number of inpatient operations in private hospitals (*operation*).

(3) *Control variables*. To fix the effects of other variables, the following variables were considered as control variables, including per capita income of basic medical insurance in urban areas (*aver_urBMIC*), per capita disposable income of urban residents (*income_ur*), dependency ratio of the elderly population (*old_DR*), proportion of people aged six and above with tertiary education or above (*education*), and proportion of urban population in the total population (*poprate_ur*).

Table 1. Variable description and data source

Variable name	Data unit	Definition	Data source
privateHI	million yuan	Private Health insurance premium income	China Insurance Statistical Yearbook
des_HI	yuan/person	Private health insurance density, des_HI= privateHI/population	
dep_HI	%	Private health insurance depth, dep_HI= privateHI/GDP	
diagnosis	person	Number of diagnosis and treatment patients in private hospitals	China Health Statistical Yearbook
H_check	person	Number of health checkups in private hospitals	
inhospital	person	Number of inpatients in private hospital	
operation	number	Number of inpatient operations in private hospitals	
aver_urBMIC	yuan	Per capita income of basic medical insurance in urban areas	

income_ur	yuan	Per capita disposable income of urban residents	China National Bureau of Statistics
old_DR	%	Dependency ratio of the elderly population	
education	%	The proportion of people aged 6 and above with tertiary education or above	
poprate_ur	%	The proportion of urban population in the total population	

Research Sample and Data

The research objects of this study were 31 provincial-level regions in China, and sample data from 2007 to 2017 were collected. All the data were obtained from *China Insurance Statistical Yearbook (2008-2018)*, *China Health Statistical Yearbook (2008-2018)*, and China National Bureau of Statistics. The descriptive statistical results of the main research variables are shown in *Table 2*.

Table 2. Descriptive statistical results of key variables

Variable	N	Mean	Std. Dev.	Min	Max
dep_HI	341	0.24	0.20	0.00	1.99
des_HI	341	119.90	169.35	0.02	1483.29
privateHI	341	4958.21	7638.53	0.05	72225.50
diagnosis	341	10100000.00	9150593.00	95061.00	58900000.00
H_check	341	616213.60	720543.30	859.00	4691906.00
inhospital	341	549323.90	547309.30	2456.00	3145196.00
operation	341	149017.30	144199.10	641.00	779098.00
aver_ urBMIC	341	110.16	84.81	15.43	662.27
income_ur	341	23314.62	9340.76	10012.34	62595.70
old_DR	341	12.87	2.76	6.71	20.60
education	341	11.29	6.91	1.21	47.61
poprate_ ur	341	53.18	14.24	21.50	89.60

Modeling

Spatial econometric model was used to analyze the relationship between private medical care and private health insurance. So the general nesting spatial model is shown as follows,

$$Y_t = \mathrm{W}Y_t + \alpha\iota_N + X_t\beta + WX_t\theta + u_t$$

$$u_t = \lambda Wu_t + \varepsilon_t$$

The subscript *t* represents time, which runs from 1 to T. N represents the number of observations. Considering the spatial correlation caused by the correlation of explanatory variables to the explained variables, the Spatial Durbin Model (SDM) was adopted in this study, which was shown as follows

$$Y_t = \mathrm{W}Y_t + \alpha\iota_N + X_t\beta + WX_t\theta + \varepsilon_t$$

Here, take *des_HI* and *dep_HI* as explained variables separately and SDM models were established respectively. The logarithm of *des_HI* was used in the model. Explanatory variables including *diagnosis, H_check, inhospital, operation* were used to measure private medical care, and all of them were used in logarithm form. Variables including *aver_urBMIC, income_ur, old_DR, education* and *poprate_ur* were used as control variables. The logarithm of *aver_urBMIC* and *income_ur* were used. *W* was the weight matrix, defined as follow

$$w_{ij} = \begin{cases} 1, & region\ i\ and\ j\ have\ adjacent\ boundary \\ 0, & otherwise \end{cases}$$

In the calculation, the weight matrix was normalized according to the row.

Results and discussion

Spatial Correlation Analysis

The spatial correlation test for explained variables indicates that there is spatial autocorrelation of private health insurance depth, and the same result with private health insurance density. The Moran scatter diagrams are shown in Figure 1 and Figure 2. The vast majority of observations are in the first and third quadrants, indicating an apparent positive spatial autocorrelation. The Moran index of private health insurance density and depth are 0.430 and 0.194. The development of private health insurance in one province will change in the same direction as the situation in the surrounding provinces. So the spatial effect exists in the

development of private health insurance, and the spatial econometrics model is suitable for analysis.

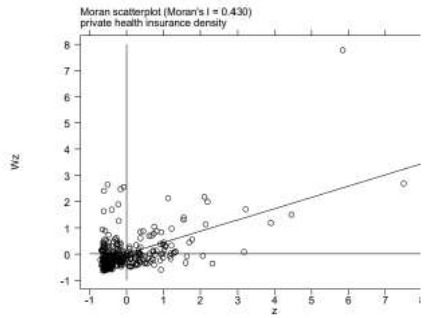

Figure 1. Moran scatter diagram of des_HI

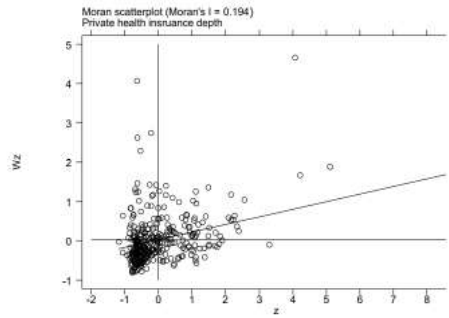

Figure 2. Moran scatter diagram of dep_HI

Estimation of Spatial Panel Data Model

Hausman test indicates that the fixed effect model should be used in the estimation (chi2=53.07, p=0.000; chi2=57.33, p=0.000). Model (1) took the private health insurance density as an explained variable, and model (2) took the private health insurance depth as the explained variable. The SDM estimation results are shown in Table 3.

According to the global estimation results shown in *Table 3*, the spatial autocorrelation coefficient (rho=0.230, p<0.01; rho=0.196, p<0.01) is positive at the significance level of 1%, indicating that the development of private health insurance in neighboring provinces promotes each other. In terms of the impact of private medical care on the density and depth of private health insurance, Model (1) shows that the number of health checkups and inpatient operations in private hospitals have a significant positive effect on the density of private health insurance. Model (2) shows that diagnosis patients' number in private hospitals has a significant negative effect on the depth of private health insurance. In contrast, the number of health checkups has a significant positive effect.

The analysis of spatial impact shows that there will be strategic competition in the development of private medical care among regions. Model (1) indicates that private medical care in one region will promote the increase of private health insurance density in this region, but competition can hamper the increase of private health insurance density in adjacent areas. For example, the number of diagnosis and treatment patients ($\theta = -0.714, p < 0.01$), Number of health checkups ($\theta = -0.148, p < 0.10$) and number of inpatient operations ($\theta = -0.768, p < 0.01$) in private hospitals have a significant negative effect on the neighboring provinces' private health insurance density. While the number of inpatients in private hospital ($\theta = 1.237, p < 0.01$) has a positive effect on the neighboring provinces' private health insurance density. That is to say, the development of private medical care

has a spatial spillover effect. It not only affect the development of private health insurance in this region, but also affect the development of private health insurance in neighboring regions. This spillover effect was only existed in private health insurance density, and we didn't find the spillover effect in private health insurance depth.

Table 3. SDM estimation results of private medical care to private health insurance

	Model (1) des_HI_LN	Model (2) dep_HI
diagnosis_LN	0.175	-0.125***
	(0.13)	(0.04)
H_check_LN	0.144**	0.039**
	(0.06)	(0.02)
inhospital_LN	-0.179	0.058
	(0.16)	(0.05)
operation_LN	0.405***	-0.052
	(0.13)	(0.04)
aver_urBMIC_LN	0.212	0.047
	(0.16)	(0.05)
income_ur_LN	0.071	0.219
	(0.66)	(0.20)
old_DR	0.008	0.020**
	(0.03)	(0.01)
education	-0.019	0.000
	(0.01)	(0.00)
poprate_ur	-0.008	-0.015***
	(0.02)	(0.01)
Wdiagnosis_LN	-0.714***	0.091
	(0.23)	(0.07)
WH_check_LN	-0.148*	-0.035
	(0.08)	(0.03)
Winhospital_LN	1.237***	0.112
	(0.38)	(0.12)
Woperation_LN	-0.768**	-0.023
	(0.30)	(0.09)
Waver_urBMIC_LN	-0.069	0.055

	(0.26)	(0.08)
Wincome_ur_LN	1.284	-0.429
	(0.83)	(0.26)
Wold_DR	0.115***	0.014
	(0.04)	(0.01)
Weducation	-0.010	0.011
	(0.03)	(0.01)
Wpoprate_ur	-0.021	0.016
	(0.03)	(0.01)
rho	0.230***	0.196***
	(0.07)	(0.07)
N	341	341
R^2	0.832	0.536
Log likelihood	-150.403	246.430

*Notes: 1. Standard errors in parentheses. 2. *stands for p<0.1, ** stands for p<0.05 and *** stands for p<0.01.*

Direct and Indirect Effects

The spatial effects of spatial econometric models can be divided into direct effects and indirect effects. In this study, a direct effect means private medical care in one region influences the private health insurance in this region, and an indirect effect means private medical care in one region influences neighboring regions' private health insurance. The indirect effect is the spatial spillover effect. The spatial effect of private medical care on private health insurance is shown in table 4.

The overall effect of the number of diagnoses and treatment patients in private hospitals on private health insurance density is negative, and the spillover effect is significantly negative. Although its overall effect on private health depth is not significant, its direct effect is significantly negative. In other words, the number of diagnosis and treatment patients blocks the health insurance depth in the region, and inhibits the density of health insurance in the surrounding areas.

The overall effect of the number of inpatients in private hospitals on private health insurance density is positive, and the spillover effect is significantly positive. It indicates that the number of inpatients promotes the improvement of health insurance density in surrounding areas. No significant effect was found in health insurance depth.

There is no spillover effect of health checkups in private hospitals on the density and depth of private health insurance. It promotes both the density and depth of private health insurance in this region, and does not affect the surrounding regions.

A negative spillover effect of inpatient operations in private hospitals on private health insurance density was found. The number of inpatient operations in private hospitals in one region blocks the increase of private health insurance densities in surrounding regions. At the same time, it promotes the insurance density of this region.

Table 4. Decomposition of spatial effects of private medical care on private health insurance

	Mode (1): des_HI_LN			Model (2): dep_HI		
	Direct	Indirect	Total	Direct	Indirect	Total
diagnosis_LN	0.139	-0.832***	-0.692**	-0.122***	0.080	-0.042
	(0.13)	(0.30)	(0.32)	(0.04)	(0.09)	(0.10)
H_check_LN	0.132***	-0.133	-0.001	0.036**	-0.029	0.007
	(0.05)	(0.10)	(0.09)	(0.02)	(0.03)	(0.03)
inhospital_LN	-0.102	1.442***	1.340**	0.068	0.135	0.203
	(0.16)	(0.55)	(0.59)	(0.05)	(0.16)	(0.17)
operation_LN	0.371**	-0.836**	-0.465	-0.053	-0.039	-0.092
	(0.15)	(0.40)	(0.48)	(0.05)	(0.12)	(0.14)

*Notes: 1. Standard errors in parentheses. 2. *stands for p<0.1, ** stands for p<0.05 and *** stands for p<0.01.*

Conclusion

This paper discussed the influence of private medical care on the development of private health insurance in China. Based on the spatial panel data of 31 provinces from 2007 to 2017, we performed a Spatial Durbin Model to explore the problem of spatial impact effect of private medical care on private health insurance. The research results reveal the following conclusions.

1) The development of private health insurance in adjacent areas promotes each other. In other words, the better the private health insurance development in one region, the better the private health insurance development in the neighboring regions.
2) Private medical care plays a significant role in the development of private health insurance. In particular, health checkups and inpatient operations in private hospitals positively influence the density of private health insurance; health

checkups positively influence the depth of private health insurance, while diagnosis and treatment patients in private hospitals negatively influence the depth of private health insurance.

3) Private medical care has a significant spatial spillover effect on the density of private health insurance. Diagnosis and treatment patients and inpatient operations in private hospitals in one region block the increase of private health insurance density in surrounding regions; the number of inpatients in private hospitals promotes the improvement of health insurance density in surrounding areas.

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