

The effect of government financial investment on the development of traditional medicine: Evidence from public Traditional Chinese Medicine hospitals (PTHs) of Henan Province, China

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Abstract

Background Traditional medicine has long been used to address relatively common illness, and Chinese government has been continually increasing its investments on Public Traditional Chinese Medicine hospitals (PTHs) in recent years. **Objectives** This study aimed to assess the scales and structure of investments on PTHs in Henan Province, China, in order to analyze the contribution of Government Financial Investment (GFI) to the revenue growth of PTHs, as well as raising practical investment strategies for decision-makers.

Methods This study was a panel data research, conducted in Henan Province, China. By collecting 143 PTHs' operational data from 2005 to 2017, the authors computed data with Barrow Economic Growth Model (BEG), Stochastic Frontier Analysis (SFA) and Vector Autoregressive Model (VAR), respectively.

Results The study observed that the contribution of GFI to PTHs' revenue growth was positive (average $MPG=2.84$), which means the scale of GFI hadn't reached an optimal level. The scales of GFI on Grade III, Grade II A, Grade II B PTHs need to be increased by -5.96%, 4.88% and 11.51% respectively in order to maximize the input-output efficiency. The third year after the investment year may be a more effective period for conducting an effect evaluation of GFI in Henan Province.

Conclusions GFI on PTHs usually has a long-term impact on PTHs. Government needs to adjust its GFI policy to maximize the input-output efficiency.

Background

Globally, traditional medicine has long been used to address relatively common illness [1], and Traditional Chinese medicine (TCM) is widely accepted in China as a complement and alternative for medical treatment [2,3,4,5]. But the contemporary private sectors which are the primary traditional medicine providers, appear to seek immediate cash payments that have frequently led to considerable debt and asset sales by traditional medicine users [6]. Government investment intervention is necessary if public traditional medicine hospitals that serve as "essential providers of last resort" tend to survive and to continue fulfilling their mission [7].

In past ten years in China, total government financial investment (GFI) in public TCM hospitals (PTHs) had reached 192.83 billion yuan, and it's currently mainly used for the improvement of house, maintenance of large medical equipment and the salary of staff. Henan Province is an agricultural and emerging industrial province with over 100 million people, a very typical and representative province in central China. In 2017, the number of PTHs in Henan province reached 257, and the open beds were more than 63,100, accounting for seven percent of the national total. The GFI reached 1.60 billion yuan in PTHs, accounting for 6.08% of the total GFI of Henan Province [8,9].

Previous researches suggest that the support of GFI can affect the development of hospitals [10,11]. Woolhandler S et al. found that when experiencing severe cutbacks in funding for public medical facilities, the census at the county hospital, Highland General, has declined by 65 percent and the number of the outpatient visits have decreased by 50 percent [10]. Similarly, Shonick W observed both government health expenditures and hospital revenues had increased sharply, and the hospitals received government subsidies amounting to at least 60 percent of their total revenues [11].

Efficiency analysis in health care has attracted significant interest [12,13] due to escalating health care costs, especially in countries which public involvement in health care provision is high [14]. Increased efficiency is one way to bend the cost curve without compromising quality of care, which means it can get higher returns to fixed investment [15]. Compared with the least efficient hospitals, high-efficiency hospitals tended to have lower average costs, higher labor productivity, and higher profit margins [16].

Rhonda Kerr found that there are opportunities for public policies to support improved efficiency in public hospitals in Australia [17]. Roberto Colomb et al. found that ownership, specialization and size are determinants of all types of efficiency [18]. Chen et al. found that the changes introduced into the health care sector in China during the last thirty years have improved the cost efficiency of the whole system, especially after the public subsidies and medical insurance reforms [19].

This study analyzed the operational status of 143 PTHs in Henan Province from 2005 to 2017 by using the Barrow Economic Growth Model (BEG) to explore the scales and structure of PTHs' GFI based on promoting hospital revenue growth. The current input-output efficiency-maximizing investment strategy of GFI to PTHs was tested by using the stochastic frontier analysis (SFA). At the same time, the most appropriate evaluation period was also estimated based on the long-time impact trend of GFI on PTH's revenue growth by using Vector Autoregressive Model (VAR).

Methods

Classification of public TCM institutions

Public TCM institutions with less than 100 beds in China generally refer to community health service centers as primary health care institutions. Institutions with 100-500 beds are set as Grade II hospitals while Grade III hospitals refer institutions with more than 500 beds (5) (Table 1). Each grade was divided into A, B and C levels depending on department set, staffing, management level, technical level, work quality and technical facilities [20].

Data Collection

The data which was used in this study includes: TCM practicing clinical workers, suitable TCM technologies implemented, GFI, revenue and value of fixed assets of total 143 PTHs (including 23 Grade III, 96 Grade II A and 34 Grade II B) in Henan Province. All the data was derived from the Henan Provincial Health Statistics Yearbook and the hospital financial year reports from 2005 to 2017. This study was submitted to Zhengzhou University Medical Ethics Committee and the need for ethics approval was waived.

Data management and analysis

Variable index selection

Considering the basic characteristics of PTHs and the effects of avoiding strong linear relationship between input indicators, the variables were selected based on importance and availability [21]. According to expert advice and requirements for the selected analysis model, this study selected the accepted indicators from five aspects of revenue, assets, technology, financial investment, personnel: 1. The revenue of PTHs (Revenue); 2. Value of fixed assets (Fixed Assets); 3. No. of suitable TCM technologies implemented (Technologies); 4. Government financial investment (GFI); 5. No. of TCM practicing clinical workers (Clinical Workers).

The scales and structure analysis method - Barrow Economic Growth Model (BEG)

The BEG was derived from the theory of Endogenous Growth, which introduces government consumption based on the Cobb-Douglas production function [22], and was often used to explain economic growth of increasing economic returns and technical externalizations [23]. The specific form of the model can be expressed as:

$$Y = AK^{\alpha}L^{\beta}G^{\delta}$$

In formula:

Y: Revenue;

A: the technological progress rate (constant term coefficient);

K: Fixed Assets;

L: Clinical Workers;

G: GFI;

α : the regression coefficients of variables K, which is also the output elasticity of assets in growth of Y, reflecting the contribution of variable K to the dependent variable Y;

β : the regression coefficients of variables L, which is also the output elasticity of labor in growth of Y, reflecting the contribution of variable L to the dependent variable Y;

δ : the regression coefficients of variables G, which is also the output elasticity of financial inputs in growth of Y, reflecting the contribution of variable G to the dependent variable Y.

The natural logarithm of the above formula can be obtained:

$$\ln Y = C + \alpha \ln K + \beta \ln L + \delta \ln G + \varepsilon$$

Among them:

C: constant term;

ε : the residual term;

$\ln^*(\text{"Y, K, L, G"})$: the logarithm of each variable, indicating the respective growth rates.

In this study, the input-output elasticity of GFI to hospital revenue growth is δ , and the marginal output of GFI is Marginal Product of Government (MPG). Following equation was used to get the marginal output and elasticity.

$$MPG = \delta \frac{Y}{G}$$

Input-output efficiency analysis method-Stochastic Frontier Analysis (SFA)

The SFA was first proposed by Aigner, Lovell and Schmidt (1977) and was widely used to estimate production functions or cost functions [14]. This study used SFA theory which was proposed by Fried based on traditional Data Envelopment Analysis model to explore the influence of environment and random factors on the evaluation object.

First, an input-oriented BCC model (a Barrow analysis model for variable-scale returns proposed by Banker, Charnes, and Cooper in 1984) [18] was established to measure the overall Input-output efficiency of PTHs under the influence of environmental and stochastic factors [24,25]. Secondly, SFA model was used to decompose the results of the BCC model, using slack variable S_{ni} (refers to the difference between the actual production process and the highest efficiency) of each input including Fixed Assets, Technologies and Clinical Workers as dependent variable and environmental factor variable GFI as independent variable, an SFA regression equation was established for each S_{ni} [26,27,28,29,30]:

$$S_{ni} = f^n(Z_{ni} \cdot \beta^n) + v_{ni} + \mu_{ni}$$

In the formula:

Z_{ni} : GFI (environment variable);

β^n : parameter which is estimated by environment variable;

f^n : the influence of environmental variables to ;

v_{ni} : the mixed error term;

v_{ni} : random interference term;

μ_{ni} : management inefficiency;

$n = 1, 2, \dots, N, i = 1, 2, \dots, I.$

Evaluation period selection method - Vector Autoregressive Model (VAR)

Based on the results of BEG, the VAR was used to estimate the most appropriate evaluation period of GFI by analyzing the long-term impact trend of Revenue and GFI on others or themselves. By building an impulse response function, the random error terms imposed on an endogenous variable GFI and the impact on PTHs' GFI and Revenue were analyzed, characterizing the response from the variable to a certain error change.

Analysis tool

The initial data was collected and processed by using Excel 2016. DEA and SFA analysis were performed by using DEAP2.1 and FORNT41 software, respectively. BEG and VAR were performed by using Eviews6.0 software. $P < 0.05$ was considered statistically significant.

Results

Operational Information of PTHs

Between 2005 and 2017, the Clinical Workers of total 143 PTHs in Henan Province increased from 32058 to 64669, with an average annual growth rate of 6.02%; the Fixed Assets increased with an average annual growth rate of 15.61%; the Revenue increased from 1.83 billion yuan to 16.37 billion yuan, with an average annual growth rate of 20.02%; while the GFI increased from 0.14 billion yuan to 1.61 billion yuan, with an average annual growth rate of 22.97% (Table 2).

Table 3 displays the descriptive statistics of Grade II A, Grade II B and Grade III PTHs in 2017 and includes information on Fixed Asset, Clinical Workers, Technologies and GFI.

Scales and structure analysis of PTHs' GFI based on Revenue promotion

Indicator selection and feasibility test

The Augmented Dickey-Fuller test method (ADF) was selected to perform the unit root test of the time series of each variable in the model. During the test process, variables without time trend term and constant term were selected for testing. Table 4 shows that the ADF value of the second-order difference result (D2) that the statistical value of each variable was smaller than critical value of the critical level (0.05), indicating that the second-order difference sequences of the four variables were stable, that was, all four variables were second-order single-integer sequences. Therefore, the model could be co-integrated.

The main purpose of the co-integration test was to judge the rationality and correctness of model's set, and thus effectively avoided the pseudo-regression of the model. Since the model contains four variables, the Johansen test method was used for co-integration test. In the test form of the model, the test was selected in the form of both trend and intercept terms. It can be seen from Table 5 that at the 5% significance level, both the tracking test and the λ -Max statistic tests display that there were three co-integration vectors between four variables, that is, there was a co-integration relationship between variables. This showed that the linear combination of four variables had long-term stability, and the model can be further analyzed.

Scales and structure analysis

In this study, the regression analysis was performed on the model by Ordinary Least Squares method. The regression results were as follows:

$$\text{Ln } Y = -1.4433 + 1.5218 \text{Ln} K - 1.4157 \text{Ln} L + 0.2503 \text{Ln} G$$

$$(-0.7498) \quad (1.7453) \quad (-0.8210) \quad (1.6261)$$

$$R^2 = 0.9858 \quad DW = 1.0740$$

It can be seen from the above regression results that the R^2 value of the model was 0.99, indicating that the model had good goodness of fit and the linear relationship between variables was relatively significant.

According to regression results, the hypothesis of $\text{MPG} = \delta Y / G$ can be obtained as $\text{MPG} = 0.25 Y / G$. The average value of Y / G in TPHs from 2005 to 2017 were 11.35, so the average $\text{MPG} = 2.84$ (the minimum value was 1.82 and the maximum value was 3.46).

Since the MPG value was greater than 1, GFI scales of PTHs hadn't yet reached the optimal level according to the "Baro Law". In addition, from $\text{MPG} > 0$, it can be seen that the GFI had a positive economic impact on promoting the growth of PTHs' revenue.

Efficiency-maximizing investment strategy of GFI on PTHs

Input-output efficiency analysis

The SFA model was used to analyze the impact of GIF on the input-output efficiency of input factors: Fixed Assets, Clinical Workers and Technologies. In three types of PTHs, management factor (γ) was the main factor affecting Fixed Assets and Clinical Workers ($\gamma \approx 1, P < 0.05$). γ values in the input relaxation equations of Technologies in Grade III PTHs were approximately equal to 1 but not pass the t-test, indicating that difference between the management factor and the random error (ϵ) had little impact on the efficiency, but it had an impact on the direction of efficiency.

Further analysis found increasing the GFI will reduce the efficiency of Grade III PTHs ($\beta > 0, P < 0.05$), but will improve the efficiency of Grade II B PTHs ($\beta < 0, P < 0.05$). In Grade II A PTHs, increasing the GFI will reduce the waste of Fixed Assets and Clinical Workers ($\beta < 0, P < 0.05$), but it will intensify the waste of Technologies ($\beta > 0, P < 0.05$). See Table 6 and Table 7 for details.

The efficiency-maximizing investment strategy of GFI

Based on the results of table 6 and table 7, this study explored the efficiency-maximizing investment strategy of GFI in three types of PTHs. We found that in order to achieve maximum input-output efficiency, Grade III, Grade II A and Grade II B PTHs' GFI need to increase -5148, 9263 and 2034 million-yuan, accounting for -5.96%, 4.88% and 11.51% of current amount, respectively. Similarly, the study also described the Investment strategy of Fixed Assets and Clinical Workers corresponding to GFI (Table 8).

This study created a VAR model with four variables including: Revenue, Fixed Assets, Clinical Workers and GFI of PTHs, and analyzed the impulse response function based on this. The specific results show that the change of GFIs' scale has a cyclical decrease trend in its long-term impact, and its overall cumulative impact was almost zero. Generally speaking, in China, the current changes in GFI will not affect the scale of future GFI, which makes it simple and feasible to adjust the current GFI according to the efficiency-maximizing investment strategy (Figure 1).

The most appropriate evaluation period of GFI

The study also analyzed the most appropriate evaluation period based on the long-time impact trend of GFI on PTH's revenue growth by using VAR. As shown in Figure 2, firstly, GIF had a positive impact on PTHs' revenue, and the impact will gradually decline after the third period (one year as a period in PTHs, generally). Secondly, this positive economic impact began to zero after the 17th period. In short, the GFI had a significant role in promoting the revenue growth of PTHs, and the third year after the investment year may be a more effective period for conducting an effect evaluation of GFI in Henan Province.

Discussions

This study found that the MPG value of GFI to PTHs' revenue was greater than 1 between 2005 and 2017, indicating the optimal GFI scales hasn't yet been reached. Schlenker T found that the traditional medical providers were included in the Medicaid Waivers to help achieving the "Triple Aim" goals in the United States Texas [31]. It's suggested that the government should carry out sustainable strategic design when designing and arranging hospital investment, and allocate sufficient resources which will help to effectively address patient needs, technological changes and increased acumen [32,33]. The growth of fixed assets also has a positive impact on PTHs' revenue growth [16]. And fixed assets have the greatest promotion impact on PTH's revenue growth of the three variables of GFI, fixed assets and clinical workers. It shows that if the PTHs' GFI can be more applied to infrastructure construction and equipment purchase, it can promote the increase in PTHs' revenue to a greater extent.

Previous studies have suggested that GFI has an impact on the efficiency of different-scale PTHs' input-output, and the degree of impact is related to characteristics of hospital and market [34,35]. This study found that increasing GFI would reduce the input-output efficiency of Grade III PTHs. For Grade II PTHs, increasing GFI would increase the efficiency of Fixed Assets and Clinical Workers. One likely reason for this phenomenon is that, large-scale and high-tech hospitals have sufficient funds, while hospitals with limited size and technology are limited in source channels, and rely more on government support [36]. Therefore, focusing the GFI on smaller traditional medicine hospitals will contribute to the development of traditional medicine [37].

Simultaneously, the impact of GFI on PTHs' revenue have been steadily weakening, lasting about 17th period, and the overall impact was positive. If the impact on the current GFI is to be evaluated, the impact evaluation within a single investment period (one year in China) is suitable for the next third period to obtain the maximum value. And the overall impact evaluation should be conducted after the 17th period. Governments and hospitals should carefully formulate GFI impact evaluation plan and select appropriate evaluation cycles to accurately assess the effectiveness of GFI.

This study attempted to estimate the current state and the efficiency-maximizing investment strategy of PTH's GFI from one of the most populated provinces of China. We recommend future studies to stress on the classification criteria of hospital categories based on the size of the beds rather than the official classification criteria. And the time span of data collection can be further extended to improve the accuracy and credibility of the analysis results. Furthermore, there is also room for optimization in the selection of indicators.

Conclusions

The GFI for TCM has experienced a period of rapid growth of the past 12 years, but there is no strong evidence that its actual impact is consistent with the expected target. Although our analysis was limited to PTHs, it provided important evidence that GFI can impact the input-output efficiency of traditional hospitals and promote its development, and governments need to make evaluation period decision carefully. Our findings can provide new evidence and decision-making basis for governments to develop policies that promote the development of traditional medicine and increase the supply of traditional medicine services.

Abbreviations

TCM: Traditional Chinese Medicine;

GFI: Governmental financial investment;

PTHs: Public TCM hospitals;

SFA: Stochastic Frontier Analysis;

BEG: Barrow Economic Growth Model;

Revenue: The revenue of PTHs;

Clinical Workers: No. of TCM practicing clinical workers;

Fixed Assets: Value of fixed assets;

Technologies: No. of suitable TCM technologies implemented;

MPG: Marginal Product of Government;

ADF: Augmented Dickey-Fuller.

Declarations

Ethics approval and consent to participate Not applicable

Consent to publish Not applicable

Availability of data and materials All data generated and analysed during this study are included in this published article.

Competing interests The authors declare that they have no competing interests.

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Tables

Table 1 Classification of TCM medical institutions

Classification	Beds	Responsibilities	District
Grade I	≤99	Provide prevention, medical, health care, and rehabilitation services	Single community
Grade II (A, B)	100-500	Provide comprehensive medical and health services and undertake certain teaching and research tasks	Multiple communities
Grade III	>501	Provide high-level specialist health services and perform higher education and research tasks	Several areas

Table 2 The operational information of sample PTHs

Year	Clinical Workers ^a	Fixed Assets ^b	Revenue ^c	GFI ^d	GFI/Revenue
	(10000 person)	(billion yuan)	(billion yuan)	(100 million yuan)	(%)
2005	3.21	2.33	1.83	0.14	7.65
2006	3.34	2.64	1.99	0.16	8.04
2007	3.27	2.56	2.45	0.20	8.16
2008	3.49	2.95	3.23	0.27	8.36
2009	3.70	3.57	4.01	0.45	11.22
2010	3.82	4.10	4.93	0.68	13.79
2011	4.31	5.10	6.35	0.67	10.55
2012	4.62	6.22	8.38	0.61	7.28
2013	5.04	7.48	9.96	0.78	7.83
2014	5.68	9.04	12.28	0.90	7.33
2015	6.12	10.33	13.37	1.19	8.90
2016	6.42	12.09	14.55	1.54	10.58
2017	6.47	13.26	16.37	1.61	9.84
Average annual growth rate	6.02%	15.61%	20.02%	22.97%	9.20%

^aClinical Workers stands for No. of TCM practicing clinical workers; ^bFixed Assets stands for value of fixed assets; ^cRevenue stands for the revenue of public TCM hospitals; ^dGFI stands for governmental financial investment

Table 3 Characteristics of PTHs' efficiency evaluation indexes

Hospital grade	Sample size	Indicators	Input indicators			Environmental factor
			Fixed Assets	Clinical Workers	Technologies	GFI
			100 million yuan	100 persons	items	100 million yuan
Grade III	23	Max ^a	4.45	21.25	40.00	5.16
		Min ^b	0.97	5.75	10.00	0.22
		AVG ^c	1.99	11.46	25.70	2.38
		SD ^d	1.311	6.95	12.54	2.45
Grade II A	96	Max	3.29	8.25	33.00	3.08
		Min	0.53	0.75	9.00	0.05
		AVG	0.80	3.61	17.26	0.92
		SD	0.37	1.75	14.57	1.02
Grade II B	24	Max	1.06	2.90	20.00	2.98
		Min	0.32	0.60	8.00	0.19
		AVG	0.42	1.50	17.22	0.76
		SD	0.18	0.70	13.29	0.85

^aMax stands for Maximum; ^bMin stands for Minimum; ^cAVG stands for Average; ^dSD stands for Standard deviation

Table 4 Unit root test results of variables (0.05)

variable	Level test result		First-order difference result (D)		Second-order difference result (D2)	
	ADF value	Critical value	ADF value	Critical value	ADF value	Critical value
LN Y	1.7439	-1.9777	-0.4981	-1.9777	-3.9300	-1.9823
LN K	7.6575	-1.9740	-0.1238	-1.9823	-5.9347	-1.9823
LN L	4.9011	-1.9740	-1.2430	-1.9777	-5.2242	-1.9823
LN G	4.0416	-1.9740	-1.2776	-1.9777	-2.8411	-1.9823

Table 5 Co-integration test results between multiple variables

Original hypothesis	Eigenvalue	Trace (<i>P</i>)	λ -Max Eigenvalue (<i>P</i>)
No co-integration vector	1.0000	338.3943 (0.0001)	267.6401 (0.0001)
At most one co-integration variable	0.9870	70.7542 (<0.0001)	47.7566 (<0.0001)
At most two co-integration variable	0.7941	22.9976 (0.0006)	17.389 (0.0037)
At most three co-integration variable	0.3998	5.6147 (0.0212)	5.6147 (0.0212)

Table 6 The impact of GIF on the efficiency of input factors

Independent variable	Fixed Assets			Clinical Workers			Technologies		
	Grade III	Grade II A	Grade II B	Grade III	Grade II A	Grade II B	Grade III	Grade II A	Grade II B
Constant term	0.56E+01*** 0.12E+01 0.30E+01	0.22+01*** 0.66E+00 0.94E+01	0.46E+01*** 0.76E+00 0.86 E+01	0.18E+01** 0.86E+00 0.24E+01	0.11E+01*** 0.76E+00 0.61 E+01	0.07E+01*** 0.10 E+00 0.36E+02	0.32E+01*** 0.82E+00 0.39E+01	0.32E+01** 0.18E+01 0.19 E+01	0.28E+01 0.19E+01 0.96E+00
GFI	0.32E+00*** 0.52E-01 0.60E+01	-0.63E-01** 0.49E-01 -0.13E+01	-0.10E+00** 0.92 E-01 -0.17E+01	0.40E-01*** 0.66E-01 0.61E+01	-0.20E-01** 0.58E-01 -0.35E+01	-0.41E-01*** 0.80 E-02 -0.51E+01	0.79E-01 0.69E-01 0.89E+00	0.90E-01 0.63E-01 0.14E+01	-0.25E-01** 0.13E-01 -0.19E+01
δ^2	0.11E+00*** 0.32E-01 0.35E+01	0.32E+00*** 0.47E-01 0.68E+01	0.77E+00** 0.35E+00 0.22E+01	0.11E+01*** 0.44E+00 0.25E+01	0.44E+00* 0.32E+00 0.14E+01	0.92E+00*** 0.92E-01 0.10E+02	0.27E+00 0.25E+00 0.11E+01	0.67E+00*** 0.93E-01 0.72E+01	0.45E+00*** 0.13E+00 0.35E+01
γ	0.95E+00*** 0.74E-01 0.13E+02	0.88E+00*** 0.36E-01 0.25E***	0.90E+00*** 0.14E+00 0.62E+01	0.95E+00*** 0.85E-01 0.64E+01	0.91E+00*** 0.61E-01 0.50E+01	0.99E+00*** 0.20E-05 0.50E+06	0.90E+00 0.51E-01 0.72E+01	0.99E+00*** 0.11E-04 0.95E+05	0.87E+00** 0.18E-01 0.42E+01
Likelihood function absolute value	-0.75E+01	-0.81E+02	-0.20E+02	-0.13E+02	-0.82E+02	-0.16E+02	-0.22E+02	-0.12E+03	-0.24E+02
Unilateral error likelihood ratio test	0.74E+01	0.13E-01	0.89E+00	0.69E-01	0.77E-01	0.47E+01	0.16E+01	0.24E+01	\

*[]**[]*** indicate significant levels at 0.1, 0.05, and 0.01, respectively. The values below the horizontal line are test values, *P* values, variances, respectively.

Table 7 Influence direction of GFI on PTHs input indicators (0.05)

Hospital grade	Fixed Assets	Clinical Workers	Technologies
Grade III	□ ^a	□	□
Grade II A	+ ^b	+	□
Grade II B	+	+	+

^a“+” means that the increase in GFI will increase the efficiency of input utilization; ^b“-” means that the increase in GFI will increase the waste of input

Table 8 The efficiency-maximizing investment strategy

Hospital grade	GFI	Fixed Assets		Clinical Workers	
	Increment ^a	Increment	Eliminate the increment after GFI impact (%)	Increment	Eliminate the increment after GFI impact (%)
	(% ^b)	(%)		(%)	
	100 million	100 million yuan	100 million	100 persons	100 persons
Grade III	-51.48 (-5.96)	5.26 (11.49)	4.58 (-1.49)	26.34 (9.99)	24.26 (-0.79)
Grade II A	92.63 (4.88)	9.99 (13.01)	13.23 (4.22)	41.55 (11.99)	47.44 (1.70)
Grade II B	20.34 (11.51)	1.28 (17.66)	2.49 (7.04)	5.28 (14.67)	6.84 (4.33)

^aIncrement refers to the amount of input required to maximize efficiency; ^bThe ratio of the amount of input required to achieve maximum efficiency to the current amount; ^cEliminate the ratio of inputs affected by GFI to the current amount

Figures

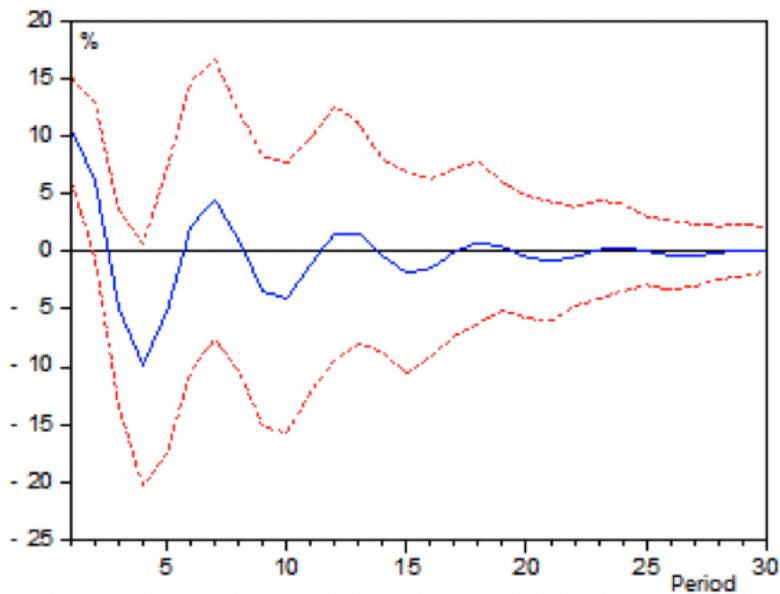


Figure 1

Impulse response of GFI to its own changes The horizontal axis represents the duration period of the impulse response function, and the vertical axis represents the responsiveness of PTHs' GFI to GIF changes. The solid line in the middle represented the impulse response function, and the dotted line represented the deviation from the standard deviation of two times

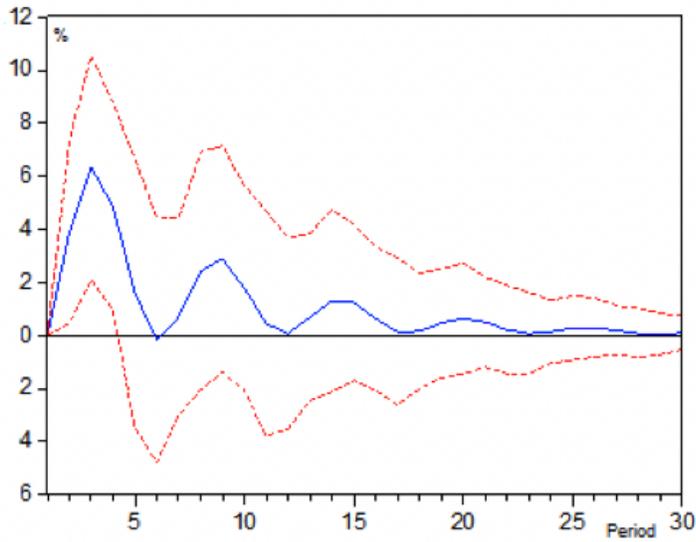


Figure 2

Impulse response of Revenue to GFI The horizontal axis represents the duration period of the impulse response function, and the vertical axis represents the responsiveness of PTHs' revenue to GIF changes. The solid line in the middle represented the impulse response function, and the dotted line represented the deviation from the standard deviation of two times