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Determinants of the performance of traditional Chinese medicine clinics in Taiwan

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ABSTRACT

The study attempts to investigate the features and determinants of the performance of Taiwanese Traditional Chinese Medicine (TCM) Clinics with data for 4905 TCM clinics over the 1998 to 2012 period. The empirical results from the fixed effects model and the Hausman-Taylor Model with cluster-robust standard errors reveal several interesting findings. First, consumer characteristics such as the frequency of disabling injuries has positive impacts on the volume of medical services provided by TCM clinics. These results imply that people are likely to select TCM as the option for medical treatment when they face the occurrence of physical injury in Taiwan. In addition, the scale measurements for TCM clinics including the numbers of physicians, medical personnel and divisions have significantly positive effects on the performance of TCM clinics, while their survival length also has the same effect. Finally, the global budget system under the NHI plays a key role in suppressing the revenue of TCM clinics through the peer review mechanism.

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1. Introduction

Taiwan's National Health Insurance (NHI) came into effect in 1995. It enables people to use medical services at an affordable price and protects people's rights to use medical care. In order to control medical expenditure, the NHI Administration also implemented a global budget payment system for Chinese medicine and Dentists in 2000. The growth rate of medical expenditure was much higher than that of health insurance premiums after July 1998. The global budget system in Taiwan is characterized by an "expenditure cap" with an ex-post floating reimbursement price for the entire medical benefits claimed. Under the global budget system, the healthcare service remuneration for hospitals and clinics is based on a fee-for-service [1]. Under the "expenditure cap", hospitals and clinics can only maximize their profits by increasing their services, but they are also forced to face more competition.

Under the current NHI global budget system, providers are paid through a mix of fee-for-service and other payment systems by using a "floating" point-value scale. The method for calculating the point value is the total budget for one year divided by the total points for one year which all hospitals and clinics gain. Thus, all of the medical institutes have the same point-value system and derive the actual income through the point-value at the end of the year. The point value becomes lower if service volumes increase, and becomes higher if service volumes decrease. The total number of points a hospital receives in one year times the point value determines the amount of the reimbursement which this hospital can obtain from the NHIA. Therefore, we can utilize the total number of points to reflect the medical institutions' operating performance. The total number of points can reflect a clinic's medical expenditure and can be converted into real money. How to obtain a higher number of points has become one of the goals of most medical institutions in Taiwan.

Among all of the medical institutions, clinics are the closest to the general public and also play an important role in Taiwan's primary health care. According to the classification of the NHIA, traditional Chinese medicine (TCM) has an independent classification and plays an important role in Taiwan's medical system. Fig. 1 illustrates that the number of TCM clinics in Taiwan increased from

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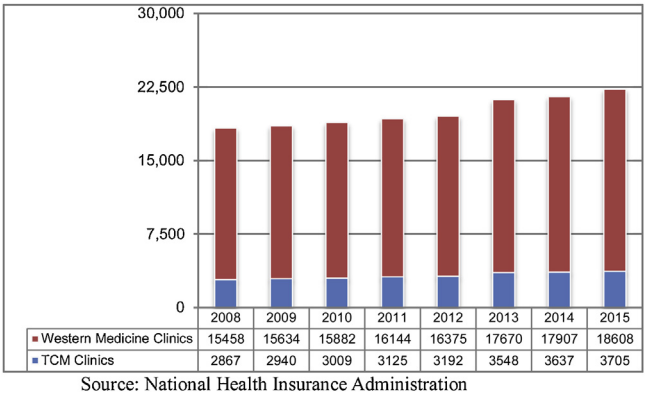

	2008	2009	2010	2011	2012	2013	2014	2015
Western Medicine Clinics	15458	15634	15882	16144	16375	17670	17907	18608
TCM Clinics	2867	2940	3009	3125	3192	3548	3637	3705

Source: National Health Insurance Administration

Fig. 1. Western Medicines Clinics and TCM clinics.
Source: National Health Insurance Administration

2867 in 2008 to 3705 in 2015, reflecting a growth rate of 29%. The ratio of TCM clinics to the total number of clinics also increased from 15.65% in 2008 to 17.09% in 2015.

The Taiwan government implements a single payer system, uniform fee schedule and global budget to achieve macro-efficiency [2,3]. The NHIA controls the prices of medical services. Patients have to choose a medical institution for medical treatment based on other reasons such as an experienced doctor, history, the size of the TCM clinic, distance, and so on. For this reason, we wish to find the determinants related to the performance of TCM clinics by utilizing panel data during the period from 1998 to 2012. In a departure from past studies, we use the total points earned by each TCM clinic as a measure of the performance of a TCM clinic in this study. Because the research data were derived from the medical institution's claims for reimbursement from the NHIA and do not include the cost of medical services, a medical institution's income becomes the most appropriate option for estimating performance. Furthermore, we engage in analyzing the determinants of the performance of TCM clinics and try to provide suggestions to improve their performance in Taiwan.

This study contains five sections. Section 2 provides a review of the literature on the measurement of medical institution performance and the determinants of such performance. Section 3 briefly presents a description of the samples, the definitions of variables, and the methodology used in this study, including the models' derivation, model analysis, and model selection. In Section 4, we perform our empirical analysis by conducting appropriate tests and then present the empirical results. Finally, Section 5 summarizes the key conclusions and provides suggestions together with the empirical implications.

2. Literature review

2.1. The development of TCM

Some medical professionals and consumers regard traditional Chinese medicine as being far behind or less developed than Western medicine [4]. In response to these challenges, countries (such as China, Japan and Taiwan) in which TCM is highly popular are making a lot of effort to protect and expand the role played by TCM in the health care system [5,6]. As more studies reveal the clinical effectiveness and safety of TCM [7], an integrated approach to disease using a combination of Western medicine and traditional approaches is becoming a possibility for the future [8]. However, TCM is still not a mainstream form of medicine. Therefore, there are few studies on the operational performance of Chinese medicine hospitals or clinics. Most researchers have explored the development of Chinese medicine from the perspective of utilization. Lee et al. [9] found that Taiwan's TCM utilization rates vary significantly among different geographical regions. Besides, patient characteristics, the attributes of diseases and regional TCM resources all have important impacts on TCM utilization rates. Yeh et al. [10] found that both the ratio of TCM users and mean visits per enrollee have important impacts on TCM utilization rates. In addition, under the global budget system in Taiwan, TCM also accounts for about 4.6% of the global budget in 2018. The competition between TCM clinics has become more intense.

In Taiwan, 80.9% of the TCM services provided relate to primary care [11]. TCM services mainly take the form of outpatient services. In order to understand the effectiveness of a TCM clinic's operations, financial indicators derived from the NHIA database are considered to be reliable tools in assessing the effectiveness of a hospital's operations. Schuhmann [12] suggested that financial indicators derived from Medicare cost reports can be used to examine trends for individual hospitals and for groups of hospitals over a period of several years. He used Medicare cost report data to evaluate financial performance. Chang et al. [13] utilized operating efficiency as a performance indicator to compare hospitals with different types of ownership. Butler et al. [14] highlighted seven performance measures from the literature and concluded that financial outcomes are one of the key indicators.

2.2. Determinants of performance

Based on prior findings, many scholars have more recently focused on research related to various determinants of the performance of medical institutions such as factors related to the internal controls and the external environment. The internal control factors include the numbers of physicians, medical staff, divisions and years that the clinics have been open. The variables represent the clinics' ability to make adjustments to maximize their revenues or performance. The external environmental factors, which include such items as traffic accidents, the penetration rate of running water, frequency of disabling injuries, aging index, unemployment rate and degrees of urbanization, refer to the exogenous impacts on the performance of medical institutions.

2.2.1. Internal control factors

Solo practices could not easily survive in the medical market due to intensive competition and lack of support. Liu [15] found that the quality of medical care among group practices was higher than that for solo practices. Thus, we would like to demonstrate that group practices can reduce the risks faced by clinics in relation to their financial affairs. Kuntz et al. [16] found that an increase in physician participation was positively associated with financial performance, but that the number of nurses was observed to have a negative effect on such performance. Ersoy et al. [17] found that the number of physicians has a significantly negative effect on hospital performance in Turkey, while inefficient hospitals utilized 47% more physicians and produced less service volume. Improved working environments and reduced ratios of patients to nurses were associated with increased care quality and patient satisfaction [18]. However, increases in manpower may also result in an increase in costs that affects the performance.

As for medical institutions, the number of divisions is an important indicator determining whether patients will go to them for medical services. Ersoy et al. [17] also found that specialists had a significantly positive effect on hospital performance, but Capkun et al. [19] obtained a contrary outcome. Lindrooth et al. [20] measure the effect of urban hospital closure on the operating efficiency of the remaining hospitals in the local market. They found that closed were less efficient at baseline, and after closure their

Table 1
Summary descriptive statistics of variables.

Variable	Mean	Std. dev.	Min	Max	VIF
total points in tens of thousands (tt_amt)	515.85	502.86	0	12731.9	–
physician (py_num)	1.75	1.62	1	45	1.92
medical personnel (mp_num)	1.06	2.67	0	80	1.92
division (func_num)	1.012	0.23	1	12	1.10
history (open_years)	8.74	8.12	0	103	1.03
the penetration rate of running water (water_pt)	92.69	9.47	40.89	99.76	1.27
traffic_accidents	46.78	34.25	0.06	132.82	2.03
disabling_injury	974.84	580.97	1	1938	2.29
age_index	59.25	18.51	27.53	127.86	1.31
unemployment rate (unemp_rate)	4.34	0.81	1.3	6	1.57
global budget system (global_budget)	0.92	0.27	0	1	1.85
metropolitan area (urbanization)	3.62	1.61	1	5	1.57
mean VIF					1.62

competitors realized lower costs. Therefore, we pay attention to the open years of the clinic which will effects the performance.

2.2.2. External environmental factors

In addition to a hospital's internal control variables, external environmental factors also affect hospital performance. A safe, reliable, affordable, and easily accessible water supply is essential for good health. Hunter et al. [21] indicated that improvements in water supply are essential prerequisites for improved personal and home hygiene and to enable sanitation facilities to be kept clean. Norman et al. [22] suggested that residents in communities without piped water are at a greater risk of contracting gastrointestinal illnesses from the consumption of compromised drinking water. Consequently, the direct health effect of improved water supply is likely to be extended by its indirect effects on sanitation and hygiene. That is to say, it might have some influence on the demand for healthcare services. Therefore, in this study, we define the penetration rate of running water as an index of infrastructure and discuss the effect of the availability of water to people, which is calculated on the basis of the effect of the penetration rate of running water on TCM performance.

Traffic accidents may result in disabling injuries, hip fractures, open wounds, head-brain injuries, and property damage, all of which could promote the demand for medical services. Lu et al. [23] indicated that utilizing TCM is likely to be common in Taiwan's patients with dislocations, sprains and strains because of the effectiveness of TCM modalities in pain management and function improvement, which are the main treatment goals of musculoskeletal injuries [24,25]. found that the top three major disease categories for TCM visits in Taiwan were diseases of the respiratory system, musculoskeletal system and connective tissue.

An aging population is a crucial public issue nowadays. Whether increasing life expectancy as such causes higher health care expenditures (HCE) in a population has not been clearly confirmed. Howdon and Rice [26] provided evidence to show that the aging of its population was not the cause of the growth of its medical expenditure. HCE is principally determined by proximity to death rather than age. Getzen [27] used panel data for 20 OECD countries covering the period from 1966 to 1988 and found that population aging has increased, but has had a limited effect on the demand for health care. Zweifel et al. [28] adopted data from 1983 to 1992 for Swiss hospitals and pointed out that the aging of the population is the "red herring" of HCE. Per capita HCE is not necessarily affected by the aging of the population due to an increase in life expectancy, but rather an increase in the share of elderly in the population seems to shift the bulk of HCE to those who are older, leaving per capita HCE unchanged. However, Felder and Werblow [29] found that extending life results in an increase in the "maintenance" cost, which because of the impact of advances in medical technology may lead to a "steepening" of such costs. Hashimoto and Tabata [30] showed that population aging has increased the demand for health care services in Japan. Nozaki et al. [31] indicated that aging increases health care spending because the elderly spend more on health than the young. Although there are still differences in the way population aging increases HCE, the impact of an aging population on medical expenditures cannot be ignored.

Unemployment and poor quality employment are particularly strong risk factors for mental disorders and are a particularly significant cause of inequalities in mental disorders [32]. Catalano et al. [33] referred to the health impacts of economic downturns. In addition, undesirable job and financial experiences also increase the risk of psychological and behavioral disorders, including violence and suicide. Urbanos-Garrido and Lopez-Valcarcel [34] argued that anxiety and stress regarding the future that are associated with unemployment could have a large impact on an individual's health. Reine et al. [35] also found there to be a strong positive relationship between unemployment and poor health among people. They suggested that long-term unemployment at a young age could have various health effects.

Many countries, such as Germany, Japan and Canada, utilize the global budget system to control medical expenditure and discourage mass expenditure on medical resources. Medical expenditure could directly affect the performance of medical institutions under the NHI. Most researchers in the field have indicated that through the global budget system the growth of medical expenditures can be controlled (e.g., [1,36–40]). However, some scholars have different opinions. Fan et al. [41] and Benstetter and Wambach [42] found that global budgeting is likely to lead to an increase in the volume of services supplied by providers under a reasonable setting. This implies that patients do not consider the implementation of a global budget system with decreasing health care expenditure to be fair. Kan et al. [43] Lee and Jones [44,24,25] and Cheng et al. [45] also found that claimed medical expenditure has significantly increased following the launching of the global budget system in Taiwan. The research revealed that there was a 14% increase in claimed medical expenses from 2002 to 2004. Similarly, Benstetter and Wambach [42] suggested that physicians supply a larger quantity of services under the budgeting system.

Metropolitan areas are often characterized by huge populations, high population density, and a high degree of urbanization. Camenzind [46] suggested that population density is positively related to the volume of medical services in Switzerland. The trend toward urbanization also affects public health. Miao and Wu [47] found that living in more urbanized areas increases the risk of chronic diseases. Thus, urbanized areas have stronger medical demand than rural areas. On the other hand, some scholars have obtained different findings. Athanassopulos et al. [48] compared the hospital efficiency based on the location of the hospital. They indicated that in Greece rural hospitals are more efficient than urban hospitals.

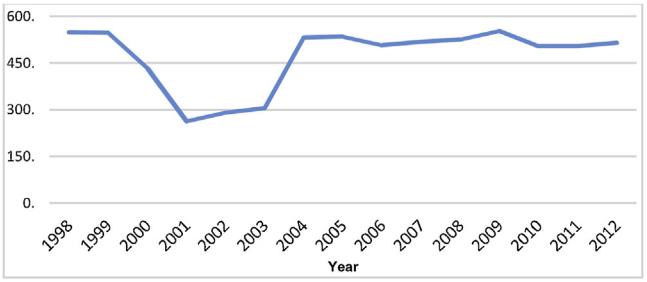

Fig. 2. Trend of average total points per clinic (in tens of thousands).

3. Materials and methods

3.1. The variables of the empirical model

After identifying these determinants in the theoretical and empirical literature and extracting them based on the characteristics and external environment of TCM clinics, the empirical model includes a dependent variable represented by the total points of TCM clinics in each year and eleven determinants, including physicians, medical personnel, divisions, history (the number of years a TCM clinic has been operating), the penetration rate of running water, traffic accidents, disabling injuries, an aging index, the unemployment rate, whether a metropolitan area and one dummy variable, the global budget system. Table A (in the Appendix) summarizes the definitions of all 12 variables being used.

3.2. Materials

3.2.1. Data source

The clinic is the main medical institution within the primary medical care system and plays an important role as part of the overall medical care system in Taiwan. For instance, a total of 113 hospitals have TCM departments, and there are 5 TCM hospitals and more than 3893 TCM clinics in 2018. However, some TCM services or types of medicine are not paid for by National Health Insurance. For instance, a total of 3521 TCM clinics had joined the National Health Insurance program in 2018. The research data are extracted from the National Health Insurance Research Database (NHIRD). A total of 4905 TCM clinics can be observed during the 15-year period from 1998 to 2012. The average operating time of these clinics is 5.65 years.

The panel data in this study are unbalanced, partly due to the limitations of the NHIRD dataset and partly due to the number of years that each TCM clinic has been in operation being different. The NHIRD dataset includes the contract that the clinics have with the NHIA, the income of clinics, the number of doctors, the number of staff and the location of the clinic. In order to understand the impact of the external environment on the operation of the clinics, the information on population and other socio-economic characteristics such as the location of the clinic are linked to the National Statistics in Taiwan and the Department of Statistics, Ministry of the Interior.

3.2.2. Total points system

We adopt total points as the dependent variable in this study. The total points represent the claims made by the TCM clinics for the reimbursement of medical expenses from the NHIA in each year. The NHIA will review the total number of points for services reported by the medical facility and then pay the amount in full after calculating the amount due for each point. The point of value is transferred into a "floating" point-value scale especially following the implementation of the global budget system. Fig. 2 shows the average total points applied in each year for each clinic. The

Table 2
Pairwise Correlation Coefficients Matrix for the Model.

	$total\_point_{it}$	py_num_{it}	mp_num_{it}	$func\_num_{it}$	$open\_year_{it}$	$water\_pt_{it}$	$traffic\_accident_{it}$	$disable\_injury_{it}$	age_index_{it}	$unemp\_rate_{it}$	$global\_budget_t$	$urbanization_{it}$
$total\_point_{it}$	1.00											
py_num_{it}	0.65*	1.00										
	(0.00)											
mp_num_{it}	0.65*	0.65*	1.00									
	(0.00)	(0.00)										
$func\_num_{it}$	0.03*	0.21*	0.29*	1.00								
	(0.00)	(0.00)	(0.00)									
$open\_year_{it}$	−0.14*	−0.11*	−0.11*	−0.001	1.00							
	(0.00)	(0.00)	(0.00)	(0.89)								
$water\_pt_{it}$	−0.04*	−0.05*	−0.03*	0.01	−0.03*	1.00						
	(0.00)	(0.00)	(0.00)	(0.20)	(0.00)							
$traffic\_accident_{it}$	0.002	−0.11*	0.05*	−0.03*	0.04*	0.23*	1.00					
	(0.74)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)						
$disable\_injury_{it}$	−0.02*	−0.10*	0.02*	−0.04*	−0.02*	0.40*	0.65*	1.00				
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)					
age_index_{it}	0.01	−0.16*	0.01	0.02*	0.03*	−0.08*	−0.08*	−0.14*	1.00			
	(0.17)	(0.00)	(0.19)	(0.10)	(0.00)	(0.00)	(0.01)	(0.00)				
$unemp\_rate_{it}$	0.003	−0.11*	−0.002	−0.01	0.07*	0.06*	0.30*	0.14*	0.28*	1.00		
	(0.61)	(0.00)	(0.73)	(0.11)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)			
$global\_budget_t$	−0.02*	−0.20*	−0.02*	−0.02*	0.06*	0.08*	0.04*	0.24*	0.35*	0.58*	1.00	
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)		
$urbanization_{it}$	−0.01	−0.005	0.06*	−0.02*	−0.01*	0.40*	0.36*	0.54*	−0.21*	0.04*	0.02*	1.00
	(0.07)	(0.44)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	

* Denotes significance at the 5% level; () denotes the P-value.

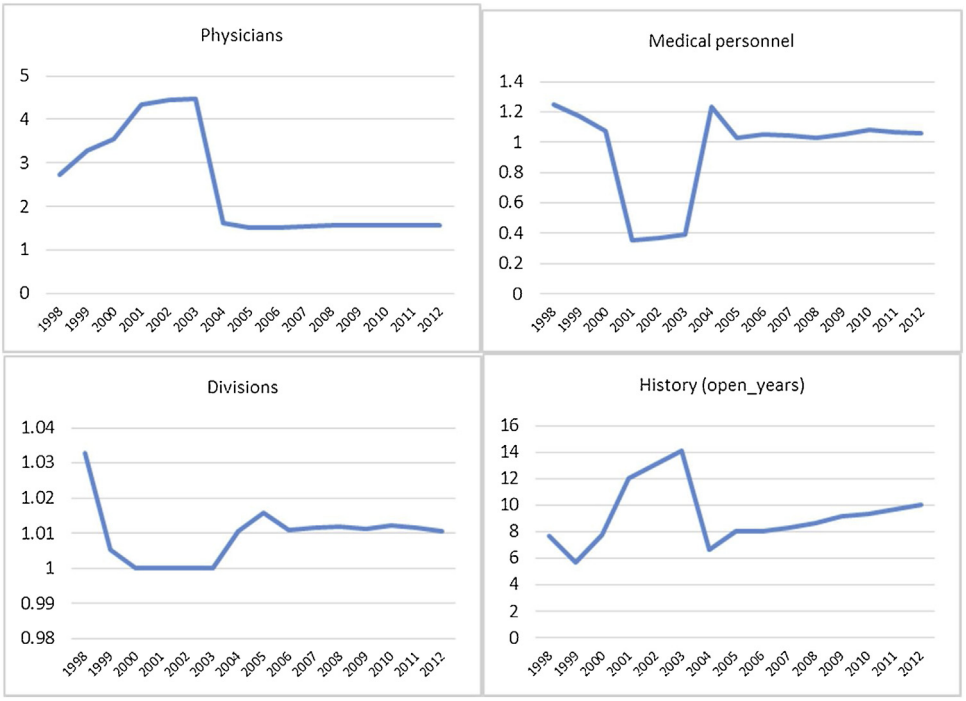

Fig. 3. The means of the TCM clinics' internal variables by year.

mean number of total points in tens of thousands is 515 and the maximum can reach 12,731.

3.2.3. Descriptive statistics

After reviewing the previous literature, this study extracts eleven determinants that can be classified according to two types, manely, internal and external variables. The interior variables of a clinic include physicians, medical personnel (not including physicians), divisions, and history (the operating length of the TCM clinic). The exterior variables include the penetration rate of running water, the frequency of traffic accidents, the frequency of disabling injuries, the aging index, and whether the location of the TCM clinic is in an urban area.

Table 1 displays the information regarding the descriptive statistics for the explanatory variables. Moreover, a summary of the variables' descriptions, data sources and references is presented in Table A (in the Appendix).

As for the TCM clinic's internal variables, physicians, medical personnel, divisions and history in terms of years of operation have a small discrepancy (Fig. 3). This means that TCM clinics in Taiwan operate on a quite similar scale. The means of the internal variables of TCM's clinics in different years are described in Fig. 3. There is instability in particular by 2004.

As for the external variables, the frequencies of disabling injuries and traffic accidents have higher standard deviations. This means that there exist huge differences in the occupational structures of each county and city. Furthermore, the aging index also has big differences because there is an obvious discrepancy in the population structure between metropolitan areas and the countryside. As for the remaining external variables that have a small discrepancy between each TCM clinic, it can be observed that the penetration rate of running water, the unemployment rate, and dependency ratio in Taiwan are similar.

3.2.4. The multicollinearity test

The purpose of the multicollinearity test is to check whether the explanatory variables in a multiple regression model are highly correlated or not. We utilize Variance Inflation Factors (VIFs) and the Covariate Correlation Coefficients Matrix to test for multicollinearity. According to Table 1, the highest VIF for all the explanatory variables is 2.29 in regard to the frequency of disabling injuries for the models. Moreover, the mean VIF is 1.62, so we can conclude that there is no significant evidence of serious multicollinearity between the variables in the models. Table 2 displays the results of the pairwise correlation coefficients matrix for the explanatory variables. We can say that the model has no serious correlation problem.

3.3. Methods

3.3.1. Model derivation

In order to examine the determinants of the TCM clinic's performance, we utilize a linear regression model to perform our analysis in this study. The linear regression model is expressed as in the following equation:

$$Clinicperformance_{it} = \alpha_i + \beta' X_{it} + \varepsilon_{it}$$

where i = 1,2. . ., N, represents the TCM clinic, and t = 1,2. . ., T, represents time in years.

The $Clinicperformance_{it}$ variable represents the total points earned by clinic i in period t; the vector X_{it} consists of a set of explanatory variables from clinic i in period t; ε_{it} is an error term which is normally and identically distributed (*i.i.d.*) across clinics and over time and $\alpha_i = \eta_i + \mu_i$, where η_i is assumed to be a fixed parameter to be estimated and μ_i is an unobservable time-invariant random effect from each clinic i, where $\mu_i \geq 0$.

In order to choose an appropriate empirical model that fits the panel data, this study employs the Breusch-Pagan Lagrange multiplier (BP-LM) test [49], the Hausman test and the over-identification test of the Hausman-Taylor Model (HTM) [50] to find a suitable empirical model from among the Fixed-Effects Model (FEM), Random-Effects Model (REM), and Hausman-Taylor Model (HTM). In particular, in the process of estimating the FEM, the time-invariant variables are omitted. Based on the suggestions of Egger and Pfaffermayr [51], we use the over-identification test of the

Table 3
Specification test results and empirical model adopted.

Model	BP-LM Test	Hausman test	Hausman-Taylor over-identification	Wooldridge test	Modified Wald test
	40908.07*** (0.0000)	1613.95*** (0.0000)	4866.51*** (0.0000)	1741.821*** (0.0000)	3.7e+34*** (0.0000)

Notes: 1. *Significant at 10%; ** Significant at 5%; *** Significant at 1%.
2. P-values are in parentheses.

Table 4
Results for the Full Sample of TCM clinics.

Variables	FEM(SE) cluster-robust	HTM cluster-robust
Physicians	33.835***	33.02058***
(py_num)	(0.003)	(0.002)
Medical personnel	42.17181***	42.25313***
(mp_num)	(0.001)	(0.001)
Division	142.5144**	140.8946**
(func_num)	(0.030)	(0.032)
History	0.8997833	0.1684081
(open_year)	(0.388)	(0.843)
Running water	4.776474	2.274675
(water_pt)	(0.211)	(0.32)
Traffic accidents	0.1697406	0.2192173*
(traffic_accidents)	(0.146)	(0.052)
Disabling injury	0.0193687***	0.0192078**
(disabling_injury)	(0.009)	(0.013)
Aging index	0.3178717	0.4251977**
(aging_index)	(0.231)	(0.022)
Unemployment rate	8.129751***	8.637103***
(unemp_rate)	(0.000)	(0.000)
Global budget system	−101.8649***	−96.93073***
(global_budget)	(0.000)	(0.000)
Metropolitan area	(ommited)	−17.33431**
(urbanization)		(0.039)
Cons	−170.0014	87.96512
	(0.642)	(0.665)
Number of obs.	27,736	27,736
Number of groups	4,905	4,905

Note: *** Significant at 1%; ** Significant at 5%; * Significant at 10%; () denotes the P-value.

HTM to estimate the fitness of the HTM. As shown in Table 3, we mainly adopt the FEM as the appropriate model for the empirical analysis in this study. Additionally, the VIF are below generally accepted threshold (<5), but there are two regressors highly correlated (r = 0.65) for numbers of physicians and medical personnel. We also test the sensitivity without medical personnel. The results will not change due to exclude variable of medical personnel.

3.3.2. Autocorrelation and heteroskedasticity

In addition, we use the Wooldridge test to check for autocorrelation and the modified Wald test [52,53] to check for heteroskedasticity in the fixed effects regression model. As shown in Table 3, the Wooldridge test and the modified Wald test are significant. Following Cameron and Miller's [54] suggestion, we further cluster TCM institutions by city and utilize the cluster-robust standard errors (SE) in the FEM and HTM to estimate the autocorrelation. Table 4 summarizes the empirical results for the cluster-robust standard errors (SE) in the FEM and HTM respectively.

4. Empirical findings and analysis

4.1. Clinic factors determining performance

Table 4 summarizes the results of the cluster-robust standard errors (SE) in the FEM and HTM models as follows. First, the number of physicians in a TCM clinic has a positive impact on the clinic's performance at the 1% level for all four models tested. The positive coefficient means that TCM clinics that have more physicians can provide a larger volume of medical services, and this will then increase the total number of points that TCM clinics can earn. On the other hand, more physicians may also offer more choices to patients. This result is consistent with Liu [15] and Kuntz et al. [16] but is contrary to the findings of Ersoy et al. [17].

Secondly, the medical personnel include nurses, physical therapists, occupational therapists, pharmacists, radiologists, and other medical personnel who provide medical services in the TCM clinic. Those people who wish to serve as medical personnel in such medical institutions should pass the national examination for medical personnel and obtain a medical personnel certificate in accordance with Taiwan's Medical Personnel Act. In general, the numbers of doctors and medical personnel can reflect the scale of the clinic, and when the numbers of doctors and medical personnel are higher, the clinic can provide a larger volume of medical services. According to the empirical results, the number of medical personnel in the TCM clinic has a significantly positive coefficient at the 1% level in all testing models. According to the statistics of the Taiwan Hospital Association, the salary of medical technicians in Taiwan is about NT$545,595 per year [55]. The increase in total points throughout the year seems to be lower than the average salary of the personnel. The TCM clinics therefore have to evaluate the benefits they will derive from these personnel before recruiting manpower.

Third, the coefficient for the number of divisions in the TCM clinics is significantly positive at the 1% level in all four models. The empirical results reveal that the relationship between Western and Chinese medicine appears to be complementary rather than substitutionary. Similar to [24,25] argument, TCM still is a complementary and alternative medicine, even though TCM is very popular in Chinese society. Some very large clinics could affect the results as large TCMs enjoy the advantage of economies of scope as more specialized departments attract more patients [24,25]. Employ complete datasets of TCM outpatient reimbursement claims from 1996 to 2001 in Taiwan and compare the frequencies of outpatient visits between TCM and Western medicine. Their findings show that people visited Western medicine clinics more frequently than TCM clinics for their illnesses. TCM is not the main choice when patients choose medical services in Taiwan. Fourth, the history of TCM clinics is not significant with performance. The longer history only means that the TCM clinics can maintain basic operations and cannot represent good performance.

4.2. Musculoskeletal issues and TCM

The frequency of traffic accidents has no significant effect to the FEM but has a significantly positive effect in terms of the performance of TCM clinics according to the HTM. Traffic accidents usually lead to contusion, bruises, and other injuries, and consequently give rise to an increase in the demand for TCM medical services. In fact, according to [24,25], the most common reasons for TCM visits are diseases of the respiratory, musculoskeletal, digestive and genitourinary systems, as well as related symptoms, signs and ill-defined conditions. Linde et al. [56] found that most people

consult complementary and alternative medicine (CAM) for chronic pain resulting from chronic conditions or musculoskeletal system disorders. In addition, Chen et al. [57] reported that more than 80% of visits to TCM clinics for acupuncture treatment in Taiwan were related to musculoskeletal issues. Furthermore, an increase in the frequency of visits for disabling injuries could raise the TCM clinics' performance. Lu et al. [23] indicated that the use of TCM is likely to be common among patients in Taiwan with dislocations, sprains and strains because of the effectiveness of TCM modalities on pain management and function improvement, which are the main treatment goals of musculoskeletal injuries. This result is similar to the finding by Williams et al. [58]. Occupational injuries contribute significantly to the overall incidence of injuries and are responsible for significant medical charges each year. By contrast, the clinic's performance could improve as well.

4.3. Aging affects the maintenance cost

The aging index has no significant impact on the performance of TCM clinics according to the FEM (SE), but its coefficient is both positive and significant according to the HTM models. The insignificant result is consistent with Howdon and Rice's (2018) finding. The aging of the population was not the cause of the growth of its medical expenditure, nor has it affected the performance of the TCM clinic. Therefore, the main target market for TCM is not only the elderly. Instead, TCM clinics can develop special care according to the demands of all ages.

4.4. A higher unemployment rate increases HCE

Similar to our findings, a number of reports and studies [32,33,35] have revealed that unemployment has an impact on an individual's health and increases the demand for health care. For instance, Reine et al. [35] found that the ratio of unemployed people over the age of 45 to total unemployed people in Taiwan had remained above 50% from 2009 to 2016. There exists a positive relationship between unemployment and poor health among people. Hence, we guess that the positive relationship between the unemployment rate and the performance of TCM clinics is mainly caused by the characteristics (such as age, health condition or living style) of people unemployed. For instance, these characteristics could favor TCM clinics more than Western Medicine clinics since there is less opportunity cost of time in TCM clinics. On the other hand, more patients and longer treatments in TCM clinics could attract more unemployed people.

4.5. TCM lacks competitiveness in urbanized areas

Our results indicated that the coefficient for urbanization is significantly negative for HTM. In general, urbanized areas are rich in medical resources. This result is consistent with Wu's [59] finding, but contrary to Liang's [60] result. We found that medical needs may be inelastic and not obviously affected by supply in areas with adequate medical resources. Where the availability of different types of medical resources is better, there may be less utilization of TCM due to there being increased competition. Therefore, TCM clinics in urban areas have a negative impact on business performance. Liang [60] found that metropolitan areas had higher TCM utilization rates. The people in these regions have higher incomes and are more concerned about their own health. Hence, they are willing to spend more on TCM medical treatment.

4.6. The impact of the Global Budget

The dummy variable, the global budget system, has a significantly negative impact on the total points earned by TCM clinics in all models. The aim of the global budget system under the NHI is to restrict unnecessary expenditure on medical resources. The NHIA not only utilizes a five-segment payment program to maintain the volume of outpatient services in each TCM clinic, but also uses a sampling peer review that is operated at a reasonable level to more efficiently control medical expenditure. In addition, the global budget system in Taiwan is characterized by an "expenditure cap"with an ex post floating reimbursement price for the entire medical benefits claimed. Under the "expenditure cap", hospitals and clinics can only strengthen service to increase their profits. Thus, their revenue could decline if their service cannot attract more patients under the global budget system.

5. Conclusions and suggestions

5.1. Conclusions

The use of TCM among the Chinese population is widespread since TCM has been developed in China for more than 2000 years. Many concepts of TCM, such as the balance of Qi-blood, the regulation of body constitution and the mixing of herbs with food, have been a part of life [24,25]. Although there has been much research on the use of TCM, there have been few studies on the performance of TCM institutions. This study mainly explains the features and examines the determinants of the performance of TCM clinics under the NHI system for 4905 TCM clinics during the period from 1998 to 2012. In order to choose an appropriate empirical model, we employ the cluster-robust standard errors (SE) in the FEM and HTM model to evaluate the performance of TCM clinics.

The empirical results first show that the scale measurements of TCM clinics such as the numbers of physicians, medical personnel and the number of divisions have significant positive effects on the performance of TCM clinics while a clinic's length of operations also could be helpful to its performance. For instance, the positive coefficient of the number of divisions implies that TCM in group practices combined with different western medicine specialists could strengthen a TCM clinic's performance. In other words, TCM and Western medicine seem to be complementary to each other, since TCM is very popular but is not the main choice when patients choose medical services. They also reflect the synergistic effect of specialization, especially collaboration between Western medicine and TCM will improve the organization's performance.

TCM is popular among the Chinese population and serves as a CAM. Our results further reveal that the frequency of disabling injuries and traffic accidents have positive impacts on the volume of medical services provided by TCM clinics. This result implies that Taiwanese are likely to choose TCM as the option for medical treatment when they face the occurrence of physical injury. According to Linde's (2001) research, most people resort to CAM for chronic pain resulting from chronic conditions or musculoskeletal system disorders. Chen et al. [57] reported that more than 80% of indications for acupuncture visits in Taiwan were for musculoskeletal diseases. These findings not only explain the difference in the order of disease categories between TCM and Western medicine, but also help TCM to find its characteristic advantages. In addition, TCM clinics can develop treatment for musculoskeletal diseases in areas where injuries can be highly disabling.

Furthermore, population aging has no significant on TCM clinic performance in FEM(SE). The result is consistent with the recent causal literature on the topic [26,28]. Age is not directly related to TCM demands. Instead, TCM clinics can develops special care according to the demands of all ages.

Our results also show that the positive relationship between unemployment rate and the performance of TCM clinics. We guess that the characteristics (such as age, health condition or living style)

of people unemployed and longer and more comprehensive treatment from TCM clinics could attract more people unemployed to visit TCM clinics while they have less opportunity cost of time in TCM clinics.

The dummy, metropolitan area, which represents an index of urbanization, reveals that TCM clinics could be forced to excessively compete in more highly urbanized cities or counties, which could adversely impact their revenue. Finally, the negative impact from the global budget system implies that the implementation of a peer review system may be helpful in weakening the total points earned by TCM clinics and then reducing the amount reimbursed by the government.

5.2. Suggestions

According to the above results, we can obtain a more comprehensive and fuller picture of the TCM clinic's performance. In relation to government policy, we would like to suggest that the government should encourage cooperation between TCM and Western medicine to create characteristics that belong to Taiwan's health care. The government should help TCM clinics develop more advanced treatment for musculoskeletal diseases in areas of high disabling injuries. In future studies, researchers could also further investigate additional variables that might help explain the features of a clinic's performance. We believe that more wide-ranging data, such as data for clinics offering multiple services, as well as a comparison of the results with those for other types of medical institutions, would serve as a useful avenue for further research.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.healthpol.2019.01.009.

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