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Taiwan's NHI Program: An Economic Analysis of Physicians Working in a Community United Clinic

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中文摘要

臺灣所實施的全民健康保險制度不僅有極高的覆蓋率，更提供民眾在改善健康上足夠的誘因，當面對疾病發生時得以有許多不同的醫療選項。然而同時，民眾使用醫療資源所衍生的各式相關費用卻遠超過全民健康保險局目前所能徵收的保險費。相對於小型的社區診所，都會區的民眾在面對緊急的醫療需求和慢性疾病治療，例如高血壓和糖尿病等定期回診，皆傾向在大型醫學中心尋求醫療照護。在全民健保制度下，由於缺乏有效的管理機制，無法在醫學中心和小型社區診所間確實作到疾病分流，醫療服務無法有效率地進行且醫療資源也未能正確分配。為了提供因應的對策，必須建立了一個醫師群得以聯合執業的醫療環境，像這樣的社區型聯合診所的醫療機構型態在臺灣十分少見。根據許多研究結果顯示，社區導向的基層醫療在慢性疾病的治療管理相對上能達到較佳的效果。除了探討慢性疾病治療管理之有效性，如何建立一個財務永續性的醫療機構，也是目前在全民健保制度下重要的議題。在本研究中，我藉由分析評估此聯合診所中個別的執業醫師，來檢視和此診所的經濟表現可能相關的變數。我分析了自民國九十八年至一〇一年間四十個醫師的相關資料，根據迴歸分析的結果，將有助於未來診所醫師招募與合理的醫師薪資結構設計，以期診所醫師們和診所的日常管理作業皆因此獲益。在建置這樣一個社區型聯合診所系統的過程之中，經由這些議題深入探討的成果，我得以認知到如何有效經營管理診所。社區聯合診所的目標在確保這些飽受慢性疾病之苦的民眾，能就近在他們所居住的社區內接受具醫療經驗的醫師所提供的醫療照護，同時因為醫病關係的增進，最終能同時幫助醫師和病患更有效的治療特定的慢性疾病。進而將治療導向預防，這樣的結果是全民健康保險制度設立最原始的目的。

關鍵字：全民健康保險制度、醫師表現評比、醫師收入、聯合診所、社區型基層醫療、永續醫療

Abstract

With the high coverage rate, the National Health Insurance (NHI) program in Taiwan has provided people more incentives for achieving improved health when choosing from available forms of medical care during their times of sickness. At the same time, however, associated costs and related expenses currently far exceed the income NHI is able to collect for its services. In urban areas people regularly seek medical care in larger medical care centers as opposed to smaller community clinics both for emergencies and for the routine checkup of chronic diseases such as hypertension and diabetes. Without any effectively managed mechanisms of separation between large medical centers and smaller community run clinics under NHI, medical services are often applied inefficiently and medical resources are not allocated appropriately. As a proposed solution, it is important to build a physician group practice environment in the form of a community united clinic of which there are currently only a few of in Taiwan. Many studies have shown that community-oriented primary care is more effective in the management of chronic illnesses. In addition to this suggested effectiveness of chronic disease management, a financially sustainable model is also desired under the current form of NHI. In this study I have examined possible factors that are related to the economic performance of a clinic by evaluating the individual work practices of physicians in this clinic. Focusing on more than forty physicians from 2009 to 2012, I were able to deduce an empirical model to assist in future physician recruiting and also design a reasonable salary structure, which benefits both the physicians and the daily operations of the clinic. By building up a community united clinic system, I've realized more deliberate and efficient outcomes in the ways that the clinic can be managed and operated. The ultimate goal is to keep patients who are suffering from chronic diseases, within the reach of knowledgeable physicians in their communities, which should lead

to improved patient-physician relationships and ultimately would better equip both patients and physicians with the ability to effectively treat specific diseases. The outcome of this would bring cure toward prevention, which was an original purpose of the NHI program.

Keywords: NHI program, physician performance, physician's income, united clinic, community-oriented primary care, sustainable health care

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1. Introduction

1.1. Background of Taiwan's National Health Program

The National Health Insurance (NHI) program in Taiwan was launched in 1995 and is known for its extensive population coverage rates reaching to 99% coverage by 2004. According to the latest version of the insurance plan, an NHI enrollee under employment is responsible for 30% of the insurance expense while his/her employer pays for 60% and the Taiwanese government pays for 10%. In 2011 the average monthly salary in Taiwan was NT$ 45,642 (approximately USD 1,521) and reflected a total monthly NHI payment of NT$1,900 (approximately USD 63). With the promised access to health care, NHI has optimally increased the life expectancies for its citizens: the average age of males has increased from 72 years to 76 years and for females from 78 to 83. These increases in life expectancies in Taiwan were calculated from 1998 until 2012.[1]

NHI is a single-payer compulsory social insurance plan that centralizes the disbursement of health-care funds. However, by centralizing the disbursement of funds to health care providers, a price ceiling to the medical service market became a part of the centralized provision in NHI. The effects of NHI, as a single-payer insurance plan, have been two-fold, the first has mainly been a social benefit; by providing affordable medical care, NHI has reduced or eliminated some potential health hazards and risks individuals may otherwise have faced without it. (Cheng, 2003; Lu et al., 2003) Accordingly, patients under NHI are never faced with the decision of whether or not to receive medical care in the cases of an emergent or chronic illness. From the view of a free market economy, according to the law of demand, NHI provides a relative affordability and thus increases the demand for its medical services. (Card et al., 2008 and Dong, 2013) Corresponding to the change in the old demand curve, an average 9%[1] yearly growth in medical use has been reported by the NHI office and accurately reflects

an increased demand for medical care and services under the current NHI system. An offset effect of the decrease in supplier surplus is that many health care providers, in order to maximize their monetary gains, either reduce the extent of quality care and basic services they offer under NHI or simply opt to find other means of income outside of those covered under the NHI system. Physician shortages, as well as career switches by some physicians, especially those in high-risk departments in hospitals to more lucrative fields related to medical cosmetics are becoming a commonplace phenomenon under the current system. (Chang, 2012; Chen, 2013) In response to reduced incomes under NHI, some physicians have chosen to pursue higher incomes in the medical cosmetic markets not covered under NHI, while others have taken a more conservative approach by avoiding higher risk treatment procedures and applications in their original fields. The reward and benefit surpluses for health care providers and producers of health care services and equipment prior to NHI simply don't exist any longer. (Kuo, 2012; Lee, 2012; Taipei Times, 2012)

Currently, government is borrowing funds in order to continue to offer NHI at the low fixed price it had originally conceived for enrollees. The pressure of increased demand and higher use of medical facilities and services under NHI has created an accumulating financial deficit due to overspending and mismanagement. For the officials in charge of facilitating NHI, a simple increase in the insurance payment rate has not been an option. Enrollees under the NHI depend on the system as it is and price increases would not be viewed favorably.

In the first few years after the creation of NHI, when the beginning of the health information system had been applied to connect enrollees to the NHI system, the rampant abuse and overuse of the system demonstrated the disequilibrium of demand and supply in the Taiwanese medical care market. Since, in its inception, the new

applied health care system was not perfectly monitored, both medical providers and NHI enrollees had financial incentives to enhance the use of unnecessary medical services, procedures and medicines by exploiting the flaws that were inherent in the system. Besides, with the current general economic health in a financial recession, legislators at the time generally refused to approve the raise of insurance payment rates to compensate for the inflated medical expenditures under the current plan. I have deduced therefore, without the possibility to gain more monetary support or funding externally within the single-payer design, rebuilding the equilibrium back into the medical market will have to happen both by improving system efficiency internally with improved management practices and by developing better resource allocation. If done correctly, it is possible to not only reduce the abuse of medical services and resources but also to provide sufficient incentives for physicians to stay in their professions and offer good quality health care for enrollees under NHI.

1.2. Clinic group practice reform

In the original design framework of NHI, in order to carry out planned health care with the best efficiency, it was supposed enrollees suffering from acute symptoms of illness as well as those with chronic diseases such as hypertension and diabetes would most likely seek care in local clinics. In contrast, medical care centers and regional hospitals were mainly arranged to treat emergency situations and to offer care in the case of life threating symptoms. By 2011 more than ten thousand clinics were registered under the Department of Health in Taiwan and yet medical centers were still overcrowded by patients with chronic diseases. (Shih et al., 1999; Huang et al., 2003) The overcrowding of large medical centers by patients seeking all forms of care, especially those forms of care which smaller clinics were equipped to handle, left those larger facilities overburdened while many of those ten thousand local clinics were not.

As well, in a busy medical center with extremely high patient to doctor ratios, doctor to patient contact times were reduced and so were the opportunities to discuss the patients' offset biological details in any depth.

In order to begin to better manage costs under NHI more efficiently and without raising current rates, multiple strategies toward efficiency will need to be necessary. In Taiwan, hemodialysis procedures, for example, are relatively high cost and are responsible for incurring some of the highest costs to debt ratios absorbed under NHI. Yet, many or most of the hemodialysis procedures conducted are resultant from chronic physical situations, especially diabetes mellitus. (Hwang et al., 2008) Many studies have indicated the most effective treatment options for patients with diabetes vary from patient to patient and invariably include combined adjustments to diet as well as levels of physical activity, in addition to prescribed medications. (Nelson, 2007; Marwick, 2009) Devising multiple strategies to treat chronic situations like diabetes requires a better relationship between the physician and the patient in order for improvements or cures to be possible. To guide quality improvement, the Chronic Care Model (CCM) was developed by Wagner and his colleagues (2001) in which assuring productive interaction between medical professionals and patients was emphasized. In the meantime, Renders et al. (2001) carried out a systematic review and concluded that multifaceted interventions and organizational interventions added to the regular review of patients were effective in improving the process of care. A health system is established with the main goal to improve the health of its people; it achieves this by preventing and treating the occurrence of sickness as well as meliorating chronic situations in patient populations. It is my belief that a better system is not only possible but also necessary. This can take pressure off of an already overburdened NHI by reducing current expenses as well as eliminating future medical costs. So, fitness

regimens and a healthy diet recommended under the care of registered nutritionists and sports medicine specialists are examples of preventative care approaches to counter the costliness of caring for chronic forms of disease that have reached their critical stages.

Community-oriented primary care (COPC) has been shown to have a striking, positive impact on the health of communities where it is practiced. (Longlett et al., 2001) Formulated more than two decades ago by Centers for Disease Control and Prevention in the United of States, Healthy Communities Program (HC) works with communities in improving leaders and stakeholders' skills and commitments to establish population-based strategies that reduce the burden of chronic diseases. COPC and HC work together as natural allies in regularly engaging additional citizens in public health improvement. (Cashman and Stenger, 2003) With this in mind, the community united-clinic has set out with these common goals for the community as well. Since 2007 the team has set up as a community united-clinic in the urban area of Taipei city, the capital city in Taiwan. As a platform for group practice there are on average more than 40 physicians with 20 different care specialties who share medical equipment and facilities measuring around 1825 meters squared. This united clinic provides not only multidisciplinary medical services to its community but also a well-managed platform for physicians to carry out their professional practice with fewer concerns for administrative matters including equipment purchase, nurse hiring, NHI reimbursement declaration, and other incurred operating affairs. To be noted, in Taiwan's clinics there are merely 5% built as united-clinics[2], i.e. with managed and shared space and resources; those united-clinics of a scale of 40 or more physicians trained in 20 or more specialties are even fewer. The united clinic is set up with high-tech equipment as well as an information system for medical examination data sharing, repetitive medical waste prevention and drug cross-effects monitoring. The major effects proposed by the utilization of these united-clinics

are improvement of economy occurring through cost and resource sharing as well as standardized data-management leading to increased internal efficiency of both resources and application of care. (American Medical Association, 1996; Aspen Health Law and Compliance Center, 2001) The expected result in this setting is a maximization of economy leading to the possibility of equilibrium as well as consumer and producer surpluses. In addition to the financial balance being achieved, patients are able to receive checkups and treatments for various physical issues categorized according to modern medicine inside a two-story building; this helps convenience and accessibility for the elderly as well as disabled patients. In the meanwhile, patients with chronic illness tend to claim a multidisciplinary medical need, which is costly; taking diabetes as an example, cardiomyopathy must be diagnosed by a cardiologist, nephropathy diagnosed by a nephrologist, skin ulcers diagnosed by a dermatologist and retinopathy diagnosed by an ophthalmologist. All of these are common complications following the mismanagement of diabetes. (Alberti and Zimmet, 1998) A united clinic with the kind of setting actually provides integrated care for chronically ill patients and results in positive effects on their cure process and reduces their associated medical costs. (Von Korff et al., 1997; Ouwens et al., 2005; Berwick et al., 2008) When medical equipment and the building are counted as fixed costs, salaries and rewards for various physicians in the clinic are considered the main variable costs in daily operation. (Roberts et al., 1999; Sørensen et al., 2003) In order to optimize the efficiency and minimize the marginal cost in a group practice arrangement, in this study, I intended to review the total monthly income brought into the clinic by different physicians throughout the past five years in order to reinstall the proper incentives for physicians; furthermore I've set out to design a formula assuring the down trend of variable costs for future application of these united-clinics working under the umbrella of NHI. (Hickson et al., 1986; Gosden et al.,

2000) My study comprised a fourfold investigation; I checked both demographic variables and income variables on two sets of panel data: one set is the cross section of twenty-nine physicians from October of 2009 to October of 2012, and the other set is composed of thirty-four physicians working in their first year in the clinic.

2. Models and Methodology

Resulting from the Hausman test I employed a random effect model using a generalized least square (GLS) method to examine the efficacy of physician-derived income related variables. GLS is a generalized method that specifies the variance-covariance matrix of the error structure, allowing for the modeling of differences in variances across panels (heteroscedasticity) and panel-specific autoregressive error terms, which are both potential problems in panel data. (Chang et al., 2011) The detailed empirical model follows:

$$f_{it} = \beta x_{it} + \beta' X_{it} + \alpha_i + \varepsilon_{it} \quad (1)$$

where f_{it} represents the total monthly income generated by physicians in the clinic, which consists of NHI reimbursements and patient co-payments for the 29 contiguous physicians *i* (from 1 to 29) at time *t* (from October, 2009 to October, 2012, for 37 continuous months). α_i captures unobserved time-invariant heterogeneity between physicians and ε_{it} is the individual-specific error distribution with normal properties also known as random disturbance. *x* represents the dummy variables examined in the study: birthplace as in Taipei (TPEb), the type of graduated medical school (PuMS as public medical school, MMS as military medical school or PMS as private medical school), physician specialty (InMed as internal medicine, SuMed as Surgery or speMed as other specialized medicine), the gender of physicians (GED: male as 1 and female as 0) and license registered under the clinic (LR) while X represents other demographic control variables including age (AGE), the number of cumulative working months in the clinic (cWM), and competition factor (fCPT).

Due to the homogeneity of eight income variables related to the total monthly income brought into the clinic by a physician I employed a fixed effect model for these variables. The total income of individual physician mainly is made up of fees from four

medical service income categories: attending physician (APF), Lab testing and radiographs (EXAM), local treatments or/and OPD operations (TAO), prescribed medication (DRUG). In addition to those variables mentioned above I also examined NHI reimbursement income (NHIr), the number of patients visited per month (PxNo) and the total monthly clinic income (TCI) in a fixed effect model listed below:

$$f_{it} = \beta' X_{it} + \alpha_i + \varepsilon_{it} \quad (2)$$

which any time-invariant unobserved variables and their coefficients were not explicitly included but were folded into α_i.

In order to be more adaptable for the use of implementing future physician salary designs and recruitment strategies, furthermore, simultaneous quantile regressions were run for the panel data. Various effects of different variables correlated to the physician total income were seen in three populations with their total incomes separated into: lower quartile (q25), median (q50) and upper quartile (q75).

3. Data, medical income categories and competition indexes

The demographic variables were obtained from the Human Resource Management System (HRMS) of the administration department while the primary variable, total monthly income generated by physicians (TMI) and the seven income variables were collected from the Hospital Information System (HIS) of the medical department in the clinic. There were two sets of data I examined: one set is a time series of physician cross-sections for twenty-nine contiguous physicians from October of 2009 to October of 2012 and the other set is the time series of physician cross-sections for thirty-four physicians from their first month to their twelfth month in the clinic.

HIS has applied a consistent methodology for counting various categories of income generated by physicians monthly and annually since 2007 when the clinic was first opened. The details of the primary variable TMI is described below:

Total monthly income generated per physician (TMI) – includes both NHI reimbursements and copayments; i.e. out of pocket payments made by patients that a physician could generate for the clinic per month. TMI includes all income generated by physicians for the clinic as gross income; TMI is income prior to salaries being paid and is not equal to how much doctors were actually paid every month. Generally speaking, with the exception of a local treatment or an operation, physicians were usually paid salaries according to each time slot they attended.

Seven categories of physician-generated incomes were analyzed for correlations with respect to TMI physicians brought into the clinic. All these income categories are reimbursed either by NHI to the clinic when a patient's condition meets NHI requirements for reimbursement or by the patient in the form of a co-payment (self payment) when a patient's condition is not covered under NHI or is only partially covered. The details of four medical service income categories are as followed:

Attending physician fee (APF) – when a patient visits a physician this payment is reimbursed at a specially designed sliding scales to prevent a physician from seeing too many patients in any one outpatient shift and thus to maintain a standard of healthcare quality. To reflect the reality of a physiatrist's (rehabilitation medicine specialist) generated income for the clinic, I also included physical therapy reimbursements in this income category.

Lab testing and Radiographs (EXAM) – this counts all the reimbursements and payments that occurred when a test is ordered in a medical laboratory including blood examinations, routine urine examinations, routine fecal examinations, electrocardiography tests, pathological section analyses and other microscopic examinations, tests or analyses. When it comes to the detection of diseases of the skeletal system as well as detecting some diseases in soft tissues, radiographs are useful. Commonly taken x-ray graphs are: chest x-rays for heart and lung diseases, abdominal x-rays for problems of the digestion system, joint x-rays for osteoarthritis and spinal x-rays for scoliosis and osteophytes. In the clinic certain physicians also order bone mineral density x-ray tests for the elderly for the detection of the existence of osteoporosis in order to prevent a bone fracture.

Local treatments or/and OPD operations (TAO) – since the clinic is built to provide outpatient medical services all the treatments and operations are performed without the need for a formal hospital admission or overnight stay. The OPD treatments and operations performed in the clinic are diverse. Treatments and care vary from something as easy as superficial wound care to the treatment of something as serious as a hemorrhoidectomy. Along with incomes generated from those operations incomes generated from introscopies and ultrasounds were also counted in this income category.

Prescribed medication (DRUG) – between the NHI reimbursements for medications and the actual cost of drug purchases, there is a price gap that varies from clinic to clinic. In the clinic I consider this premium a significant part of the income and thus in this study I was interested in the correlation of drug income to every physician's total generated income.

The total income a physician is expected to bring into the clinic is made up of NHI reimbursements and out of pocket payments made by patients including co-payments. In general, both NHI reimbursements and other expenses are sorted into one or more of those five medical service income categories listed above: APF, EXAM, TAO, and DRUG (Figure).

Other than those four categories, I also included three more income variables: NHIr, and PxNo for data set 1 and NHIr, PxNo, and TCI for data set 2 in the Eq. (2) regression. More details of NHIr and PxNo are described below:

NHI reimbursement income (NHIr) – represents all the medical services a physician provided, ordered and prescribed for patients, reimbursed by NHI. In this study the time period applied was monthly. Co-payments or expenses not covered under NHI were not included in this income category.

The number of patients visited per month (PxNo) – records the total monthly number of patients every physician sees in the clinic. With a growing patient population and an improving reputation in the local community, the clinic owner started hiring more than one physician in every division (e.g. divisions of family medicine, cardiology, and dentistry etc.). Thus, I was also interested in whether more physicians in the same division would affect an individual physician's performance in terms of his/her total

income generated for the clinic. I included three related and data-tractable competition indexes as variables in the study of the twenty-nine physicians during the thirty-seven months this study was conducted.

Total weekly shift in the same division (wTS) – in the clinic every physician designates his/her work in a three-hour time slot with three shifts available each day, Monday to Saturday. Physicians with different specialties may share the same work time designation, working in different examination rooms, but one shift shared by physicians with the same specialty is not allowed. This index represents the weekly sum of shifts provided in every division.

Within competition (inCPT)– this is the result of the (wTS) in the same specialty division; to achieve this I subtracted the number of shifts a physician worked in his/her specialty division from the total number of available work shifts in a given work week. For example, if in a given work week physician A worked in 6 time slots associated with his/her specialty division and the (wTS) associated with that specialty was 13, then I achieved an (inCPT = 7) for physician A.

Competition factor (fCPT) – by dividing inCPT by wTS, I arrived at fCPT; I developed this competition factor to neutralize the positive effect caused by the increasing number of wTS and the negative effect resulted from the increasing number of inCPT, I will use this criteria to evaluate its significance within each physician specialty as well as consider it's effects when a given physician's work shifts are either increased or decreased within a given specialty. All of the former stated variables descriptions, statistical summary, and detailed sources are presented in Table 1.

4. Empirical results

4.1. Twenty-nine physicians in thirty-seven months

The baseline empirical results of Eq. (1) for the twenty-nine physicians from October 2009 to October 2012 are provided in the first column of Table 2. MMS and LR are the dummy variables that both showed a positive impact at the 1% level of significance; approximately a 1.06% increase to the total monthly income of any physicians graduated from the military medical school and a 1.31% increase to the total monthly income for any physician who registered his/her license under the clinic. In addition, AGE is the only non-dummy variable that has shown a significant deterrent impact ($p < 0.05$) on the physician's total monthly income generated for the clinic (TMI); holding other variables constant, a 1% increase in AGE yielded a 1.84 decrease in TMI.

To compare impacts of different variables on different income groups, a simultaneous quantile regression was run on the lower (q25), median (q50) and upper (q75) income groups of physicians and the empirical results are provided in the second, third and forth columns respectively. TEPb presented significant ($p < 0.01$) negative impacts on the median and upper income group, an approximate 0.37% reduction and 0.70% reduction respectively in TMI. PuMS showed a negative impact ($p < 0.01$) on the lower income group yielding a 2.14% decrease in TMI while PuMS showed a positive impact ($p < 0.01$) on the upper income group with an approximate 0.51% increase in TMI. MMS demonstrated significant ($p < 0.01$) positive impacts among the lower, median, and upper income groups with 0.61%, 0.77%, and 0.37% increases respectively in TMI. InMed only showed a positive impact ($p < 0.05$) on the median income group (0.21% increase in TMI) while SuMed only showed a positive impact ($p < 0.01$) on the lower income group (0.22% increase in TMI). LR carried out an equal force ($p < 0.01$) of positive impacts among the lower, median, and upper income groups (Respectively

1.50%, 1.27%, and 1.32% increases in TMI). AGE has lost its elasticity in the baseline when the simultaneous quantile regression was run. cWM presented a positive impact at 5% level of significance on the lower income group and a positive impact at 1% significant level on the upper income group; every 1% increase in cWM results in 0.19% and 0.21% increases in TMI of the lower and upper income groups respectively. With respect to fCPT, significant ($p < 0.01$) negative impacts were shown on the lower, median, and upper income group; every 1% increase in fCPT yields 1.23%, 0.73%, and 0.83% reduction respectively in TMI.

The first column of Table 3 demonstrated the empirical baseline results for eight income variables of Eq. (2) and the second, third and fourth columns demonstrated further results of a simultaneous quantile regression for the lower, median and upper income groups. In the baseline results, APF, DRUG, and NHIr presented positive impacts on TMI at 1% level of significance (0.04%, 0.15%, and 0.91% increase in TMI per % increase in APF, DRUG, and NHIr) while PxNo showed a negative impact on TMI at 5% significant level (0.04% reduction in TMI per % increase in PxNo). In the quantile regression, APF maintained its positive impact ($p < 0.01$) on the lower income group (0.05% increase in TMI), lost its elasticity on the median income group, and then showed a negative impact ($p < 0.01$) on the upper income group (0.15% reduction in TMI). EXAM and TAO demonstrated significant ($p < 0.05$ for EXAM versus q25 and $p < 0.01$ for the others) positive impacts among the lower, median, and upper income groups with an overall increase percentage smaller than 0.01%. Similar to APF, DRUG also maintained its positive impact ($p < 0.01$) on the lower income group (0.01% increase in TMI), lost its elasticity on the median income group, and then presented a negative impact ($p < 0.01$) on the upper income group (0.04% reduction in TMI). NHIr maintained its elasticity in the quantile regression; every 1% increase in NHIr yields

0.80%, 0.79%, and 0.87% increases respectively in TMI of the lower, median, and upper income groups. Opposite to the negative impact in the baseline, PxNo demonstrated an equal force of significant ($p < 0.01$) positive impacts on the lower, median, and upper income groups; per 1% increase in PxNo resulted in 0.14%, 0.17%, and 0.30% increase respectively in TMI of the lower, median, and upper income groups.

4.2. First year for thirty-four physicians

Table 4 presented the results of Eq. (1) for the thirty-four physicians during their first twelve months in the clinic, the first column being reserved for the baselines. LR was the only dummy variable that showed a significant ($p < 0.05$) positive impact in the baseline with a 0.76% increase in TMI. Among the non-dummy variables, only cWM presented a positive impact ($p < 0.01$); every 1% increase in cWM yielded an approximate 0.27% increase in TMI.

The results of simultaneous quantile regression for the thirty-four physicians' first twelve months were demonstrated in the second, third, and forth columns of table 4. Of the median, and upper income group TPEb showed negative impacts ($p < 0.01$ in q50, and $p < 0.1$ in q75) with approximate 0.53% and 0.32% reductions in TMI while the lower income group was not significantly correlated to TPEb. In the results of quantile regression, GED demonstrated an equal force of significant ($p < 0.01$) positive impacts resulting in approximate 0.50%, 0.72%, and 1.00% increases respectively in TMI of the lower, median, and upper groups. When it came to the schools physicians graduated from, neither PuMS nor MMS showed any significant impacts among the lower, median, and upper income groups. With respect to the specialties of a physician, InMed showed an overall negative impact ($p < 0.01$ in q25 and q50, $p < 0.05$ in q75) resulting in approximate 0.34%, 0.65%, and 0.47% reductions respectively in TMI of the lower, median, and upper groups. In addition, SuMed also presented significant ($p < 0.01$ in

q50 and $p < 0.05$ in q75) negative impacts on the TMI of the median, and upper income groups (0.67%, and 0.50% reductions, respectively). On the other hand, LR still played a dummy variable with significant positive impacts ($p < 0.01$) among the lower, median, and upper income groups with approximate 0.97%, 0.98%, and 0.83% increases respectively in TMI. When it came to the non-dummy variables, AGE showed no significant impacts among three income groups while cMW carried out an equal force of significant ($p < 0.01$) positive impacts on three income groups yielding 0.32%, 0.29%, and 0.29% increases respectively in TMI of the lower, median, and upper income groups per 1% increase in cWM.

I also applied the total 408 observed data of the thirty-four physicians during their first twelve months to the Eq. (2) and the baselines are shown in the first column of Table 5. All the four medical service categories demonstrated positive impacts at 1% level of significance, per 1% increase in APF, EXAM, TAO, and DRUG resulted in approximate 0.37%, 0.02%, 0.01%, and 0.07% gains respectively in TMI. Considering the influence ($p < 0.01$) of NHIr, an approximate 0.51% increase resulted from every 1% increase in NHIr when the other variables were held constant. In addition, observing the results of the baseline, TCI and PxNo both showed positive impacts at a 10% significant level and in turn resulted in 0.11% and 0.06% increases in TMI.

Along with the baseline results of Eq. (2), I also ran a simultaneous quantile regression for the 408 observed panel data and presented the results in the second, third, and forth columns in Table 5. Compared to the results in the baseline, TCI and PxNo both demonstrated more significant ($p < 0.01$) positive impacts on the three income groups; per 1% increase in TCI yielded 0.11%, 0.12%, and 0.19% increases and per 1% increase in PxNo yielded 0.19%, 0.23%, and 0.25% increases in TMI of the lower, median, and upper income groups. Among the four medical service income categories,

APF and EXAM both lost their elasticity when the simultaneous quantile regression was run. However, TAO still presented significant ($p < 0.01$) positive impacts on TMI of the lower and median income groups (approximately 0.01% increase in TMI per 1% increase in TAO). Similar to TAO, DRUG also showed significant ($p < 0.01$ in q25 and $p < 0.1$ in q50) positive impacts on the lower and median income groups and then lost its elasticity on the upper income group. Every 1% increase in DRUG resulted in approximate 0.02% and 0.01% increases respectively in TMI of the lower and median groups. NHIr maintained an equal force of significant ($p < 0.01$) positive impacts among the three income groups; it demonstrated approximate 0.77%, 0.77%, and 0.81% increases respectively in TMI of the lower, median, and upper income groups per 1% increase in NHIr.

5. Conclusions and discussions

5.1. Application of demographic variants to clinic management

In order to satisfy researching the daily operation and to evaluate the monthly income physicians were able to bring into the clinic, I summarized different demographic variant effects between data set 1 and 2 focused on the results of baselines and the upper income groups (Table 6). Among those variables presented in Table 6, LR played the most consistent income-predicting marker for both short term (the first twelve months) and long-term results. Beside the lack of significant impact on the baseline of data set 1, cWM could be a reliable monthly monitoring index during the first twelve months for a newly arrived physician. When a physician has decided to register his/her license under the clinic, it usually meant he/she regards the clinic as his/her main career execution location. In a community clinic settling like the clinic, sufficient focus on relationship establishment between physicians and patients usually resulted in good echoes and improved reputation and in turn brought in more patients. In the upper income groups of both data sets, TEPb might play a negative income predictor that displayed physicians originally born in Taipei generated less income for the clinic compared to the physicians born in places other than Taipei. On the other hand, MMS and PuMed played as long-term indexes. Observing the results in baseline, compared to the physicians graduated from neither public medical school nor private medical school, the empirical result implied that the physicians graduated from a military medical school system brought more income into the clinic. The physicians graduated from public medical schools showed their competitive abilities to generate income for the clinic as the upper income group when running the simultaneous quantile regression. From the perspective of medical services demanded in the clinic, physicians who practice specialties other than internal medicine and surgery such as dermatology,

ophthalmology, and rehabilitation medicine etc., relatively generated more income for the clinic during their first twelve months. Moreover, the results of InMed and SuMed also implied the potential needs on other medical specialties than internal medicine and surgery medicine. Although in my original hypothesis, which was, I expected middle-aged physicians to perform better than the elder ones, AGE only showed a significant negative influence in the baseline of data set 1. In general, I've identified two prototypical types of physicians who are likely to be found working in a community clinic; one kind has an extensive body of work experience and is nearing retirement and the other kind of physician has more recently accomplished his/her full period of residency training in a medical center. In comparing the results of both data sets, AGE wasn't shown to be a preferred income-predicting marker when interviewing a newly applied physician.

5.2. GED indicator for the first year and competition factor for the long term

Thanks to the lack of gender balance in data set 1, GED was not included in the variable evaluation correlated to TMI. In the meanwhile, resulting from the incompletely traceable fCPT in data set 2, fCPT was not included in the evaluations of data set 2. Of simultaneous quantile regression, of the upper income group, GED showed a significant positive impact in data set 2 while fCPT showed a negative impact in data set 1. Comparatively, female physicians who are married tended to demonstrate income generation with less fluctuation over time, whereas married men tended to show greater fluctuation with respect to the incomes they generated for the clinic; in other words, male physicians who are married demonstrated a greater capacity for competitive income generation, and their incomes tended to increase over time. This observed effect could be merely a local/cultural effect and may be of interest in future studies. Focused on the effect of fCPT, the possible scenarios were further depicted in Table 7.

Considering the change from scenario A to B for doctor 1, when doctor 1 decided to add one more shift every week, it caused the 10% change in fCPT of doctor 1, in turn resulting in an approximate 8.3% increase (Table 2, column of q75) in TMI of doctor 1. Relatively, due to the increased shift load for doctor 1, an approximate 8.3% reduction in TMI of doctor 2 was observed. Therein the challenge of maintaining the balance between the increases and decreases for individual physicians lies, as well as total impacts on the income generated for the clinic, from the perspective of the clinic, are likely an area for further study and consideration.

5.3. Insights of the medical income categories studied

PxNo not only had a positively significant level correlated to TMI but also held a consistent quality in the simultaneous quantile regression of both data sets. PxNo can be tracked easily through the computerized patient number generator system in the clinic that is visible and renewed daily so that I suggest PxNo be the best real-time index to estimate physicians' daily income performance before running a monthly financial income sheet. In contrast, the insignificant results of TCI in data set 1 (TCI was excluded in the final evaluation of data set 1), TCI demonstrated a significant relationship with TMI of data set 2, first-year income for new-arrived physicians. With regards to APF, in the quantile regression of data set 1, the impact on TMI moved from positive to negative, which was in accordance with the reimbursement policy NHI executes to control the number of patients a physician sees per time slot. In order to encourage physicians to focus on their professional practice and relationship with patients NHI sets up income threshold to the reimbursements as APF, the general scale of patient number to see any one physician followed as under 50, 51 to 70, and more than 70. Although in the long term EXAM presented a significant relationship with TMI of data set 1, both the empirical results of data set 1 and 2 suggested EXAM had small

percentage impacts on the three income groups. Considering empirical results of both data sets in quantile regression, TAO showed a consistent quality of positive influence in TMI among three income groups. TAO in the clinic is regarded as either high NHI reimbursement services or higher payments received as out of pocket payments, which generates a better cash flow for the clinic, compared with NHI reimbursement payments, as well. So far, on average, TAO only accounts for 12% toward the clinic's total income (Figure). It reflects the general habits as well as impression of patients using ED room services when any of TAO is required. In addition it also implies that the clinic may need a broader public promotion about the medical services it offers, especially in the category of TAO, to the patients in the community. Another interesting result I observed in the study was the impact on quality shift from positive to negative in the quantile regression of both data sets that DRUG likely caused a reduction in TMI especially in the upper income group. The results coincided with NHI's policy that intends to cut down on the prescription of drug medications.

6.4. Alternative health care market development

When I focused on the empirical results of both data sets, as was my expectation before running the statistical work, NHIr showed the most significant impacts on TMI in both baseline and quantile regression. As I mentioned in the introduction, as the financial deficit of NHI has increased, so the clinic was reimbursed less per year when the services provided by the clinic are equal compared to years before. Maintaining the role as a community medical service provider in the NHI system, the clinic has offered every enrollee increased solutions on both sides of the health equation; the physicians catered their services to patients in search of cures for his/her diseases, but they've also offered a growing number of preventative side medical care options such as access to professionally trained nutritionists and sports medicine practitioners. The foremost goal

in all of this is bringing people in the community to a healthier way of living, so be it on the side of cure or prevention. By maintaining a different approach to health care and a perspective as a community health care provider, compared with other clinics in the NHI system, the clinic has been able to create a competitive advantage. By providing quality care in the cases of chronic disease and in the management of acute symptoms for patients, including novel prevention care options, it's been able to create additional income in the health care market, as is. At the same time, this value added into the market, in addition to what the NHI already affords, has created premiums for both the clinic and physicians; the ultimate goal of this is to extend the health care market by improving internal efficiency, all the while leading more people in the community to better overall health.

With respect to the practical and daily management of a health clinic, this study was carried out utilizing a retrospective method. Lacking a prospective design and an original data set for manipulation, I was unable to arrange data set 1 and 2 with exactly identical physicians under the same time period. Although some results were proved in the routine operation, it would still take more prospective researches to further confirm the conclusions.

Figure: Medical Services pie chart depicts the proportion of TMI generated by various clinical services

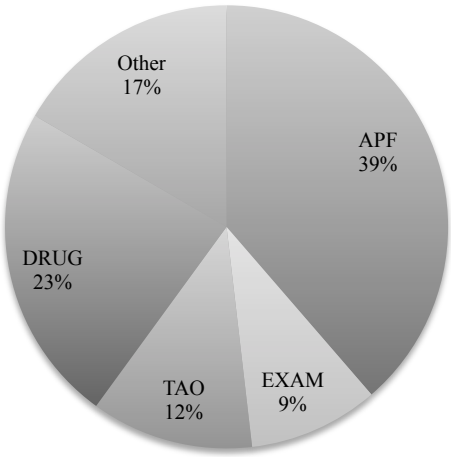

Table 1

Definitions, means, and standard deviations of the variables.

Variable	Definition	Mean, and SD		Source
Primary:		Data set 1	Data set 2	
TMI	Total monthly income generated per physician prior to salary being paid.	Mean = 12.03, SD = 1.24	Mean = 11.60, SD = 0.99	HIS
Demographic:				
TPEb	Dichotomus variable that was coded one if the physician was born in Taipei.	Mean = 0.28, SD = 0.45	Mean = 0.44, SD = 0.50	HRMS
GED	Dichotomus variable that was coded one for the male physicinas.	NA	Mean = 0.59, SD = 0.49	HRMS
PuMS	Trichotomus variable that was coded one when the physician graduated from a public medical school.	Mean = 0.28, SD = 0.25	Mean = 0.24, SD = 0.43	HRMS
MMS	Trichotomus variable that was coded one when the physician graduated from a military medical school. When the physician graduated from a private medical school, PuMed and MMS were both coded zero.	Mean = 0.45, SD = 0.50	Mean = 0.18, SD = 0.38	HRMS
InMed	Trichotomus variable that was coded one for the physicians of internal medicine.	Mean = 0.24, SD = 0.43	Mean =0.21, SD = 0.40	HRMS
SuMed	Trichotomus variable that was coded one for the physicians of surgery medicine. For physicians with other specialties than internal and surgery medicine, both InMed and SuMed were coded zero.	Mean = 0.17, SD = 0.38	Mean = 0.24, SD = 0.42	HRMS
LR	Dichotomus variable that was coded one if the physician registered his/her license under the clinic.	Mean = 0.34, SD = 0.48	Mean = 0.47, SD = 0.50	HRMS
AGE	Age of the physician in the designated month.	Mean = 3.93, SD = 0.21	Mean = 3.87, SD = 0.20	HRMS
cWM	Cumultative working months a physician had worked in the clinic by the designated month.	Mean = 3.77, SD = 0.69	Mean = 0.98, SD = 0.59	HRMS
fCPT	Internal competition factor that describes the level of competition for a physician in his/her division; the ratio of competition shifts and the total shifts in the same division.	Mean = -0.43, SD = 0.39	NA	HRMS
Income-related:				
TCI	Total monthly income generated by all the physicians in the clinic.	NA	Mean = 16.27, SD = 0.13	HIS
APF	The monthly sum of attending physician fees incurred per patient visit that were either reimbursed by NHI or paid out of patient's pocket.	Mean = 10.72, SD = 1.50	Mean = 10.43, SD = 1.16	HIS
EXAM	The monthly sum of payments of lab and radiographic tests prescribed for patients that were either reimbursed by NHI or paid out of patients' pocket.	Mean = 8.41, SD = 3.38	Mean = 8.15, SD = 3.11	HIS
TAO	The monthly sum of payments of local treatments and clinic operations executed for patients that were either reimbursed by NHI or paid out of patients' pocket.	Mean = 7.31, SD = 4.12	Mean = 6.42, SD = 4.43	HIS
DRUG	The monthly sum of medication fees prescribed for patients that were either reimbursed by NHI or paid out of patient's pocket.	Mean = 10.17, SD = 1.76	Mean = 9.62, SD = 1.37	HIS
NHIr	Total monthly income reimbursed by NHI for every physician.	Mean = 11.71, SD = 1.26	Mean = 11.25, SD 0.98	HIS
PxNo	Total monthly number of patients attended to by every physician.	Mean = 5.89, SD = 1.12	Mean = 5.53, SD = 1.03	HIS

NOTE: HIS denotes hospital information system and HRMS denotes human resource management system.

Table2

Demographic multivariante regression and quantile regression analyses of total monthly income (TMI) for twenty-nine physicians.

Variable	Baseline			Simultaneous quantile regression bootstrap (1000) SEs								
				q25			q50			q75		
	coef.	z		coef.	t		coef.	t		coef.	t	
TPEb	-0.504	-1.18		0.004	0.05		-0.366	-2.72	***	-0.701	-7.85	***
PuMS	-0.105	-0.13		-2.137	-9.37	***	0.401	0.34		0.508	2.93	***
MMS	1.056	2.39	***	0.606	7.72	***	0.774	3.98	***	0.367	3.65	***
InMed	0.112	0.25		0.101	1.22		0.212	1.99	**	0.241	1.52	
SuMed	0.519	0.96		0.220	2.48	***	0.221	1.61		-0.267	-1.04	
LR	1.308	3.36	***	1.498	17.63	***	1.270	14.17	***	1.322	7.58	***
AGE	-1.838	-1.93	**	-0.290	-1.34		0.184	0.43		0.076	0.20	
cWM	0.024	0.33		0.191	2.19	**	0.106	1.18		0.206	3.40	***
fCPT	-0.096	-0.38		-1.227	-7.66	***	-0.727	-3.55	***	-0.829	-4.93	***
Constant	18.314	5.22	***	11.817	17.07	***	10.5562	7.45	***	11.654	7.66	***
Obs	1073			1073			1073			1073		

Note: (1) Total monthly income (TMI) is in natural log.

(2) AGE, cWM, and fCPT are in natural log.

(3) 1, 5, and 10% levels of significance are denoted by ***, **, and *, respectively.

Table 3
Medical income multivariante regression and quantile regression analyses of total monthly income (TMI) for twenty-nine physicians.

Variable	Baseline			Simultaneous quantile regression bootstrap (1000) SEs								
				q25			q50			q75		
	coef.	t		coef.	t		coef.	t		coef.	t	
APF	0.043	6.34	***	0.053	4.51	***	0.020	0.83		-0.153	-2.56	***
EXAM	0.002	1.44		0.001	2.43	**	0.004	3.82	***	0.006	3.67	***
TAO	0.000	-0.04		0.005	10.27	***	0.006	8.95	***	0.009	6.60	***
DRUG	0.148	15.58	***	0.012	7.87	***	0.008	1.36		-0.043	-6.18	***
											54.4	
NHIr	0.908	79.46	***	0.796	110.88	***	0.790	47.32	***	0.873	3	***
PxNo	-0.039	-2.32	**	0.139	9.26	***	0.173	7.14	***	0.301	5.10	***
Constant	-0.383	-5.81	***	1.072	13.71	***	1.342	11.50	***	2.057	9.02	***
Obs	1073			1073			1073			1073		

Note: (1) Total monthly income (TMI) is in natural log.
(2) APF, EXAM, TAO, DRUG, NHIr, and PxNo are in natural log.
(3) 1, 5, and 10% levels of significance are denoted by ***, **, and *, respectively.

Table 4
Demographic multivariante regression and quantile regression analyses of total monthly income (TMI) for thirty-four first-year physicians.

Variable	Baseline			Simultaneous quantile regression bootstrap (1000) SEs								
				q25			q50			q75		
	coef.	z		coef.	t		coef.	t		coef.	t	
TPEb	-0.259	-0.74		-0.292	-1.55		-0.528	-2.69	***	-0.315	-1.69	*
GED	0.434	0.94		0.498	2.72	***	0.721	2.83	***	0.998	3.12	***
PuMS	0.197	0.50		-0.110	-0.75		-0.016	-0.08		0.479	1.57	
MMS	0.041	0.08		-0.170	-0.69		-0.270	-1.20		-0.235	-1.01	
InMed	-0.248	-0.61		-0.340	-2.55	***	-0.654	-4.33	***	-0.469	-2.01	**
SuMed	-0.217	-0.45		-0.321	-1.51		-0.670	-2.84	***	-0.499	-2.10	**
LR	0.758	2.20	**	0.967	8.81	***	0.983	7.63	***	0.827	5.29	***
AGE	-0.136	-0.14		0.073	0.17		0.208	0.56		-0.780	-1.29	
cWM	0.269	9.67	***	0.317	4.62	***	0.287	3.99	***	0.287	3.28	***
Constant	11.241	3.14	***	9.885	6.36	***	10.060	7.34	***	14.076	6.27	***
Obs	408			408			408			408		

Note: (1) Total monthly income (TMI) is in natural log.
(2) AGE and cWM T are in natural log.
(3) 1, 5, and 10% levels of significance are denoted by ***, **, and *, respectively.

Table 5
Medical income multivariante regression and quantile regression analyses of total monthly income (TMI) for thirty-four first-year physicians.

Variable	Baseline			Simultaneous quantile regression bootstrap (1000) SEs								
				q25			q50			q75		
	coef.	t		coef.	t		coef.	t		coef.	t	
TCI	0.109	1.92	*	0.108	3.46	***	0.115	3.37	***	0.188	2.86	***
APF	0.368	13.38	***	0.014	0.57		-0.020	1.24		-0.064	-0.68	
EAXM	0.016	3.49	***	0.000	0.18		0.002	1.24		0.005	1.63	
TAO	0.012	3.31	***	0.005	4.43	***	0.005	3.94	***	0.004	1.35	
DRUG	0.073	3.99	***	0.015	4.30	***	0.010	1.89	*	-0.018	-0.85	
NHIr	0.507	13.02	***	0.767	61.78	***	0.766	41.84	***	0.807	21.35	***
PxNo	0.062	1.94	*	0.191	6.53	***	0.229	6.25	***	0.252	3.01	***
Constant	-0.972	-1.01		-0.236	-0.46		-0.132	-0.23		-1.136	-0.90	
Obs	408			408			408			408		

Note: (1) Total monthly income (TMI) is in natural log.
(2) TCI, APF, EXAM, TAO, DRUG, NHIr, and PxNo are in natural log.
(3) 1, 5, and 10% levels of significance are denoted by ***, **, and *, respectively.

Table 6

Demorphic multi-variante effects between data set 1 and 2.

		Variantes									
		TPEb	PuMS	MMS	InMed	SuMed	LR	AGE	cWM	GED	fCPT
Data Set 1:	Baselines			XXX			XXX	(XX)		NA	
	q75	(XXX)	XXX	XXX			XXX		XXX	NA	(XXX
Data Set 2:	Baselines						XX		XXX		NA
	q75	(X)			(XX)	(XX)	XXX		XXX	XXX	NA

Note: X denotes a positive effect and (X) denotes a negative effect with significant level 10%.

XX denotes a positive effect and (XX) denotes a negative effect with significant level 5%.

XXX denotes a positive effect and (XXX) denotes a negative effect with significant level 1%.

Table 7
Internal competition scenarios vs. competition indexes

Scenarios		Variants							
		Weekly Shifts	wTS	ΔwTS	inCPT	ΔinCPT	fCPT	%ΔfCPT	Income impacts
A	Doctor 1	5	10	-	5	-	0.50	-	-
	Doctor 2	5	10	-	5	-	0.50	-	-
B	Doctor 1	6	11	1	5	0	0.45	-10%	8.3%
	Doctor 2	5	11	1	6	1	0.55	10%	-8.3%

Note: (1) ΔwTS, ΔinCPT, and %ΔfCPT indicate the differences of wTS, inCPT, and fCPT resulted from scenario A to B.
(2) Income impacts were calculated according to the results in the forth column of Table 2, in the regard of changes from scenario A to B.

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[2]Data were obtained from Taiwan Medical Association

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