The Elasticity of Demand for Ambulatory Care Services across Different Socioeconomic Status: Evidence from Taiwan

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Word count: 5,689
Table count: 3
Figure count: 2
Appendix table count: 5

Conflict of interest: none declared

Summary

The paper estimates the price elasticity of ambulatory care services, and explores the relationship between price elasticity and socioeconomic status (SES). The Taiwanese National Health Insurance (NHI) claim data and income tax files were used. Following a devastating earthquake in central Taiwan on September 21, 1999, the government exempted earthquake victims from cost-sharing obligations for one year when using the NHI services. The price change resulting from the implementation of the exemption policy served as an exogenous price reduction. To reduce possible endogenous concern of using individual victim status as group assignment, individual's residential status in earthquake affected areas was used. We employed difference-in-difference and intention-to-treat approaches for price elasticity estimation. The Coarsen Exact Matching method was applied to match the treatment (quake area residents) and the control (non-quake areas residents) groups. It finds that on average, the price elasticity of demand for ambulatory care services in Taiwan was -0.22 for both number of visits and expenditure. The price elasticity did not vary significantly by SES. The significant negative price elasticity suggests that demand-side cost sharing can help to control ambulatory care utilization in Taiwan.

JEL classification: C33; I13

Key words: Price elasticity of demand; Ambulatory care services; Intention to treat; Socioeconomic status; Taiwanese National Health Insurance

1. Introduction

In the literature, the effect of patient cost sharing on demand for health care has been the subject of extensive theoretical and empirical analyses and of intense policy debate for decades (Manning *et al.* 1985; Manning *et al.* 1987; Schellhorn 2001; Van de Voorde *et al.* 2001; Wedig 1988). Of the numerous studies in this field, the Rand Health Insurance Experiment is most well known and provides authoritative evidence on the effects of cost sharing under experimental conditions (Manning *et al.* 1985; Manning *et al.* 1987; Van de Voorde *et al.* 2001). The results of the Rand experiment confirm that, relative to a zero out-of-pocket price, the 95% cost-sharing plan reduces average health expenditure by 31% and the probability of any medical use by 21.7%. The price elasticity of the demand for health services ranges from -0.2 to -0.1, which is significantly different from zero.

More recently, some experimental or quasi-experimental studies have continued to measure the price sensitivity of the demand for medical services in various developed or developing countries. Farbmacher and Winter (2013) observed price elasticity of demand for doctor visits in the young male population is -0.06 to -0.09 from a natural experiment that a per-quarter fee of €10 for a doctor visit was introduced in German in 2004. Kim et al. (2005) used a 1998 national survey to estimate the price elasticity of demand for ambulatory care utilization in South Korea. The price elasticity of demand for ambulatory care was -0.14. However, the study faced an endogeneity problem and lacked a comparison group. Only limited research is available in Asian societies with universal health insurance coverage. As many countries in Asia are moving towards universal coverage or reforming their national health insurance programs, the tradeoff between moral hazard and risk pooling becomes critical. It is important to provide more relevant estimates of price elasticity of the demand for health care services, particularly for ambulatory care services. People in many Asian societies tend to have more frequent ambulatory care visits and ambulatory care services consumed a significantly higher proportion of health care dollars, relative to Western countries (Gauld *et al*. 2012). Therefore, this study first aimed to estimate price elasticity of demand for ambulatory care services in Taiwan, a typical Asian society with universal insurance coverage.

A second objective of this paper is to evaluate how price elasticity of demand for ambulatory care services varies by the individual's socioeconomic status (SES). The proponents of patient cost sharing maintain that cost sharing reduces unnecessary care, while opponents argue that cost sharing is a barrier to needed care. Vulnerable subpopulations, such as those with lower incomes, may be at a higher risk. Knowledge of how people at different SES levels respond differently to a price change has important implications for health policy makers during this era of increasing cost sharing. Studies of the relationship between co-payment effects and SES are often not feasible because of the unavailability of data on household income or other appropriate SES measures. The Rand experiment suggests that price responsiveness is not significantly higher for low-income groups than for high-income groups, except for ambulatory care visits, although the magnitude is small (Manning *et al.* 1987). Some recent non-experimental findings have suggested that the poor may be more price sensitive than the rich for ambulatory care visits (Ching 1995; Kim *et al.* 2005; Kupor *et al.* 1995; Sauerborn *et al.* 1994), but the others have suggested that price responsiveness may be similar among higher and lower income enrollees (Bratt *et al.* 2002; Cherkin *et al.* 1992; Cockx/Brasseur 2003). In our study, we explored the relationship between income and the price elasticity of demand for ambulatory care services in Taiwan.

In this context, our study exploits a natural experiment that is able to cope with the above methodological challenges and thus provides more reliable estimates for the price elasticity of demand for ambulatory care services. On September 21, 1999, a devastating earthquake hit central Taiwan. The epicentre was at the Jiji town of the Nantou in central Taiwan. According to the official statistics, the earthquake left more than 2,415 people dead, 11,305 people injured, 105,479 homes destroyed, and hundreds of medical facilities damaged.[1] Due to the scale of the earthquake, the entire region and population of Taiwan were affected by the earthquake. But areas surrounding the epicentre in central Taiwan suffered more severely than the rest of Taiwan. According to the level of human casualties, facility damages, and financial losses, the central government administratively announced the 28 most severely hit districts/cities/counties in Taiwan as official earthquake disastrous areas (hereafter "quake areas")[2]. The Ministry of Interior defined individuals according to two criteria: physical injuries and financial losses. "Earthquake victims" were defined as individuals who were severely physically injured due to the earthquake, or individuals with any co-residing family member who died or injured, or individuals who had a large financial loss such as housing damages. Proofs for physical injuries including professional diagnostic reports from physicians, or for financial losses including official certificates from local authorities were needed to be eligible.

The co-payment exemption policy for the National Health Insurance (NHI) program was one important earthquake relief intervention by the government. The Bureau of National

[1] National Fire Agency, Ministry of Interior, Taiwan (2011). The annual statistics of natural disasters. Retrieved 27 July, 2014 from http://www.nfa.gov.tw/Show.aspx?MID=1024&UID=1029&PID=1024.

[2] The 921 Earthquake Relief Foundation. 2009. Subsidy plans for investigation of community renewal projects in 921 earthquake affected areas. Retrieved 18 September, 2014 from http://www.taiwan921.lib.ntu.edu.tw/4.html.

Health Insurance distributed quake-cards to earthquake victims through its regional branches in Taiwan and temporary posts throughout the “quake areas”. Quake card exempted people from co-payment associated with the NHI services. We then used the 1999 Taiwan earthquake as a natural experiment and adopted the approach of intention-to-treat (ITT) (Montori/Guyatt 2001) to compare the effects of the price reduction on ambulatory utilization following the earthquake between people living in earthquake-afflicted and non-earthquake afflicted areas. The changes in utilization and prices between the pre- and during the copayment exemption policy for the two groups were used in estimating price elasticity. In addition, as the NHI program covers ambulatory care services and has relatively comprehensive databases, Taiwan serves as a suitable setting for studying the effects of patient cost sharing on ambulatory utilization.

This paper is organized as follows. The following section describes the Taiwan’s health care system and the NHI co-payment exemption policy following the 1999 earthquake. Section 3 describes the data and estimation. Section 4 presents the results. A discussions and concluding remarks form the final section.

2. Institutional background

2.1 Taiwan’s NHI Program

Implemented in 1995, the NHI program provides mandatory universal health care coverage to all Taiwanese residents. The enrolment rate of the NHI program gradually increased from 94.2% in 1998 to 97.1% in 2002. The comprehensive benefits package includes ambulatory care, inpatient services, dental services, Chinese medical services and prescription drugs. In the year of 2000, the average NHI claim amount per ambulatory visit was NTD 587 (average currency exchange rate during the study period: NTD/USD = 32.967)[3].

Under the NHI program in Taiwan, individuals need to pay out of pocket (OOP) for registration fees and co-payments when they use ambulatory care services. Registration fees are paid on a per-visit basis and covers administrative costs of providers. There is no specific regulation on registration fees in Taiwan. Generally, the registration fee ranged from NT$100 to NT$200. The registration fees did not vary among different income levels. According to the information available in the 2005 National Health Interview Survey (NHIS) in Taiwan, the most commonly charged registration fee was NT$100, and it was used as our estimate of the registration fee in this study when computing OOP. [4]

In addition to registration fees, in 1999 for ambulatory visits to Western medical practitioners, beneficiaries needed to pay co-payments of NT$50 for a clinic visit or an outpatient visit to district hospitals, NT$100 for an outpatient visit to a regional hospital, and NT$150 for an outpatient visit to a medical centre. In August, 1999, the Bureau of National Health Insurance instituted a new co-payment policy on prescription drugs and high services users in ambulatory care setting (Lin/ 2009). Prior to this policy, no co-payment was charged for prescription drugs in ambulatory care setting. Since August, 1999, when total medication expenditure per visit exceeded NT$100, an additional NT$20 was charged for every incremental increase of NT$100 medication expenses. The maximum prescription drug co-payment per visit was NT$100. Furthermore, also since August, 1999,

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[3]The exchange rate varied substantially during the study period (2000-2002), the annual average American Dollar (USD) cash rates for different year were 32.266 in 1999, 31.225 in 2000, 33.800 in 2001 and 34.575 in 2002.

[4] Descriptive statistics of registration Fee (NT$) for ambulatory services from 2005 National Health Interview Survey in Taiwan: mode (NT$ 100), median (NT$ 100), and mean (NT$ 87.7).

the NHI enrollees were required to pay additional NT$50 per visit after their 25th visits and additional NT$100 after the 157th visits in one year. The prescription drug and high user co-payment policy was implemented to all enrollees, regardless where they lived in Taiwan. Some subgroups of Taiwan population are exempted from NHI co-payments include individuals whose income below the national poverty line and those who are veterans or their dependents. Since these individuals who are regularly exempted from copayment, they were excluded from this sample.

Furthermore, there was only one other major policy change in physician payment during the study period, which was the separation policy of prescribing and dispensing authorities for physicians practicing in local clinics or physician offices (Liu *et al.* 2012). The separation policy was instituted in March 1997 and expanded incrementally to all local physicians throughout Taiwan over four years. However, this separation policy may not have impacts on out-of-pocket prices of patients (Chou *et al.* 2003). No significant change in registration fees was observed during the study period.

2.2 The NHI Co-payment Exemption Policy following the 1999 Taiwan Earthquake

Immediately after the earthquake on September 21, 1999, the tremendous infrastructural damage and the financial losses in the aftermath severely impeded access to medical services. In response to the situation, the Taiwan's Bureau of National Health Insurance (BNHI) implemented a copayment exemption policy on October 1, 1999. The policy issued quake cards to people who were "earthquake victims" regardless whether they lived in "quake areas." The policy exempted quake card recipients from NHI cost sharing associated with NHI services. The co-payment exemption policy for ambulatory care services expired in September, 2000, but quake card recipients continue to be exempted for patient cost sharing associated with inpatient services until a year later. The content and implementation details of the exemption policies for ambulatory care and inpatient care are different. Different study designs may be needed for evaluating price effects of ambulatory care and inpatient care. Our study only focused on ambulatory care. Figure 1 shows the timeline of the copayment exemption policy for ambulatory care services.

(Insert Figure 1 here)

3. Methodology

3.1 Data and variables

The main data sources were the NHI sample files, the 1998-2000 income-tax files, the household registry, and death certificates. The NHI sample files, constructed and managed by the NHRI, contains comprehensive enrollment and utilization information on a nationally representative sample of 100,000 NHI enrollees out of a population of 21,400,826 enrollees throughout Taiwan in 1996-2000 . The NHI sample files include the longitudinal NHI claims data, the enrollment files, the earthquake victims file, and the major disease/illness files at the individual level over 1998 to 2002.

The primary outcome measures of interest were the number of visits and total expenditure per person per quarter for ambulatory care services. The NHI program covers all medically necessary services for western medicine such as consultation, diagnostic and laboratory services, prescription medication, and treatment procedures. Therefore, specific types of expenditure (diagnosis fees, treatment fees, and prescribing drug fees) per person per quarter for ambulatory care services were also analyzed. Data of demographic characteristics (age, sex, and aborigine), health status (disabled and catastrophic illness status) and pre-quake inpatient utilization were obtained from the NHI sample files. Information on level of urbanization and administration region of individual's residential towns was collected from the household registry.

Our analyses defined out-of-pocket (OOP) payment per person per quarter as the sum of registration fee and NHI co-payments. The NHI co-payment was obtained from the NHI claims data. Due to the lack of data on registration fee charged by individual providers, we computed our estimate of registration fee, NT$100, according to the information available in the 2005 National Health Interview Survey (NHIS) in Taiwan. The survey indicates that the most commonly charged registration fee for ambulatory care visits was NT$100. Sensitivity analyses were also conducted for different values of registration fee (i.e. the mean of registration fees obtained from the NHIS, NT$87.7). The results remained robust (Table A3).

The income tax-return files covering the years 1998-2000, managed by the Ministry of Finance, were also linked to provide taxable income information on household incomes over the three-year period, the number and age of household members within each economic family unit. We defined the socioeconomic status (SES) as average per capita household income using a common equivalence scale proposed by Aronson et al. (1994) and Buhmann et al. (1988). Individuals were then grouped into tertiles: high, middle and low SES group. Of the sample subjects, about 19% did not file a tax return for all three years. The majority of these individuals were exempted from income tax mainly because the annual income was below the level at which tax returns are required. These individuals were categorized as the low SES group.

3.2 The sample

Of the randomly selected sample of 100,000 NHI beneficiaries, we excluded individuals who were regularly exempted from NHI co-payments. Those individuals who lacked identification information, complete household registration record or NHI enrollment record (n=16,676, 16.7%), who were regularly exempted from NHI co-payment (n=5,856, 5.66%), who died during the study period (n=1,655, 1.65%), or victims who lived outside the quake areas (n=239, 0.24%), were excluded. We excluded who died during the study period because they might have skewed health care utilization nearing the end of life (Chang *et al.* 2014). Due to few single buildings collapsed outside the quake areas resulting from the earthquake due to possible weak constructions, some people who lived outside the quake areas were physically injured and received quake cards. We excluded those individuals from our analysis to improve homogeneity of our control group. Sensitivity analyses of including the victims living outside the quake areas were conducted and the results remained stable. The final sample consisted of 79,076 individuals, hereafter "the study sample." The descriptive statistics of the study sample are reported in Table 1. The numbers, characteristics and ambulatory service utilization by exclusion categories are presented in Table A1.

(Insert Table 1 here)

3.3 Study design

We adopted a natural experimental design, complemented by longitudinal data to identify utilization changes due to a price change resulting from the co-payment exemption policy following an earthquake. A difference-in-difference methodology (Gruber 1994; Gruber et al. 1997) was applied. We compare the change (or difference) in the variable of interest (for example, health care utilization) before and after implementation of the policy (for example copayment exemption) in the experimental group to that of the control group. The policy exempted quake card recipients from the NHI cost-sharing obligations and directly faced an exogenous price change for ambulatory care services. However, using victims as the treatment group may be potentially endogenous because they might be correlated with unobservable variables that lead to high health care utilizations. Therefore, an intention-to-treat (ITT) approach was adopted (Montori/Guyatt 2001). Instead of using victim status as a random assignment, we used the event of the 921 earthquake as an exogenously assigned our sample into two groups: quake-area residents (the treatment group) and non-quake area residents (the control group). The *treatment group* was defined as the individuals who lived in quake areas regardless whether they were victims. The *control group* was referred to the individuals who lived outside the quake areas and who were not victims. This allows us to eliminate possible endogenous bias arising from using the victim as the main identification strategy. According to the 1999 Earthquake Relief Foundation in Taiwan, 28 out of 368 towns in Taiwan were defined as the quake areas. In the study sample (N=79,076), 8.2% (n=6,506) of people were quake area residents (i.e. the treatment group) and 91.8% (n=72,570) were non-quake area residents (i.e. the control group). Of the quake areas residents (n=6,506), 1,073 (16.5%) individuals were victims and 5,433 individuals (83.5%) were non-victims. Consequently, ITT approach might lead to an underestimation of the effect of copayment exemption policy. The results of the first stage of the ITT approach are presented in Table A2.

However, using everyone who lived outside the quake area as control may not be valid. First, it created a very large control group which may likely lead to significant findings. Second, not everyone in the control was similar to the treatment group. King *et al.* develop Coarsened Exact Matching (CEM) method for improving the estimation of causal effects by reducing imbalance in covariates between treatment and control groups (King *et al.* 2016). The idea of CEM is to temporarily coarsen each variable into substantively meaningful groups (strata), exact match on these coarsened data and then only retain the original (coarsened) values of the matched data. The CEM bounds the maximum imbalance between the treatment and control groups in some feature of the empirical distributions through the coarsening. As the coarsening on any variable becomes finer (the strata becomes more narrow), the bound on the maximum imbalance on the moments of that variable becomes tighter. CEM also meets the congruence principle, is robust to measurement error, and automatically restricts the matched data to areas of common empirical support (King/Zen 2006). The comprehensive overall imbalance is measured by the L1 statistic (Iacus *et al.* 2012). Perfect overall balance is indicated by L1 = 0, and larger values indicate larger imbalance between the treatment and control group, with L1 = 1 indicating complete separation. The overall L1 statistic measure included imbalance with respect to the full joint distribution, including all interactions, of the covariates.

The CEM method was applied, and matched 3,713 quake area residents (the treatment group) with 10,024 non-quake area residents (the control group) to yield two comparable groups for analyses. The overall L1 statistic (0.5142) in Table 1 indicates that CEM produced a good match and substantially reduced imbalance not only in the means, but also in the quantile distributions and joint distributions of variables of the two groups (Table 1 and Table A3). The covariates included in the matching were demographic characteristics (age, sex and aborigine or not), disability status, levels of urbanization and administrative region of individual's residential location (whether central branch of BNHI), and were all measured in the beginning of the year 1999. The only variable measured in 1998 was the number of ambulatory care visits. The descriptive statistics and the sample size of the CEM sample are also reported in Table 1.

3.4 Econometric approach

To estimate utilization responses to the co-payment exemption policy following the 1999 Taiwan earthquake, we used a DD methodology. The empirical estimation was run on the CEM matched sample. We specified a reduced form of health care utilization as a function of individual-level time-invariant variables, policy intervention and time trend. This can be represented as follows:

$$\begin{aligned} Y_{it} &= \alpha_0 + \alpha_1 Pre_t + \alpha_2 Post_t + \theta Treated_i + \delta_1 Pre_t \times Treated_i + \delta_2 Post_t \times Treated_i \\ &\quad + \beta_1 trend_t + \beta_2 season_t + \gamma X_i + u_i + \varepsilon_{it} \end{aligned} \tag{1}$$

where y_{it} is the ambulatory care utilization for person i at time t. Pre_t and $Post_t$ indicate pre- and post- the period of copayment exemption. The utilization data at the individual level spans 1998-2002 covering the pre- copayment exemption period (the years 1998 and 1999), during (the year 2000), and post- copayment exemption period (the years 2001 and 2002). In the empirical estimation, we included first and second quarters of each year for the following reasons: First, the third quarter of the year 1999 was not included because the earthquake occurred in September 1999. The 3rd quarter of the year 2000 was also excluded in order to reduce possible behavioral response by the patients in expectation of the end of co-payment exemption (the co-payment ended on September 30, 2000). Secondly, in order to minimize possible immediate transition effect following the 921 earthquake on utilization, the first three months of the exemption policy (October, November and December 1999, the fourth quarter of 1999) was excluded for analyses. To remove possible seasonal influences, we kept only the first and second quarters of the years 1998, 1999, and 2000 for the analyses. Results of the sensitivity analyses for different length of periods are presented in the Table A4. The results were relatively robust.

The pre and no exemption period included the first and second quarters of the years 1998 and 1999 (Pre_t =1, 0: otherwise). The during-exemption period included the first and second quarters of the year 2000. The post and no exemption period included the first and second quarters of the years 2001 and 2002 ($Post_t$ =1, 0: otherwise). $Treated_i$ is a dummy variable equal to 1 if person was in the treatment group, 0 otherwise (the control group). X_i is a vector of individual specific time-invariant characteristics measured in 1999 including age, age squared, sex (women was the reference group), disabled (non disabled was the reference group), socioeconomic status (high, middle and low SES, high SES was the reference group) and urbanization of residential township (high, middle and low urbanization, high urbanization was the reference group). We regrouped seven urbanization levels of township as three levels: high (including high and moderate urbanization, the reference group), middle (including new developed and ordinary urbanization) and low (including ageing and agriculture society and remote areas) urbanization.

The models also were controlled for time trend ($trend_t$) and season fixed effects ($season_t$) simultaneously. The u_i represents the individual specific and time-invariant random error component, assumed to be drawn from a distribution with mean zero and constant variance. ε_{it} is a classical mean zero disturbance, assumed to be distributed as $N(0,\sigma_\varepsilon^2)$ and is assumed to be uncorrelated with x_i and the individual specific effect, u_i.

In the present study, the NHI copayment exemption was regarded as policy intervention, i.e. “price reduction.” The utilization of the two groups in 1998 and 1998 (pre-intervention period) was used to assess whether the important parallel assumption of DD was satisfied.

The DD estimates of the effects of the exemption policy were captured by the coefficients of the interaction terms, δ_1. We expected δ_1 to be negative because a decrease in the price of health care leads to an increase in demand of health care.

To model health care utilization, we used a hurdle model for number of visits and a two-part model for expenditure. The hurdle model combined the logit model as the first part to estimate the probability of visiting doctors (y>0|x) and the truncated negative binominal model (y|x, y>0) with mean dispersion for non-zero number of visits as the second part. For the expenditure, the second part of the model we regressed the log-transformed non-zero expenses on a set of covariates as shown in Equation 1. The predicted non-zero expenditure was retransformed using the Duan's smearing estimator (Duan *et al.* 1983). The objective of estimation is prediction of y|x equal to the product of the probability of positive use and the conditional mean of the zero-truncated density, (y>0|x)×(y|x, y>0). All models were estimated by fixed-effect model with robust standard errors to capture individual-specific effects. Hausman specification tests were conducted and failed to reject equality of the coefficients between the two estimates of time-varying covariates from fixed and random effect models. The fixed effect estimator remained consistent. Therefore, we estimated equation (1) by fixed effect models.

To investigate the differential effects among different socioeconomic groups, we conducted stratification analyses for high, middle and low socioeconomic group. The price elasticity was computed as the percentage change in demand for *predicted utilization E(y|x)* divided by the percentage change in the amount of out-of-pocket payment (OOP) on the matched sample. The percentage change of demand is calculated as the difference in predicted ambulatory utilization between the pre and during exemption periods of the treatment group minus the difference of the control group, and then divided by predicted utilization of the treatment group and multiply by 100. Similar algorithm was applied to calculate the percentage change of OOP.

3.5 Robustness Checks

For the DD methodology to be valid, two assumptions need to be satisfied. First, the experiment – random group assignment – is exogenous. In other words, the treatment group – the people lived in quake areas – should be exogenously assigned, and there should not be any systematic relationship that is unobservable or uncontrolled for between the treatment and control groups and the growth of the dependent variables of interest (i.e. health care utilization in the present study). We examined the extent to which this assumption was satisfied. The trends in average utilization per quarter pre exemption using the CEM sample were examined and found that the pre-exemption trends were similar for the treatment and control groups. In particular, a t–test was conducted for the difference in average pre-exemption utilization growth rate (i.e. number of visits) between the treated (-0.534%) and control groups (-0.087%, |t|=0.30, two-tailed p-value=0.7677). The average pre-exemption expenditure growth rates were 2.92% and 5.47% for treatment and control groups (|t|=1.20, two-tailed p-value=0.229). We also had tested interaction term of treatment status and trend and the interaction term was not statistically significant (See Table A5). The results confirm that there was no systematic relationship that is unobservable or uncontrolled for between the treatment and control groups, and assure the validity of the DD methodology.

The second assumption is that the trends in uncontrolled factors should be similar for the treated and control individuals across the period of policy. These factors, such as supply-side policies, technological changes or supply-side markets, might confound the effect of exemption. However, during the study period, there is no evidence that these uncontrolled factors had influenced health care utilization of the people living in the quake areas (the treatment group) and those living outside the quake areas (the control group) differently.

4. Results

Figure 2 presents the trend of ambulatory service utilization of the study sample (N=79,076) throughout the study periods by whether quake area residents or not and by whether victims or not. It shows a sizeable increase in the utilization of the victims during the copayment exemption periods. The utilization for quake area residents throughout the exemption periods was also higher than that for non-victims and non-quake area residents, but not as the magnitude of increase was not as large as victims. It thus is plausible that ITT approach using quake area residents as a random assignment might lead to an underestimation of the effect of copayment exemption policy on the utilization.

(Insert Figure 2 here)

Table 2 presents the first and second part regression of utilization for the CEM sample of equation (1). In the first part regression, the δ_1 was negative but insignificant at the 5% level in all utilization. But in the second part regression, it was negative and significant at the 5% level in number of visits and diagnosis expenditure. These results indicate that the copayment exemption policy was associated with an increase in ambulatory utilization in the treatment group. With respect to the covariates, low SES group was more likely to visit doctors, but had less likely to have positive expenditure than the high SES group. Compared to individuals inhabiting high urbanization areas, those inhabiting low urbanization areas had higher number of visits, but lower positive expenditure. Generally, men had low utilization than women, and individuals with disabled status had higher utilization than the counterparts. We also found that positive time trend for all types of expenditure but negative time trend in total number of visits.

(Insert Table 2 here)

Table 3 reported the estimated results on the Coarsen Exact Matching sample (N=13,737). The estimated price elasticity is -0.218 for total number of visits, indicating that a 10% decrease in the OOP price causes the number of visit of the beneficiary to increase by 2.18%. Moreover, the price elasticity for total expenditure, drug, treatment, and diagnosis expenditure for ambulatory care were -0.22, -0.11, -0.15, and -0.29, respectively. The results reveal that diagnosis expenditure and total expenditure were more responsive to price change than drug and treatment expenditure. The price elasticity for number of visits did not vary significantly by SES. The poor were only slightly more responsive to a price change of ambulatory care services than the rich (-0.217 in low SES vs. -0.206 in high SES). It was the middle SES group (-0.226) had the largest response. In contrast, a negative relationship between price elasticity for expenditures and SES were observed. The low SES group (-0.244) had the largest price elasticity for expenditures, followed by the middle SES (-0.225), and lastly by the high SES (-0.195). However, the differences were somewhat minor.

(Insert Table 3 here)

5. Discussion and concluding remarks

This study analyzed how the co-payment exemption policy following the 1999 Taiwan earthquake influenced ambulatory care utilization in Taiwan. We proposed a DD and intention-to-treat methodology to estimate the effects of the price decrease (the implementation of the copayment exemption policy) on the demand of ambulatory care services and examined how price elasticity of demand is related to income level.

The main results are that the price decrease resulting from the co-payment exemption policy did significantly increase the ambulatory utilization for people living in the quake areas, relative to the people in non-quake areas, after controlling for individual time-invariant characteristics, time trend and season effects. The price elasticity of demand for ambulatory care services in Taiwan was -0.22 for both total number of visits and total expenditure, which are within the range (-0.14 to -0.39) observed in the previous literature (e.g. Manning *et al*. 1987; van de Voorde *et al.* 2001; Wedig 1988). The price elasticity for drug, treatment procedures, and diagnosis were -0.109, -0.154, -0.294, respectively.

The estimates we observed in Taiwan were higher than the price elasticity of demand for ambulatory utilization in Korea reported by Kim et al. (2005) (-0.14). Different study design may be one main explanation. The Korean estimates were based on a cross-sectional design and lacked of an exogenous price change. Our natural experimental design with an exogenous price change ought to provide a less biased and more reliable estimate. Our results may imply that patient cost sharing may function well in reducing ambulatory utilization in Taiwan. The higher price elasticity for ambulatory care services suggests a possibility of greater risk of moral hazard with free access to ambulatory care services. Hence, cost sharing may become an essential part of the insurance package in order to reduce the moral hazard but without imposing a financial burden on patients.

More importantly, similar to the Rand Health Insurance Experiment, we found no significant difference in price elasticity across people with different income levels. It implies that the poor are not more sensitive to price changes than the rich under the NHI program in Taiwan where there is a relatively low copayment for ambulatory care services (based on our data, 8% of total ambulatory expenditure). One explanation may be that the observed difference in ambulatory care utilization among different income groups may result from a mixed effect of income and other variables correlated with income. The complex interplay among utilization, price and income may require further investigation.

The policy implications of our results have to be drawn with some caution. Firstly, compared to the randomized controlled experimental design, our quasi-experimental design with the use of an exogenous change may still not have worked as well as randomization. If the policy change is correlated to the error term, our estimates may be biased. For instance, the unmeasured differences in changes in market characteristics (e.g. provider competition) between quake areas and non-quake areas during the study period may influence our results. Although we have controlled for such differences by including urbanization fixed effects, we cannot fully rule out such possibility. Secondly, although no major change in price for ambulatory services of Western medicine during the study period, there might still be some potential sources of bias from supply-side interventions, which may correlate with both the policy and outcomes of interests. One example is the separation policy implemented to remove dispensing authorities from physicians in order to combat increasing drug expenditure. The policy was implemented on 1 March 1997 and phased in over 4 years. The physicians practicing in local clinics or physician offices can no longer dispense medications in their practice or they need to hire a pharmacist onsite to dispense medications (Chou *et al.* 2003; Liu *et al.* 2012). However, this intervention only affected physicians who practiced in clinics or physician offices since hospitals have long had a pharmacy department and hospital physicians have only been responsible for prescribing. The empirical findings indicate that the separation policy did significantly reduced drug expenditure and affected prescription behavior, but no significant reduction was observed for total health expenditure (Chou *et al.* 2003). As clinical decision is always a joint decision between patients and physicians, it may be possible that the concurrent supply-side intervention may influence physician's prescribing behavior and as a result, reduce the drug utilization and the possible reduction in drug expenditure. This may lead to an underestimate of the price elasticity. The true estimate may be larger than what we observed in this study.

Thirdly, several data limitations should be noted and these are (1) the household economic unit for tax purposes is not necessarily the same as the co-resident household unit and (2) some individuals belonging to low incomes who file an income tax return may be exempted from income tax. This does not mean that their income is below the minimum income filing requirement. Fourthly, although the two-part calculation of expenditure is used as a standard recently, we acknowledge that there is still an ongoing discussion on its pros and cons (Jones 2000; Angrist/Pischke 2009). Some literature suggests that the use of two-part models need to be cautious. Since, similar to the Rand trial, we were interested in predictions of $E(y \mid x)$ from $E(y \mid x)=p(y>0 \mid x)E(y \mid y>0,x)$, not the coefficients *per se*, the use of two-part model in this context is appropriate.

In summary, our results report price elasticity of ambulatory care services in Taiwan, a typical Asian society where people are comprehensively covered by a universal health insurance and rely frequently on ambulatory care services. More importantly, our results demonstrate that price elasticity of ambulatory care does not vary significantly by income level. Hence, policy makers may be able to institute cost sharing to reduce moral hazard and to address efficiency concern without worrying about potential equity concerns. The study results can serve as an important reference for policy makers in considering cost-sharing mechanism as a potential policy tool in reducing demand-side inefficiency in ambulatory utilization.

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Figure 1: Timeline of the NHI copayment exemption policy for ambulatory care services

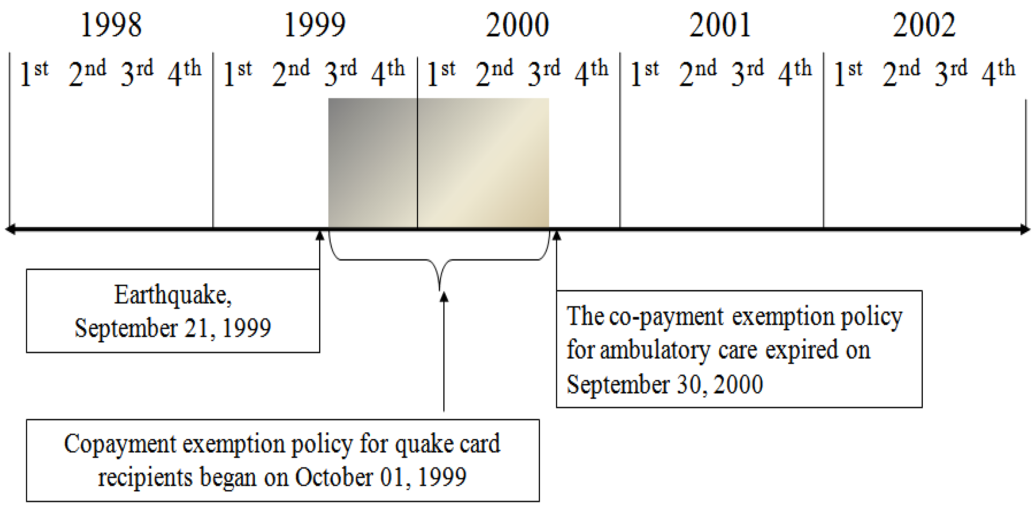
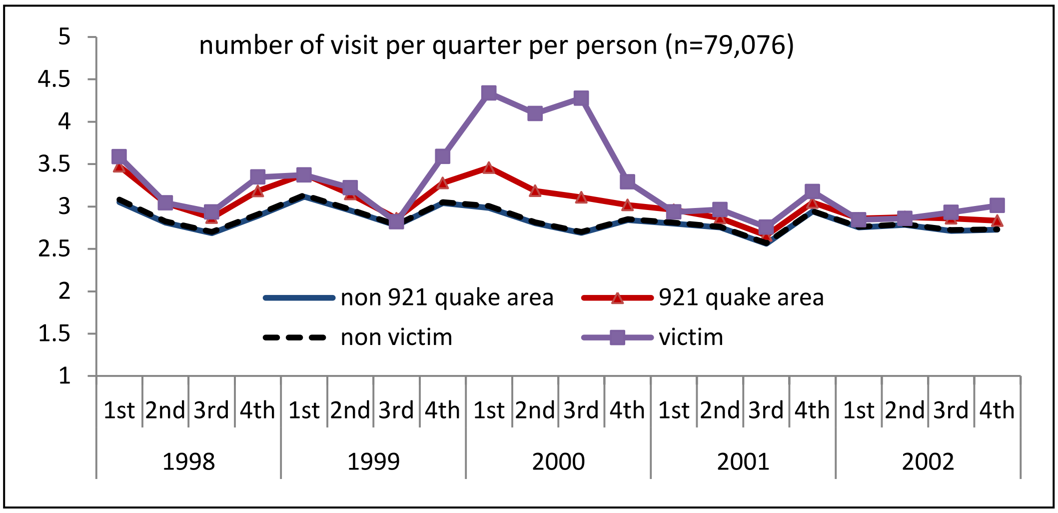
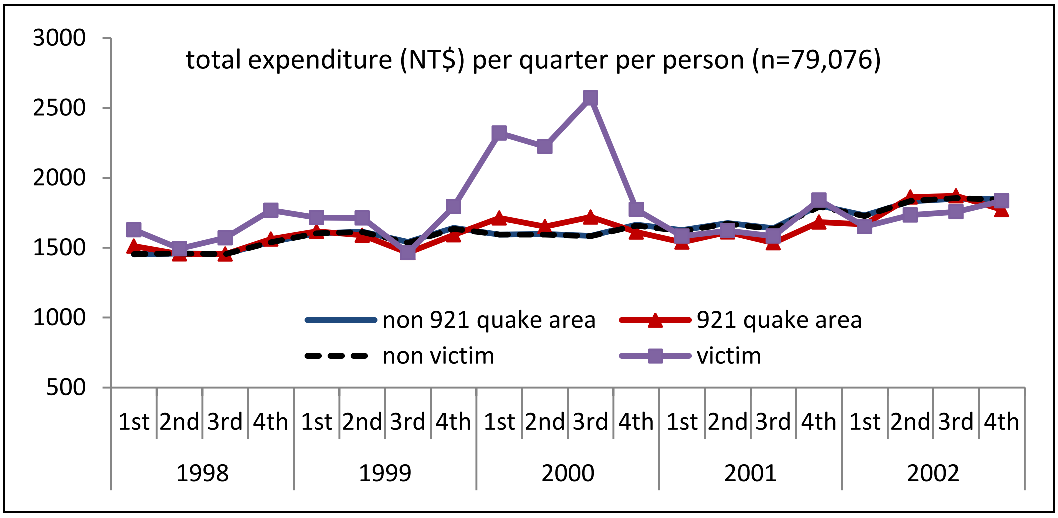


Figure 2: Utilization of ambulatory care per quarter per person among the study sample

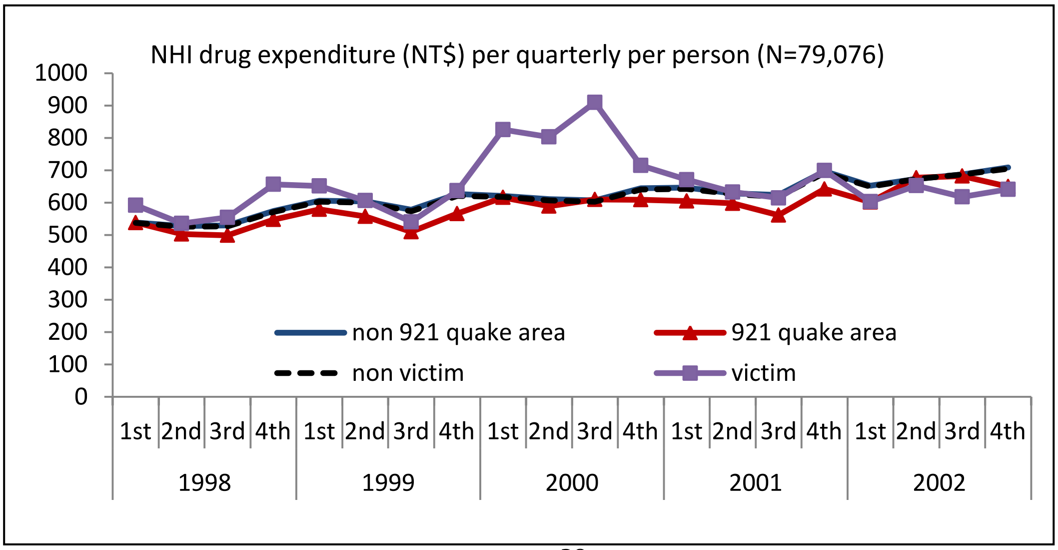
(1) Number of visits



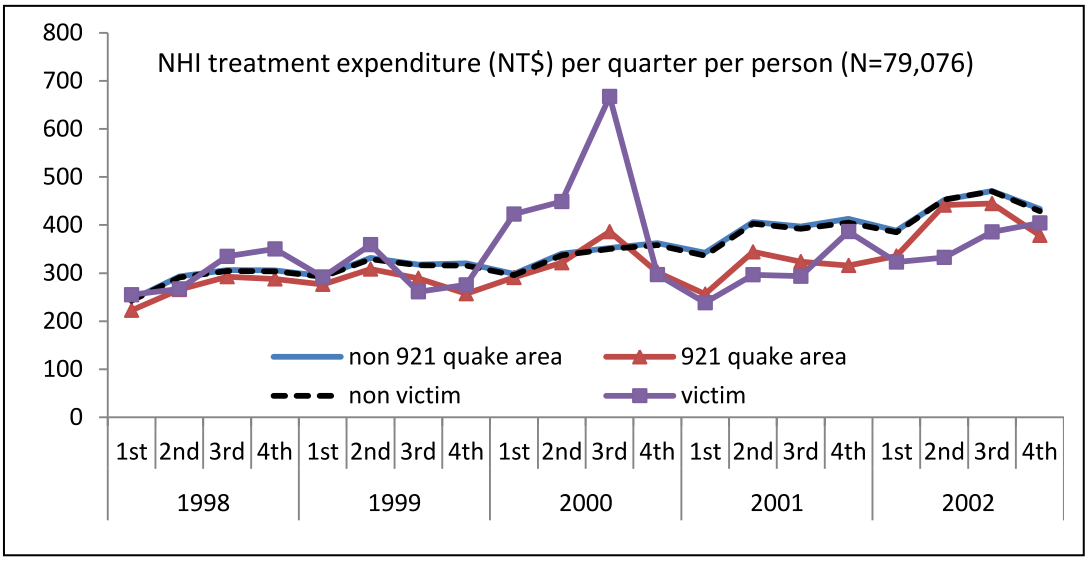
(2) Total expenditure (NT$)



(3) Drug expenditure (NT$)



(4) Treatment expenditure (NT$)



(5) Diagnosis expenditure (NT$)

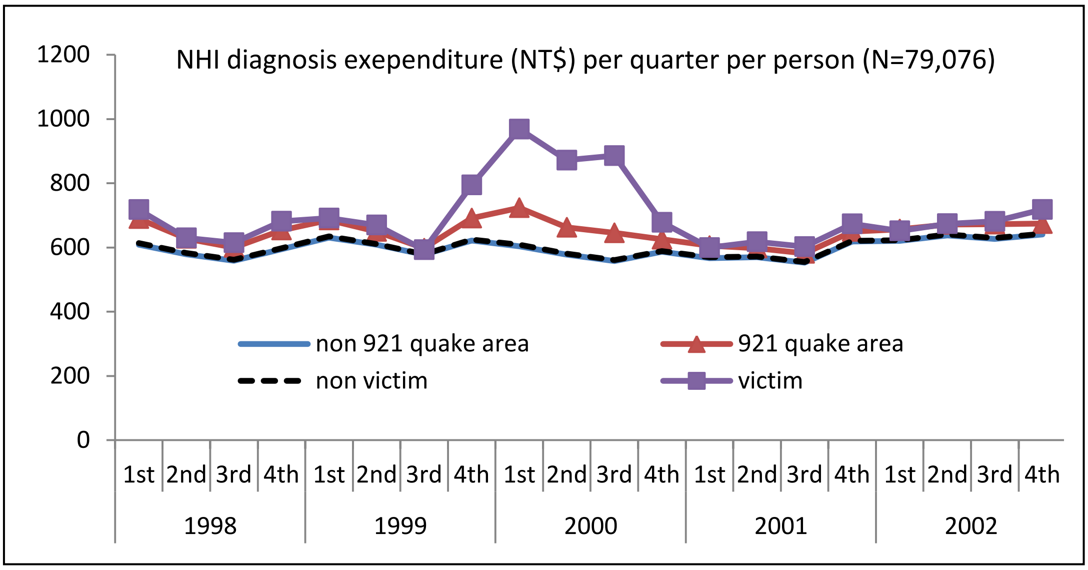


Table 1: Variables and mean values of the study sample and Coarsened Exact matching sample

Independent Variable Name	Definition	Data source	Study sample N= 79,076		Coarsened Exact matching N= 13,737	
			Mean	Standard Deviation	Mean	Standard Deviation
Age	Individuals age in years	A	32.32	19.84	30.00	16.73
Men	Dummy = 1 if men, 0 if women	A	0.50	0.50	0.52	0.50
Aborigine	Dummy = 1 if aborigines	C	0.02	0.13	0	0
Disabled	Dummy = 1 if disabled	A	0.04	0.19	0.002	0.05
SES, Social economic status		B				
SES_high	Dummy = 1, High SES, if 60-100 percentile of household income		0.35	0.48	0.26	0.44
SES1	Dummy = 1 if 80-100 percentile of household income		0.18	0.38	0.11	0.32
SES2	Dummy = 1 if 60-80 percentile of household income		0.18	0.38	0.14	0.35
SES_mid	Dummy = 1, Middle SES, if 20-60 percentile of household income		0.35	0.48	0.38	0.49
SES3	Dummy = 1 if 40-60 percentile of household income		0.18	0.38	0.19	0.39
SES4	Dummy = 1 if 20-40 percentile of household income		0.17	0.38	0.20	0.40
SES_low	Dummy = 1, Low SES, if 0-20 percentile of household income		0.30	0.46	0.36	0.48
SES5	Dummy = 1 if 0-20 percentile of household income and those who did not file a tax return		0.30	0.46	0.36	0.48
Urban, Urbanization of resident town		C				
City_high	Dummy = 1 if individuals lived in high and moderate level of urbanization		0.51	0.50	0.22	0.41
Urban1	Dummy =1 if high urbanization		0.23	0.42	0	0
Urban2	Dummy =1 if moderate urbanization		0.29	0.45	0.22	0.41
City_mid	Dummy = 1 if individuals lived in middle level of urbanization		0.37	0.48	0.68	0.46
Urban3	Dummy =1 if new developed urbanization		0.21	0.41	0.32	0.47
Urban4	Dummy =1 if ordinary urbanization		0.16	0.37	0.36	0.48
City_low	Dummy = 1 if individuals lived in low level of urbanization		0.12	0.32	0.10	0.30
Urban5	Dummy =1 if ageing society		0.03	0.16	0	0
Urban6	Dummy =1 if agriculture society		0.05	0.21	0.04	0.20
Urban7	Dummy =1 if remote areas		0.04	0.20	0.06	0.23
Opd98	Annual number of visit in 1998 of the individual	A	6.21	9.27	4.50	7.32
Cen_Branch	Dummy = 1 if individuals lived in towns within the central branch of BNHI	C	0.20	0.31	0.88	0.32

Coarsened Exact matching report: Multivariate L1 distance: 0.51421576

Univariate imbalance	L1	mean	min	25%	50%	75%	Max
Age	.04058	.05418	0	0	0	0	0
Men	9.2e-16	1.4e-15	0	0	0	0	0
Aborigine	0	0	0	0	0	0	0
SES	7.2e-15	-3.5e-14	0	0	0	0	0
Disable	6.5e-17	2.4e-17	0	0	0	0	0
Urban	5.9e-15	-2.3e-14	0	0	0	0	0
Opd98	0.01351	0.00851	0	0	0	0	0
Cen_branch	8.5e-15	-1.7e-14	0	0	0	0	0

Notes: 1. All independent variables were measured in the beginning of the year 1999, except for Opd98.
2. Data sources: A: the NHI sample, B: income tax files, C: household registry file.

Table 3: Price elasticity of demand for ambulatory services by socioeconomic status among the Coarsen Exact Matched sample (N=13,737)

	Total number of visits	Total expenditure	Drug fee	Treatment fee	Diagnosis fee
Registration fee = NT$100					
Total sample	− 0.218	− 0.222	− 0.109	− 0.154	− 0.294
	(0.034)	(0.034)	(0.034)	(0.032)	(0.039)
High SES	− 0.206	− 0.195	− 0.090	− 0.134	− 0.259
	(0.057)	(0.059)	(0.063)	(0.058)	(0.065)
Middle SES	− 0.226	− 0.224	− 0.109	− 0.151	− 0.294
	(0.053)	(0.051)	(0.049)	(0.050)	(0.062)
Low SES	− 0.217	− 0.244	− 0.125	− 0.173	− 0.323
	(0.060)	(0.062)	(0.059)	(0.057)	(0.074)

Notes:

1. Estimated according to specification (1) for the Coarsen Exact Matched sample (N=13,737).
2. Registration fee was set as NT$100.
3. Copay exemption periods: 1st, 2nd quarters of 2000; copay periods: 1st, 2nd quarters of 1998 and 1999.
4. Treated group: quake area residents n = 3,713, control group: non-quake area and non-victim n = 10,024, weighted by coarsened exact matching weights.
5. Standard errors in parentheses. All estimates are statistically significant at 1% level.

Table 2: Estimation of two part model among the Coarsened Exact matching sample (N=13,737)

A: First part: Logistic regression

Variable	Description	Number of visits		Total expenditure		Drug fee		Treatment fee		Diagnosis fee	
		Coef.	S. E.	Coef.	S. E.	Coef.	S. E.	Coef.	S. E.	Coef.	S. E.
Pre×Treated	(δ_1)	-0.050	0.106	-0.022	0.036	-0.049	0.035	-0.058	0.037	-0.023	0.036
Post×Treated		-0.079	0.115	-0.060	0.036	-0.045	0.035	-0.003	0.037	-0.061	0.036
Treated	(=1 if quake area residents, reference group: non quake area residents and non victims)	0.061	0.913	0.023	0.027	0.051	0.029	-0.014	0.030	0.039	0.029
Period (Whether during exemption period or not, reference period: pre-exemption, 1^{st}, 2^{nd} quarters of 1998and 1999)											
During	(=1 if during exemption period, 1^{st}, 2^{nd} quarters of 2000)	-0.045	0.108	0.060*	0.026	0.076***	0.026	-0.105***	0.028	0.022*	0.027
Post	(=1 if post-exemption period, 1^{st}, 2^{nd} quarters of 2001 and 2002)	0.197	0.158	-0.121***	0.041	0.024	0.041	-0.274***	0.043	-0.121***	0.041
Age	(individual age)	0.095***	0.004	-0.073***	0.041	-0.074***	0.001	0.021***	0.001	-0.073***	0.001
Agesq	(individual age squared)	-0.001***	0.000	0.001	0.000	0.001	0.000	0.000	0.000	0.001***	0.000
Men	(=1 if men, reference group: women)	1.370***	0.072	-0.612***	0.012	-0.561***	0.011	-0.408***	0.012	-0.611***	0.012
Disable	(=1 id any disabled, reference group: non disabled)	-2.618	2.422	0.716***	0.168	0.664***	0.164	0.705***	0.151	0.717***	0.168
Urbanization (reference category: City_high, high urbanization)											
City_mid	(=1 if middle urbanization)	0.186***	0.049	-0.101***	0.014	-0.078***	0.014	-0.035*	0.015	-0.101***	0.014
City_low	(=1 if low urbanization)	0.489***	0.069	-0.296***	0.022	-0.299***	0.022	-0.135***	0.023	-0.296***	0.022
SES	(reference category: SES_high, high SES)										
SES_mid	(=1 if middle SES)	0.215**	0.070	-0.017	0.015	-0.006	0.015	0.039*	0.015	-0.018	0.015
SES_low	(=1 if low SES)	0.656***	0.066	-0.258***	0.015	-0.242***	0.015	-0.066***	0.016	-0.259***	0.015
Trend		-0.057***	0.012	0.025***	0.003	0.045	0.003	0.024***	0.003	0.025***	0.003
Season	(=1 if 2^{nd} season, reference season: 1^{st} season)	0.090	0.047	-0.084***	0.012	-0.011***	0.012	-0.045***	0.012	-0.083***	0.012
Constant		4.463*	1.918	-1.950*	0.494	0.074*	0.488	-4.865***	0.518	-1.943*	0.494

Table 2: (continue) Estimation of two part model among the Coarsened Exact matching sample (N=13,737)

B: Second part: General Linear Regression with Gamma family and log link

Variable	Description	Number of visits[a] Coef.	S. E.	Total expenditure Coef.	S. E.	Drug fee Coef.	S. E.	Treatment fee Coef.	S. E.	Diagnosis fee Coef.	S. E.
Pre×Treated	(δ_1)	-0.070*	0.030	-0.055	0.034	-0.013	0.048	0.003	0.088	-0.074***	0.019
Post×Treated		-0.118***	0.029	-0.067*	0.033	0.036	0.048	-0.157	0.087	-0.095***	0.019
Treated	(=1 if individual living in quake areas, reference group: non quake area residents and non victims)	0.102***	0.024	0.043	0.027	-0.023	0.039	0.007	0.071	0.108***	0.016
Period	(Whether during exemption period or not, reference period: pre-exemption)										
During	(=1 if during exemption period, 1st, 2nd quarters of 2000)	-0.043	0.029	-0.111***	0.025	-0.075*	0.036	-0.103**	0.066	-0.124***	0.015
Post	(=1 if post-exemption period, 1st, 2nd quarters of 2001 and 2002)	-0.068	0.045	-0.128***	0.039	-0.141**	0.056	-0.009	0.101	-0.159***	0.023
Age	(individual age)	-0.047***	0.001	-0.019***	0.001	-0.023***	0.001	0.013***	0.003	-0.033***	0.001
Agesq	(individual age squared)	0.001***	0.000	0.001***	0.000	0.001***	0.000	0.000	0.000	0.001***	0.000
Men	(=1 if men, reference group: women)	-0.123***	0.013	0.001	0.011	0.113***	0.016	0.042	0.030	-0.094***	0.006
Disable	(=1 id any disabled, reference group: non disabled)	0.277*	0.139	0.950***	0.138	0.900***	0.198	1.235***	0.309	0.275**	0.080
Urbanization	(reference category: City_high, high urbanization)										
City_mid	(=1 if middle urbanization)	-0.047***	0.013	-0.059***	0.013	-0.091***	0.019	-0.032	0.036	-0.050***	0.008
City_low	(=1 if low urbanization)	-0.107***	0.022	-0.108***	0.022	-0.169***	0.031	-0.026	0.056	-0.086***	0.013
SES	(reference category: SES_high, high SES)										
SES_mid	(=1 if middle income)	0.071**	0.016	0.026	0.014	0.002	0.020	-0.022	0.037	0.048***	0.008
SES_low	(=1 if low income)	0.016	0.016	0.011	0.014	-0.020	0.021	0.008	0.038	0.022*	0.008
Trend		0.001	0.004	0.014***	0.003	0.010*	0.004	0.020*	0.008	0.014***	0.002
Season	(=1 if 2nd season, reference season: 1st season)	-0.063***	0.013	0.0089	0.011	-0.023	0.016	0.158***	0.030	-0.036***	0.007
Constant		1.485**	0.563	5.343***	0.473	4.693***	0.681	2.907*	1.235	4.870***	0.274

Note: [a] We employed negative binominal distribution to fit number of visits.

Table A1: Numbers, characteristics and ambulatory service utilization by exclusion category

Exclusion Category	Number of individuals [a]	Number of individuals as % of NHI sample (N=100,000)	Characteristics		NHI utilization [b]				
			Men (%)	Age in 1999	Number of visit	Drug fee	Treat fee	Diagnosis fee	Total fee
A: The Study samples	79,076	79.1	44	29.4	4.5	422	2.6	909	1405
B: Lack of identification and household information	16,676	16.7	-	-	5.3	504	2.3	1052	1646
C: Individuals regularly exempted from NHI co-payment Low incomes	5,658	5.66	47	35.3	5.3	498	4.4	1109	1694
D: Individuals died between study periods (1998-2002)	1,655	1.65	56	66.6	6.7	612	10.6	1402	2130
E: Non quake area victims	239	0.24	44	27.5	4.9	453	2.6	992	1528

Notes: [a:] Total number of the NHI sample was 100,000 individuals. Sum of the number of each category is not equal to 100,000 because one individual can be assigned to more than one category among C, D and E category.

[b:] NHI outpatient quarterly utilization between 1^{st} and 2^{nd} quarters of 1998 and 1999. Unit of fee: NT$.

Table A2: The first stage of intention to treat approach: logistic regression of whether living in quake areas on victim status (n=79,076)

Independent Variables		Odds Ratio		95%	C.I.
	'Quake area residents' (=1, 0=non quake area residents)	12.97	***	10.88	15.48
Individual factors	Age	1.00		0.99	1.01
	Age squares	1.00		1.00	1.00
	Men (=1, 0=women)	0.96		0.85	1.08
	Aborigines	0.54		0.13	2.32
	Socioeconomic status (reference: Q5, 80-100 percentile)				
	Q4 (60-80 percentile)	0.94		0.74	1.18
	Q3 (40-60 percentile)	0.89		0.71	1.12
	Q2 (20-40 percentile)	0.93		0.74	1.16
	Q1 (0-20 percentile)	1.09		0.89	1.33
	Disable (=1, 0= without disabled)	1.25		0.88	1.77
	Annual number of visit of outpatient care in 1998	1.00		0.99	1.01
Area factors	Urbanization of residential areas(reference: high)				
	Middle	1.21	*	1.01	1.46
	Low	3.91	***	3.21	4.76
	Central branch of NHI	9.14	***	7.21	11.59
	Constant	0.00	***	0.00	0.00
	Log likelihood=－3978.06				
	LRchi2(14)=4806.01				

Notes:

1: Estimation for the equation (A-1) shown below. The IV regression model (A-1) and (A-2),

$$Victim_i = \beta_0 + \beta_1 quake\_area_i + \gamma X + \mu_i \quad \text{(A-1)}$$

$$Utilization_i = \delta_0 + \delta_1 Victim_i + \Phi X + \varepsilon_i \quad \text{(A-2)}$$

where Victim is an endogenous variable, X is a matrix of exogenous variables, 'quake_area' is an exogenous variable to be used as an instrument.

2: Variable description is shown in Table 1.

Table A3: Comparison of means of the treatment and control among the study sample and Coarsen Exact Matching sample

Variable [a]	Total sample (n=79,076)			Coarsen Exact Matching sample (n=13,737)		
	Control group (non quake area residents)	Treatment group (quake area residents)	Differences between means of treatment and control groups	Control group (non quake area residents)	Treatment group (quake area residents)	Differences between means of treatment and control groups
(N)	(72,570)	(6,506)		(10,024)	(3,713)	
	(A)	(B)	(C=A-B)	(D)	(E)	(F=D-E)
Age	33.15	32.69	0.46	29.96	30.02	-0.054
Men	0.50	0.50	-0.01	0.53	0.53	0.000
Aborigine	0.01	0.00	0.01	0.00	0.00	0.000
Disabled	0.06	0.05	0.00	0.00	0.00	0.000
SES_high	0.36	0.29	0.07	0.25	0.25	0.000
SES1	0.18	0.13	0.05	0.11	0.11	0.000
SES2	0.18	0.16	0.02	0.14	0.14	0.000
SES_middle	0.34	0.37	-0.02	0.38	0.38	0.000
SES3	0.18	0.18	0.00	0.19	0.19	0.000
SES4	0.17	0.19	-0.02	0.19	0.19	0.000
SES_low	0.29	0.34	-0.04	0.36	0.36	0.000
SES5	0.29	0.34	-0.04	0.36	0.36	0.000
City_high	0.55	0.18	0.37	0.22	0.22	0.000
Urban1	0.25	0.00	0.25	0.00	0.00	0.000
Urban2	0.30	0.18	0.12	0.22	0.22	0.000
City_mid	0.35	0.62	-0.27	0.68	0.68	0.000
Urban3	0.20	0.27	-0.07	0.32	0.32	0.000
Urban4	0.15	0.34	-0.20	0.36	0.36	0.000
City_low	0.11	0.21	-0.10	0.10	0.10	0.000
Urban5	0.03	0.00	0.03	0.00	0.00	0.000
Urban6	0.04	0.12	-0.09	0.04	0.04	0.000
Urban7	0.04	0.08	-0.04	0.06	0.06	0.000
Opd98	6.04	7.04	-1.00	4.43	4.43	-0.009
Cen_branch	0.13	0.91	-0.78	0.88	0.88	0.000

Note: [a] Variable description is shown in Table 1.

Table A4: Estimates of price elasticity from various strategies

(A) Description of strategies

Strategy	Matching method	Hypothesized registration fee (NT$)	Selection of samples		Study periods (unit: quarter)	
			Treatment group (n_1)	Control group (n_0)	No-copay periods (t_1)	Copay periods (t_0)
A (presented in the article)	Coarsened exact matching	100	quake area residents n_1 = 3,713	non-quake area & non-victims n_0 = 10,024	1st, 2nd of 2000 t_1 = 2 quarters	1st, 2nd of 1998 & 1999 t_0 = 4 quarters
B	Coarsened exact matching	100	Victim n_1 =627	Non-victim n_1 = 2,689	1st, 2nd of 2000 t_1 = 2 quarters	1st, 2nd of 1998 & 1999 t_0 = 4 quarters
C	Coarsened exact matching	87.7	quake area residents n_1 = 3,713	non-quake area & non-victims n_0 = 10,024	1st, 2nd of 2000 t_1 = 2 quarters	1st, 2nd of 1998 & 1999 t_0 = 4 quarters
D	One to one nearest neighbour matching with propensity score	100	quake area residents n_1 = 5,333	non-quake area & non-victims n_0 = 5,333	1st, 2nd of 2000 t_1 = 2 quarters	1st, 2nd of 1998 & 1999 t_0 = 4 quarters
E	None	100	quake area residents n_1 = 6,506	non-quake area & non-victims n_0 = 72,570	1st, 2nd of 2000 t_1 = 2 quarters	1st, 2nd of 1998 & 1999 t_0 = 4 quarters
F	Coarsened exact matching	100	quake area residents n_1 = 3,713	non-quake area & non-victims n_0 = 10,024	4th of 1999 & 1st, 2nd of 2000 t_1 = 3 quarters	4th of 1998 & 1st , 2nd of 1999 t_0 = 3 quarters
G (A+ non-quake area victim)	Coarsened exact matching	100	quake area residents n_1 = 1,759	non-quake area residents n_0 = 3,702	1st, 2nd of 2000 t_1 = 2 quarters	1st, 2nd of 1998 & 1999 t_0 = 4 quarters

(B) Estimated price elasticity

Strategy		Total number of visits	Total fee	Drug fee	Treatment fee	Diagnosis fee
A	Total sample	-0.22 [0.03]	-0.22 [0.03]	-0.11 [0.03]	-0.15 [0.03]	-0.29 [0.04]
	High SES	-0.21 [0.06]	-0.19 [0.06]	-0.09 [0.06]	-0.13 [0.06]	-0.26 [0.06]
	Middle SES	-0.23 [0.05]	-0.22 [0.05]	-0.11 [0.05]	-0.15 [0.05]	-0.29 [0.06]
	Low SES	-0.22 [0.06]	-0.24 [0.06]	-0.13 [0.06]	-0.17 [0.06]	-0.32 [0.07]
B	Total sample	-0.18 [0.01]	-0.22 [0.01]	-0.18 [0.01]	-0.29 [0.02]	-0.22 [0.01]
	High SES	-0.16 [0.02]	-0.18 [0.02]	-0.14 [0.02]	-0.23 [0.02]	-0.18 [0.02]
	Middle SES	-0.18 [0.02]	-0.21 [0.02]	-0.17 [0.02]	-0.28 [0.02]	-0.21 [0.02]
	Low SES	-0.21 [0.02]	-0.27 [0.02]	-0.22 [0.03]	-0.35 [0.03]	-0.27 [0.02]
C	Total sample	-0.20 [0.03]	-0.20 [0.03]	-0.10 [0.03]	-0.13 [0.03]	-0.27 [0.04]
	High SES	-0.19 [0.05]	-0.18 [0.05]	-0.09 [0.06]	-0.11 [0.05]	-0.24 [0.06]
	Middle SES	-0.21 [0.05]	-0.20 [0.05]	-0.10 [0.04]	-0.13 [0.05]	-0.27 [0.06]
	Low SES	-0.20 [0.06]	-0.22 [0.06]	-0.12 [0.05]	-0.15 [0.05]	-0.30 [0.07]
D	Total sample	-0.25 [0.02]	-0.23 [0.02]	-0.12 [0.01]	-0.15 [0.01]	-0.28 [0.01]
	High SES	-0.26 [0.03]	-0.26 [0.03]	-0.10 [0.01]	-0.12 [0.01]	-0.23 [0.02]
	Middle SES	-0.22 [0.02]	-0.20 [0.02]	-0.12 [0.01]	-0.15 [0.01]	-0.29 [0.02]
	Low SES	-0.28 [0.04]	-0.26 [0.04]	-0.13 [0.01]	-0.17 [0.01]	-0.32 [0.03]
E	Total sample	-0.14 [0.02]	-0.13 [0.02]	-0.06 [0.03]	-0.09 [0.02]	-0.20 [0.02]
	High SES	-0.12 [0.03]	-0.12 [0.04]	-0.04 [0.05]	-0.08 [0.04]	-0.19 [0.03]
	Middle SES	-0.13 [0.02]	-0.13 [0.03]	-0.06 [0.04]	-0.09 [0.04]	-0.20 [0.03]
	Low SES	-0.15 [0.03]	-0.14 [0.04]	-0.07 [0.05]	-0.10 [0.04]	-0.23 [0.04]
F	Total sample	-0.15 [0.03]	-0.20 [0.03]	-0.15 [0.03]	-0.22 [0.03]	-0.22 [0.03]
	High SES	-0.14 [0.05]	-0.18 [0.06]	-0.13 [0.07]	-0.21 [0.06]	-0.20 [0.06]
	Middle SES	-0.16 [0.04]	-0.20 [0.05]	-0.15 [0.05]	-0.22 [0.05]	-0.23 [0.05]
	Low SES	-0.15 [0.04]	-0.20 [0.05]	-0.15 [0.05]	-0.22 [0.05]	-0.22 [0.05]
G	Total sample	-0.21 [0.01]	-0.23 [0.01]	-0.10 [0.01]	-0.13 [0.01]	-0.31 [0.02]
	High SES	-0.19 [0.02]	-0.19 [0.02]	-0.09 [0.01]	-0.11 [0.01]	-0.25 [0.02]
	Middle SES	-0.20 [0.02]	-0.22 [0.02]	-0.09 [0.01]	-0.12 [0.01]	-0.29 [0.03]
	Low SES	-0.25 [0.02]	-0.28 [0.03]	-0.12 [0.01]	-0.16 [0.01]	-0.36 [0.03]

[a] Standard errors in square brackets.

Table A5:
Pre-exemption utilization (1st, 2nd quarter of 1998 & 1999) per quarter per person between control and treatment group among the Coarsen Exact Matching sample (n = 13,737)

	Number of visit			Total expenditure			Drug fee		
	Control	Treatment	|t|-stat [p-value]	Control	Treatment	|t|-stat [p-value]	Control	Treatment	|t|-stat [p-value]
Mean use (Std. Dev)	2.30 (3.36)	2.38 (3.49)		1100.6 (2229.6)	1115.2 (2143.7)		366.42 (1074.2)	365.8 (1028.7)	
Change of mean throughout pre-exemption (std. Err)	− 0.002 (0.019)	− 0.013 (0.030)	0.3 [0.764]	60.18 (12.22)	32.58 (20.10)	1.17 [0.241]	18.09 (4.58)	6.76 (7.52)	1.29 [0.198]
Mean's change as %of mean use (std. Err)	− 0.087 (0.806)	− 0.534 (1.28)	0.30 [0.7677]	5.47 (1.11)	2.92 (1.80)	1.20 [0.229]	4.94 (1.25)	1.85 (2.96)	1.28 [0.1990]
β of trend×quake area (std. Err)	− 0.005 (0.029)		0.18 [0.859]	− 28.33 (19.11)		1.48 [0.138]	− 12.53 (9.20)		1.36 [0.173]

(continue)	Treatment fee			Diagnosis fee		
	Control	Treatment	|t|-stat [p-value]	Control	Treatment	|t|-stat [p-value]
Mean use (Std. Dev)	244.15 (1066.00)	219.04 (945.25)		461.46 (676.24)	481.06 (707.69)	
Change of mean throughout pre-exemption (std. Err)	31.38 (7.55)	19.05 (12.40)	0.85 [0.396]	6.26 (3.79)	3.03 (6.23)	0.144 [0.662]
Mean's change as %of mean use (std. Err)	14.00 (3.37)	8.70 (5.66)	0.81 [0.4207]	1.35 (0.82)	0.63 (1.30)	0.47 [0.6396]
β of trend×quake area (std. Err)	− 13.50 (8.97)		1.50 [0.132]	− 1.82 (5.93)		0.31 [0.759]