Superstitions and Medical Decisions

Shuan-Wen Lin*

December 10, 2023

Click for the latest version

Abstract

Superstitions have been shown to influence people's decision-making in various areas. However, little research discusses how superstition affects people when they make medical decisions. Using a reduced-form model with a sample of administrative data from the National Health Insurance Research Database in Taiwan, I find that when people are in their *Taisui* years, which are considered unlucky times in one's life in East Asia, they adjust their healthcare usage, and people with more severe illness have stronger reactions. However, the average change is less than 1%. From a case study on heart attack patients, I find that treatment decisions are not significantly affected by beliefs about *Taisui*. The results show that superstition can influence medical decisions, but the effects are small.

Keywords: Superstitions, *Taisui*, medical decisions, healthcare usage

JEL Codes: I12, D91

*University of Houston, slin27@uh.edu

1 Introduction

Despite increasing levels of education in many countries, superstitions are still widespread and continue to influence people's behavior in various contexts. For instance, in Western culture, the avoidance of the number thirteen due to its perceived unluckiness is commonplace. In contrast, in Chinese-speaking cultures, the avoidance of the number four stems from its phonological resemblance to the word "death." Economists have explored the demographics of superstition and its impact on significant decision-making processes.[1] Some superstitions and their affected behaviors impose little cost or harm on neither the people who are superstitious nor others. However, other superstitions can have more serious consequences. Suppose a superstition leads individuals to deviate from the best course of action advised by physicians. In such a case case, it may pose risks/costs to individual health and also possibly have negative externalities for society. This study delves into whether a specific and understudied superstition in Taiwan affects individual choices in the critical area of healthcare utilization.

I study this phenomenon in the context of superstitions concerning *Taisui* (unlucky years). Those who believe in *Taisui* would consider themselves unlucky during particular years in their lifetime, which occur once every twelve years starting at age 12 according to the zodiac calendar. In response to this perceived ill fortune, believers tend to exhibit greater risk aversion during their *Taisui* years (Zhang and Pang 2022; Wu, Zhang, and Zhou 2023). Previous works have found that even managers and CEOs of stock-listed companies exhibit more risk aversion, such as investing less in research and development (R&D) during a *Taisui* year (Li et al. 2021; Fisman et al. 2022). In this paper, I examine whether *Taisui* superstition impacts healthcare utilization.

The heightened risk aversion resulting from superstition can lead to two contrasting adaptations in medical decision-making. On the one hand, individuals with *Taisui* beliefs may reduce their healthcare usage. For instance, Halla, Liu, and Liu (2019) discovered that Taiwanese individuals experience fewer hospital admissions during the "ghost month." Such a phenomenon could be attributed to acting more carefully in daily life or to the ostrich effect, which makes people less willing to seek medical attention. On the other hand, believers could exhibit increased caution and

1. See, for example, Block and Kramer (2009), Johnson and Nye (2011), and Hirshleifer, Jian, and Zhang (2018).

opt for more health utilization, especially preventive care. For example, Hira et al. (1998) found that Japanese people may extend hospital stays so as to be discharged on lucky days instead of unlucky days. Finally, unlike other decisions, in the case of healthcare, patients may not be the sole decision-maker. Patients often take into account their physicians' opinions and make decisions jointly (Finkelstein, Gentzkow, and Williams 2016). Moreover, physicians might be the sole decision-makers in urgent cases in the emergency room (Schoenfeld et al. 2018), and we might not find that patients' *Taisui* beliefs matter. Given these countervailing forces, there is no clear prediction of overall healthcare usage concerning *Taisui*.

To investigate the impacts of *Taisui* beliefs, I utilize a dataset from Taiwan's National Health Insurance Research Database (NHIRD). Taiwan provides its residents with universal health insurance with generous coverage (Lien, Chou, and Liu 2008). This dataset covers detailed information for every inpatient, outpatient, and emergency room department visit for one million people (approximately 5% of the population) between 1996 and 2011. Since I did not directly observe who believes in *Taisui*, I estimate the impact of experiencing a *Taisui* year, instead of the actual belief in *Taisui*, on healthcare utilization. As mentioned above, *Taisui* years are tied to one's age (every twelve years), and individuals cannot choose when to experience *Taisui*, so there is neither reverse causality nor omitted variable bias. In my main specification, I control for individual fixed effects and quadratic age trends. The coefficient on experiencing a *Taisui* year will inform us whether having a *Taisui* year causes people to utilize healthcare differently. However, given the predictable nature of *Taisui* years and their duration, people who believe in *Taisui* might prepare in anticipation of an upcoming *Taisui* year or postpone treatment until after it. Regarding the heterogeneity of the effect, I also estimate the effects of superstition by individual characteristics, including biological sex, age, education (proxied by their residence's education level), and medical history.

I find that experiencing *Taisui* years does affect people's healthcare usage. During an unlucky year, people exhibit higher outpatient healthcare usage in terms of frequency and cost but lower inpatient healthcare usage (measured by inpatient cost and frequency). No impact was detected in emergency departments, suggesting that the margin of decision changes does not lie in the demand for urgent care. While the inpatient and outpatient results are statistically significant, with at least a

90% level of confidence, the size of changes is economically small. We find an absolute change of less than 1% in most outcomes. It suggests that a) very few people act on belief in *Taisui*, b) the *Taisui* effects have opposing signs that cancel each other out, or c) that medical decisions are made jointly with physicians, so there is little room for patients' *Taisui* belief.

To explore the reasons behind the minimal *Taisui* effects, I extend my analysis to two dimensions. First, I examine the heterogeneity of *Taisui* effects based on individuals' health statuses. The findings indicate that individuals with poorer health exhibit more pronounced reactions to *Taisui* in outpatient visits and inpatient admissions, whereas those in good health show minimal responses. Given that over 70% of the observations pertain to individuals categorized as healthy, it is unsurprising that the overall average *Taisui* effects are minor. Second, I focus on the treatment after a heart attack. Typically, after a heart attack, the usual courses include angioplasty, catheterization, or medication such as aspirin, heparin, or nitroglycerin (Cutler, McClellan, and Newhouse 1998). Both angioplasty and catheterization are more invasive than the pharmaceutical approach. I find that conditional on having a heart attack in the given year, the impacts of *Taisui* on invasive surgery adoption are statistically insignificant. The data suggests that when it comes to decisions with serious consequences, individuals defer to the expert's decision, and therefore, *Taisui* has no impact.

This paper contributes to three key strands of academic inquiry. First, I contribute to the literature on the degree to which *Taisui* belief may affect people's decision-making.[2] Previous papers have studied the same *Taisui* superstition in terms of risk preferences and managerial behaviors. Zhang and Pang (2022) and Wu, Zhang, and Zhou (2023) have examined individual willingness to take on financial risk (*e.g.*, insurance and investment decisions) in the survey and in the lab. They find that individuals behave more risk-averse during *Taisui* years. Li et al. (2021) and Fisman et al. (2022) found that if the CEO or manager is experiencing a *Taisui* year, the company temporarily increases cash holding by 3.88% and lowers its R&D rate by 5.3%. To the best of my knowledge, this paper is the first to analyze the *Taisui* effects on individual healthcare utilization. In the case of health utilization decisions, that physicians may serve as gatekeepers and the patient may have limited

2. Although it shares similarities with the "zodiac year" belief in Chinese culture, the *Taisui* belief should be recognized as a distinct superstition owing to its distinct cultural origins. Despite the similarities in their mechanisms, these beliefs stem from different cultural backgrounds.

power in decision-making may explain why I find a small effect relative to the effect of *Taisui* on finance-related decisions found in other studies.

This paper also contributes to the literature on how superstitions affect fertility and health. For example, Almond et al. (2015) discovered that Chinese descendants in the United States schedule Cesarean sections (C-sections) around auspicious times/dates, and Huang et al. (2021) find that Chinese parents time births to have their children born in lucky (dragon) years and result in delays for 6.7% of births. Halla, Liu, and Liu (2019) discovered 4% fewer hospital admissions and births during the Taiwanese ghost month. However, the effect in my study is consistently less than 1%. Compared to other superstitions, the perceived misfortune of Taisui lasts for the entire year. While people might be able to delay treatment or schedule surgeries around the auspicious/unlucky day for one week or even one month, it is more difficult for people to schedule treatments if the duration of the bad luck lasts for a full year.

Lastly, I examine how an exogenous shock on patients can affect medical decisions. Medical decisions are usually made jointly by providers (physicians) and consumers (patients). Changes in healthcare providers' decision-making are widely discussed in previous research. For instance, Kessler and McClellan (1996) conclude that malpractice reforms that reduce physicians' liability pressure can reduce defensive medicine on elderly patients with serious heart diseases. Currie and MacLeod (2008) find that the Joint and Several Liability reforms reduce the usage of the Cesarean section. Besides law and policy changes, Jin et al. (2023) find that in emergency departments, physicians' decisions can depend on their treatment of previous patients. Another example on the demand side is that Chandra, Gruber, and McKnight (2010) observe and record patients' price sensitivity through a Medicare cost-sharing reform in California. Instead of policy change, Finkelstein, Gentzkow, and Williams (2016) use patient migration within the U.S. to find that patient characteristics contribute to 40–50% of the geographic variation of healthcare utilization. In this paper, I use a popular superstition as an alternative path to capture changes in patients' risk preferences and thus possible changes in medical decisions.

The remainder of the paper is organized as follows. Section 2 provides background information of the superstition and the data source. Section 3 presents the identification strategy and the findings on general healthcare utilization. Section 4 discusses a case study on heart attack patients. Section 5 concludes this paper.

2 Background and Data

2.1 *Taisui* Belief

The *Taisui* superstition originated in ancient China. According to legend, *Taisui* refers to an imaginary astronomical object represented by a group of gods. Individuals are believed to “offend” *Taisui* if their Chinese zodiac sign of birth matches the zodiac sign of the current lunar year. Consequently, these years are associated with bad luck and are referred to as “*Taisui* years” in this article.

Each person’s *Taisui* years are determined by their zodiac sign of birth, which follows the Chinese zodiac cycle of twelve animal signs. The cycle repeats every twelve years, so individuals experience their *Taisui* years at the ages of 12, 24, 36, and so on (*i.e.*, multiples of twelve). These *Taisui* years are tied to the Chinese lunar calendar.[3] Since the dominant zodiac sign changes on Lunar New Year’s Day, each *Taisui* year begins on that day and ends on Lunar New Year’s Eve. The lunar calendar incorporates leap months, resulting in variations in the length of a lunar year, ranging from twelve months (354–355 days) to thirteen months (384–385 days). As a result, the duration of a *Taisui* year also varies. Furthermore, the date of Lunar New Year’s Day in the Gregorian calendar fluctuates between January 21 and February 20. As Lunar New Year’s Day is a national holiday in Taiwan, people are well aware of the change in the current zodiac sign and are able to determine the start and end of their *Taisui* year.

Traditionally, Taiwanese people would worship gods and ancestors within their homes. Simultaneously, they would also worship *Taisui* to mitigate the effects of bad luck during the *Taisui* years. However, in the 1990s, there was a growing trend of worshiping *Taisui* in temples. (Chen 2014.) People must donate to the temple to participate in *Taisui* worship. This donation system incentivizes temples to promote *Taisui* belief among the general public. As a result, *Taisui* belief has become in-

3. Although the traditional Chinese calendar is actually lunisolar, unlike other lunar calendars such as the Islamic calendar, it is commonly referred to as a lunar calendar to differentiate it from the Gregorian calendar (which is a solar calendar). In this article, I adopt the commonly used term "lunar calendar" for ease of understanding and consistency.

creasingly prevalent within Taiwanese society in recent decades. According to the 2004 Taiwan Social Change Survey (Chang and Fu 2006), 43% of Taiwanese people worshiped *Taisui* to mitigate bad luck. Additionally, 24% of Taiwanese people reported that their family members worshiped *Taisui* while they did not. The survey proved that the *Taisui* belief is widespread in Taiwanese society.

2.2 Data Source

For the empirical analysis, I utilize the Longitudinal Health Insurance Database 2000 (LHID2000) sample from the NHIRD, specifically the dataset for the year 2000. The LHID2000 sample consists of one million individuals randomly selected from the NHIRD's Registry of Beneficiaries in 2000. It is a longitudinal dataset comprising all claims records of the sampled individuals from the National Health Insurance (NHI) in Taiwan from 1996 to 2011. The Registry of Beneficiaries contains data for each beneficiary enrolled in the NHI, ensuring that each individual in the LHID2000 dataset was alive and enrolled in the NHI in 2000. Given that the NHI provides universal health insurance coverage to the entire population, with an insured rate exceeding 97% (Lien, Chou, and Liu 2008), the LHID2000 represents approximately a 5% sample of the overall population.

Several datasets from LHID2000 are included for analysis. Firstly, the Registry of Beneficiaries data provides personal information for each beneficiary, including their date of birth, gender, county of residence, and enrollment period. The date of birth is particularly crucial for this research, as it is necessary to determine each individual's zodiac sign of birth and define their respective *Taisui* years. Additionally, the date of birth is utilized to calculate the age of each individual in each year, which is an important control variable in the estimation. Gender and county of residence are included as individual characteristic controls. The enrollment period serves as a proxy for mortality since death is the most common reason for discontinuation from the NHI (Lien, Chou, and Liu 2008).

Secondly, the Ambulatory Care Expenditures by Visits (outpatient claims) data and the Inpatient Expenditures by Admissions (inpatient claims) data contain valuable information regarding healthcare usage. These datasets include the date of visit/admission, date of discharge (for inpatient admissions), diagnoses, procedures performed during admissions, claim amounts from healthcare providers, and patients' total out-of-pocket costs. The date of visit/admission is crucial because it determines whether individuals utilize healthcare more or less during their *Taisui* years and highlights their medical decision-making. The date of discharge aids in measuring the length of hospital stay, which serves as a measure of healthcare utilization. The claim amount is utilized to assess the extent of healthcare usage and the subsequent healthcare costs, which are important health outcomes. Diagnosis records serve as the control for medical history and current health status. Procedures performed are considered outcomes of interest, indicating whether individuals prefer less risky procedures during their *Taisui* years. Both diagnoses and procedures are coded using the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM).

2.2.1 Sample selection

The analysis is limited to individuals between the ages of 20 and 80 for two reasons. Firstly, children and teenagers typically do not make medical decisions independently. Instead, their parents are primarily involved in such decisions, particularly regarding hospital admissions, until they reach the age of 20.[4] Secondly, the population over the age of 80 is relatively small. Excluding the elderly population should not significantly impact the estimation, as their decision-making scope is limited due to their average health status. Since NHI did not enforce the use of ICD-9-CM in outpatient claims until 2000, I exercise the analysis with the observations in 2001 onward to include the accurate medical history of individuals.[5]

My primary analysis examines whether people's healthcare usage deviates from the age trend in the *Taisui* years. Thus, I exclude hospital admissions related to pregnancy and childbirth when studying inpatient outcomes to control the outcome trends better along the ages (ICD-9-CM, 630–679). In 2004, more than 99.5% of newborns in Taiwan were delivered in hospitals or clinics, and most were admitted to hospitals afterward. Therefore, women are admitted to hospitals more often when of childbearing age, regardless of their health status. These admissions deviate from the normal outcome trends among the ages, so I exclude them when measuring inpatient outcomes.

4. In accordance with the Civil Code in Taiwan, individuals attain full legal capacity upon reaching the age of 20. However, it is worth noting that a recent revision of the Civil Code in 2023 has lowered this threshold to the age of 18.

5. Before 2000, healthcare providers commonly use the A-code inherited from the Labor Insurance system for the diagnosis records in outpatient claims. ICD-9-CM is required to be used in inpatient claims from the beginning of the NHI in March 1995 (Lien 2008).

Observations with missing values in biological sex, date of birth, or township of residence are also excluded from the sample, which causes less than 0.5 percent loss of the sample size.

Table 1 presents the summary statistics for the outcomes of interest and individual characteristics within the sample. With the age restriction on the sample,[6] there are approximately 7.8 million observations at the individual-year level.[7] It is worth noting that there are more than 14 annual outpatient visits per person, which supports the high availability of healthcare services due to the low costs for patients in Taiwan.

3 Changes in Medical Decisions

3.1 Identification Strategy

The effect of *Taisui* belief on healthcare utilization, representing the outcome of medical decision-making, is estimated using the following ordinary least square (OLS) model:

$$\begin{aligned} y_{ict} = \alpha + \beta_1 \cdot taisui_{it} + \beta_2 \cdot 1(CCI_{i,t-1} = 1) + \beta_3 \cdot 1(CCI_{i,t-1} \geq 2) \\ + f_{g(i)}(age_{it}) + \gamma_i + \tau_{ct} + \varepsilon_{ict} \end{aligned} \tag{1}$$

where y_{ict} represents the outcome of individual i residing in county c in lunar calendar year t. The outcomes include the following variables per person-year or per visit/admission: inpatient admissions, bed days, inpatient costs, outpatient visits, emergency department (ED) visits, outpatient costs, and ED costs. The costs are adjusted for healthcare CPI in Taiwan and converted into U.S. dollars with the average exchange rate in 2011. A logarithm transformation is applied to the cost outcomes. To handle observations with zero costs, I multiply the cost by one hundred and then add one to all observations.[8]

$taisui_{it}$ is a dummy variable indicating whether lunar calendar year t corresponds to a *Taisui* year for individual i, with β_1 representing the coefficient of interest. As the proportion of the sample

6. Between 2001 and 2011, 22.37% of the observations are filtered out by the age restriction, where 20.24% are younger than 20, and only 2.13% are older than 80.

7. People who emigrated or died between 2001 and 2011 are not observed in the data after their emigration or death.

8. The reason for multiplying the cost by one hundred is to mitigate the distortion from the transformation. For example, the average annual cost for ER visits is only $19.15. Directly adding one would cause an approximately 5% change to the outcome on average.

holding the *Taisui* belief is not observed, β_1 identifies the intention-to-treat (ITT) effect.

$CCI_{i,t-1}$ is the Charlson Comorbidity Index (CCI) based on the diagnoses on the claims in the previous lunar calendar year. The CCI, introduced by Charlson et al. (1987), is a widely used measurement of comorbidity and health status. For this analysis, I adopt a later version enhanced by Quan et al. (2005), allowing the definition of comorbidities using ICD-9-CM diagnosis codes. In order to avoid double consideration of the correlation between age and healthcare usage outcomes, I exclude the age factors in the original definition of the index.

$f_{g(i)}(age_{it})$ is a function of the lunar year age of individual i in lunar calendar year t. I allow the age controls to vary by gender ($g(i)$), as it helps capture different outcome trends across different ages for men and women. In the preferred model, $f_g(\cdot)$ is a quadratic function. I modify the function form in a later section for robustness checks.

γ_i and τ_{ct} represent the individual fixed effects and the county-by-lunar-calendar-year fixed effects, respectively. Therefore, the estimated effects of *Taisui* is a comparison between *Taisui* years and non-*Taisui* years within each individual. Following the suggestion of Abadie et al. (2023), the standard errors are clustered at the individual level, which is the sampling level.

Taisui could have positive and negative effects on healthcare usage, as individuals may react differently to *Taisui*. On the one hand, people can easily access more healthcare services when they wish to be extra cautious about their health during *Taisui* years because of the well-known availability and affordability of healthcare in Taiwan. On the other hand, individuals may also opt for less healthcare during *Taisui* years under the influence of a careful lifestyle or the ostrich effect, where individuals avoid healthcare providers to evade potential bad news.

3.2 Estimation Results

Table 2 presents the estimation results regarding the effect of *Taisui* belief, where Panels A, B, C include the inpatient, outpatient, and ED outcomes, respectively. In general, Taiwanese people increase outpatient healthcare usage in *Taisui* years while they decrease inpatient healthcare usage in *Taisui* years. The effects are mostly statistically significant, but the scale of the changes is economically small. In the meantime, no significant change in ED healthcare usage is detected in *Taisui* years.

For outpatient usage, the share of people having at least one visit increases by 0.03 percentage points, which is equivalent to 0.034% of the average (88 percentage points) within the sample years. The frequency of visits increases by 0.0254 visits (or 0.18%), and outpatient healthcare costs are raised by 0.63% per person-year and 0.21% per visit. As for inpatient usage, the share of people with at least one hospital admission decreases by 0.06 percentage points, equivalent to 0.86% of the average (7 percentage points) within the sample years. The frequency of admissions decreases by 0.0015 admissions (or 1.50%). The costs of inpatient healthcare drop by 0.74% per person-year, and annual days in hospitals are cut by 0.0192 days (or 2.43%). The results above show that Taiwanese people react to the *Taisui* belief when they use healthcare services, but the reactions are not strong.

There are two possible reasons why *Taisui* does not significantly influence people's medical decisions. First, as described in the previous section, individuals may have different reactions to *Taisui*. The reactions can offset each other and result in minor average effects. Second, the actual average effects may be small. Individuals might not have substantial room to alter their medical decisions. Those with milder conditions may opt for simpler treatments only, while those who are severely ill may have fewer choices in their treatment plans. Only individuals whose health conditions are on the margin of treatment may react to their *Taisui* beliefs. Consequently, the effects average toward zero. To further investigate this, I will examine the *Taisui* effects by individual characteristics.

3.2.1 Heterogeneity in the *Taisui* Effects

Although the *Taisui* belief is not very impactful on healthcare use on average, one may wonder whether some people react more than others. Therefore, I estimate the *Taisui* effects on subsamples split by biological sex, age (above or below 65), or the average education level in the residency.

I cut the sample at age 65 following the definition in the *Senior Citizen Welfare Act* in Taiwan. Taiwanese people aged 65 and above receive various social welfare benefits for seniors, so they might perform differently from younger cohorts when making medical decisions. Education level could be correlated with the degree of superstitious belief. However, I do not observe the education attainment of each individual in the data. Therefore, I use the share of high school graduates in the township where one resides from the 2010 Taiwan Population Census to approximate people's education level.[9] The cutoff between high and low-education-level townships is at the population-weighted median of the share of high school graduates.

Figures 1, 2 and 3 show the estimates of the *Taisui* effects on each subsample on outpatient, ED, and inpatient outcomes, respectively. Most of the estimations are not very different from the estimation with the supplemented subsamples. However, men and women react to *Taisui* differently. Men have higher outpatient care usage, but their changes in inpatient care are minor. Women show stronger avoidance to hospital admissions, while they have smaller reactions on clinic visits. In other words, the *Taisui* effects on outpatient care come from men, and women mainly affect inpatient care. Besides, it is worth noting that the senior population uses more ED healthcare resources than their junior counterparts during their *Taisui* years. This finding suggests that when senior people believe they are unlucky, they have a stronger need for urgent care.

The estimation of *Taisui* effects on inpatient healthcare might be biased by inpatient deaths. If one dies during hospital admissions, the data could underestimate the inpatient healthcare usage due to an undesired end of treatment. Hence, I also estimate the *Taisui* effects on the inpatient outcomes at per-admission levels conditional on the individuals still alive at the end of the lunar calendar year. Nevertheless, Figure 3 shows that inpatient deaths do not significantly change the estimation.

Health status is another possible source of heterogeneity in *Taisui* effects. Unhealthy people could have a stronger fear of death and become more superstitious. Alternatively, unhealthy people might have fewer choices on the margin since wrong medical choices could severely impact their health. Healthier people might have more choices since they can afford to delay treatment. Therefore, people with different health conditions could vary in sensitivity to *Taisui* belief. To estimate the *Taisui* effects on people with various health statuses, I perform the following regression modified from Equation (1):

$$\begin{aligned} y_{ict} = \alpha + \beta_1 \cdot taisui_{it} + \beta_2 \cdot 1(CCI_{i,t-1} = 1) + \beta_3 \cdot 1(CCI_{i,t-1} \geq 2) \\ + \beta_4 \cdot taisui_{it} \cdot 1(CCI_{i,t-1} = 1) + \beta_5 \cdot taisui_{it} \cdot 1(CCI_{i,t-1} \geq 2) \\ + f_{g(i)}(age_{it}) + \gamma_i + \tau_{ct} + \varepsilon_{ict} \end{aligned} \tag{2}$$

9. The high school graduates include vocational school graduates and people who have at least some post-secondary education.

Following the previous section, I use CCI to define people's health status and separate the sample into three groups. 76% of people are considered healthy (CCI$=0$), and β_1 estimates the *Taisui* effects on them. 14% and 10% of people are considered mildly and severely ill, respectively. The *Taisui* effects on each group are estimated by $\beta_1 + \beta_4$ and $\beta_1 + \beta_5$.

Following the previous section, I use CCI to define people's health status and separate the sample into three groups. 76% of people are considered healthy (CCI$=0$), and β_1 estimates the Taisui effects on them. 14% and 10% of people are considered mildly and severely ill, respectively. The Taisui effects on each group are estimated by $\beta_1 + \beta_4$ and $\beta_1 + \beta_5$.

Table 3 shows each group's *Taisui* effects on outpatient and ED visits. I find that sick people react to *Taisui* more strongly than healthy people, and the effects on sicker people are even stronger. The severely ill people have 0.2108 additional outpatient visits (increasing by 0.67%, more than three times the average) in *Taisui* years, and the annual cost per person increases by 3.31% (five times the average). Nevertheless, there are still no significant changes found in ED usage.

Table 4 shows the *Taisui* effects on inpatient visits for each group. Similarly, the reduction of inpatient healthcare usage in Taisui years is more profound for ill people, and sicker people reduce the usage even more. The severely ill people cut 0.0131 hospital admissions (decreasing by 3.05%, which is double the average) in *Taisui* years, and the annual days in hospitals are shortened by 0.1247 days (or 3.18%, around 1.2 times the average). The findings support the hypothesis that unhealthy people could be more sensitive to unlucky years and want to avoid hospitals.

3.2.2 Robustness Check on the Age Controls

Since age is highly correlated to healthcare usage, the estimation could be sensitive to different forms of age control. Therefore, I reexamine the *Taisui* effects with age controls besides the quadratic function. Tables 5, 6 and 7 present the results of outpatient, ED, and inpatient outcomes, respectively. The baseline model in Column (1) uses a quadratic age control, while Column (2) explores alternative age controls in the cubic function. Despite variations in age control, the coefficients on *Taisui* effects consistently appear small. To compare people with more similar health statuses, I restrict the sample to individuals within narrower age bands around *Taisui* ages, as shown in Columns (3) and (4). The direction of the effects within these bands remains robust, but occasionally, the coefficients are no longer statistically significant with the smaller sample size.

4 Case Study: Acute Myocardial Infarction

In the previous section, I examined the *Taisui* effects on general healthcare usage. However, people not only decide whether to see a doctor but also make decisions among many treatments and procedures for some specific diseases. In this section, I will focus on those with acute myocardial infarction (AMI, *i.e.*, heart attack).

For the purpose of analysis, I define AMI patients as individuals who have at least one claim (either outpatient or inpatient) with the AMI diagnoses (ICD-9-CM, 410.xx). I choose to study AMI patients for the following three reasons. First, there can be two countervailing effects. Some use more preventive services, while others avoid clinics/hospitals. In the previous section, it is difficult to study the procedure choices people make. In the case of AMI, thanks to its acute and urgent nature, I can focus on people's decision-making on treatments.

Second, among the procedures that one can take, some are more invasive surgeries, while others can be more conservative.[10] Following the definition in Currie, MacLeod, and Van Parys (2016), I compare the adoption of two kinds of invasive surgeries, angioplasty and catheterization,[11] with other procedures and pharmaceutical treatments.

Third, many health economists have studied AMI. For instance, Jena et al. (2015) discuss whether AMI and heart failure patient outcomes differ during days of cardiology meetings. Currie, MacLeod, and Van Parys (2016) use treatments for AMI as an example to study physician practice style. Chen (2021) studies teamwork in two common invasive heart surgeries. The research above focuses on the provider side. On the patient side, Daysal (2012) discusses how uninsured heart attack patients affect insured patients. This section examines whether AMI patients make different treatment decisions in *Taisui* years.

10. See Cutler, McClellan, and Newhouse (1998) for the discussion about treatment for AMI.

11. Currie, MacLeod, and Van Parys (2016) define angioplasty using ICD-9-CM procedure code 00.66 and 36.0x and define catheterization using ICD-9-CM procedure code 37.22 and 37.23.

However, there may be some concerns. AMI patients may not be able to make many decisions, given its acute nature. It could be possible that most decisions are made by medical professionals, and patients or their family members simply follow the physicians' suggestions since the conditions are usually urgent. In this case, we might not expect to find any *Taisui* effects.

While some research on AMI restricts their observations to ED visits (*e.g.*, Currie, MacLeod, and Van Parys 2016, Chen 2021), I expand my observations to non-ED clinic visits and hospital admissions. I have two reasons for doing so. First, it is ambiguous in the data whether a patient is admitted through ED. The treatments in ED can be claimed together with the following admission, but the coding cannot distinguish. Second, some mild AMI patients might be able to choose to adjust the timing of the invasive surgeries to avoid risky treatments[12] in Taisui years, and such a decision could happen in non-ED visits. Table 8 shows the summary statistics of AMI patients.

4.1 Identification Strategy

I restrict the analysis to those with AMI in lunar calendar t, then I look at the patient i's choices. I modify Equation (1) to estimate the *Taisui* effects on AMI treatment decisions with the following model:

$$\begin{aligned} y_{ict} = \alpha + \beta_1 \cdot taisui_{it} + \beta_2 \cdot 1(CCI^*_{i,t-1} = 1) + \beta_3 \cdot 1(CCI^*_{i,t-1} \geq 2) \\ + \theta AMI_{i,t-1} + f_{g(i)}(age_{it}) + \phi female_i + \tau_{ct} + \varepsilon_{ict}. \end{aligned} \tag{3}$$

The primary outcome (y_{ict}) is whether individual i residing in county c has invasive surgeries in lunar calendar year t. Other outcomes include the number of admissions, medical costs, and days in hospitals, and all the outcomes are restricted to claims with AMI diagnoses.

I remove the control for individual fixed effects from the model because more than half of the AMI patients have only one observation in the data. Instead, I control the biological sex. Moreover, I separate the history of AMI ($AMI_{i,t-1}$) from other medical records ($CCI^*_{i,t-1}$, which equals to

12. While such procedures have better subsequent health outcomes (Currie, MacLeod, and Van Parys 2016), their invasiveness may make people feel higher mortality risk during the surgeries.

$CCI_{i,t-1} - AMI_{i,t-1})$[13] to emphasize the correlation between the previous AMI, comorbidity, and the patient's medical decisions.[14] Other controls are the same as in Equation (1), and the standard errors are clustered at the individual level.

4.2 Estimation Results

Table 9 exhibits the estimations of the *Taisui* effects on AMI patient's medical decisions. The results do not indicate any significant changes in healthcare usage from AMI patients in the *Taisui* years. To investigate the effects on specific groups of AMI patients further, I estimate Equation (3) on different subsamples, and Figure 4 shows the results. Generally speaking, the estimates are mostly consistent across subsamples, and no significant effects are found.

In the previous section, I found that the *Taisui* effects vary by health status. It could also be true that AMI patients with rich medical histories could be affected by *Taisui* differently from others who have little medical history. Therefore, I estimate the following regression:

$$\begin{aligned} y_{ict} = \alpha + \beta_1 \cdot taisui_{it} + \beta_2 \cdot 1(CCI_{i,t-1} = 1) + \beta_3 \cdot 1(CCI_{i,t-1} \geq 2) \\ + \beta_4 \cdot taisui_{it} \cdot 1(CCI_{i,t-1} = 1) + \beta_5 \cdot taisui_{it} \cdot 1(CCI_{i,t-1} \geq 2) \\ + \theta AMI_{i,t-1} + f_{g(i)}(age_{it}) + \phi female_i + \tau_{ct} + \varepsilon_{ict}. \end{aligned} \tag{4}$$

Table 10 shows the results. The estimations tell that the *Taisui* effects on treatment decisions vary by health status. While the AMI patients with the least medical history are more likely to have invasive surgeries in *Taisui* years by 1.11 percentage points (or 3.0%), the AMI patients with the most medical history are less likely to have invasive surgeries in *Taisui* years by 3.64 percentage points (or 14.0%). Nevertheless, the point estimates are not significantly different from zero.

The concern for the sensitivity of age controls also holds for the estimations on AMI patients. However, the robustness check eliminates the concern and again finds no *Taisui* effects on AMI treatment decisions. The analyses above could conclude that *Taisui* belief does not affect AMI patients' treatment plans.

13. AMI diagnoses is counted as one point in CCI. (Charlson et al. 1987)
14. Same as in Equation (1), the AMI and other medical history are based on the claims in lunar calendar year $t1$.

5 Conclusion

In this paper, I examine the influence of superstition on medical decisions with a reduced-form model. I study the *Taisui* belief in Taiwan, which posits that people believe they are unlucky at certain lunar calendar ages and become more risk-averse. I find that during unlucky times, people use more outpatient and fewer inpatient services, while the changes are small and not considered to have economic impact. I further discuss the treatment choices of heart attack patients and find that their medical decisions are not affected. My empirical findings suggest that superstition can affect people in some of their medical decisions. However, the impact is not as large as in other fields (Li et al. 2021, Fisman et al. 2022). Several hypotheses on people's behavior can be used to explain the small effect, but additional information not provided by the data is required for confirmation.

My findings support previous research suggesting that superstition has some behavioral influence on people and expand the literature to show that such biased beliefs can change the demand for healthcare. While the scale of the effect is relatively small, it is still interesting to observe how people's health outcomes are affected following changes in medical decisions. Although this paper studies a specific superstitious belief in a developed economy, the findings can be extended to provide general insights for public health policy related to behavioral and cultural factors in healthcare demands.

References

Abadie, Alberto, Susan Athey, Guido W Imbens, and Jeffrey M Wooldridge. 2023. "When should you adjust standard errors for clustering?" *The Quarterly Journal of Economics* 138 (1): 1–35.

Almond, Douglas, Christine Pal Chee, Maria Micaela Sviatschi, and Nan Zhong. 2015. "Auspicious birth dates among Chinese in California." *Economics & Human Biology* 18:153–159.

Block, Lauren, and Thomas Kramer. 2009. "The effect of superstitious beliefs on performance expectations." *Journal of the Academy of Marketing Science* 37:161–169.

Chandra, Amitabh, Jonathan Gruber, and Robin McKnight. 2010. "Patient cost-sharing and hospitalization offsets in the elderly." *American Economic Review* 100 (1): 193–213.

Chang, Ying-hwa, and Yang-chih Fu. 2006. *2004 Taiwan Social Change Survey (Round 4, Year 5): Religion.* Data File. Available from Survey Research Data Archive, Academia Sinica.

Charlson, Mary E, Peter Pompei, Kathy L Ales, and C Ronald MacKenzie. 1987. "A new method of classifying prognostic comorbidity in longitudinal studies: development and validation." *Journal of chronic diseases* 40 (5): 373–383.

Chen, Chun-Chih. 2014. "A Study on the Religion and the Worship Spaces of Tai-sui — an Investigation Focus on Taiwan." PhD diss., National Chung Hsing University, Taichung, Taiwan.

Chen, Yiqun. 2021. "Team-specific human capital and team performance: evidence from doctors." *American economic review* 111 (12): 3923–3962.

Currie, Janet, and W Bentley MacLeod. 2008. "First do no harm? Tort reform and birth outcomes." *The Quarterly Journal of Economics* 123 (2): 795–830.

Currie, Janet, W Bentley MacLeod, and Jessica Van Parys. 2016. "Provider practice style and patient health outcomes: The case of heart attacks." *Journal of health economics* 47:64–80.

Cutler, David M, Mark B McClellan, and Joseph P Newhouse. 1998. *The costs and benefits of intensive treatment for cardiovascular disease.* Working Paper, Working Paper Series 6514. National Bureau of Economic Research.

Daysal, N Meltem. 2012. "Does uninsurance affect the health outcomes of the insured? Evidence from heart attack patients in California." *Journal of health economics* 31 (4): 545–563.

Finkelstein, Amy, Matthew Gentzkow, and Heidi Williams. 2016. "Sources of geographic variation in health care: Evidence from patient migration." *The quarterly journal of economics* 131 (4): 1681–1726.

Fisman, Ray, Wei Huang, Bo Ning, Yue Pan, Jiaping Qiu, and Yongxiang Wang. 2022. "Superstition and Risk Taking: Evidence from "Zodiac Year" Beliefs in China." *Management Science.*

Halla, Martin, Chia-Lun Liu, and Jin-Tan Liu. 2019. *The effect of superstition on health: Evidence from the Taiwanese Ghost month.* Working Paper, Working Paper Series 25474. National Bureau of Economic Research.

Hira, Kenji, Tsuguya Fukui, Akira Endoh, Mahbubur Rahman, and Munetaka Maekawa. 1998. "Influence of superstition on the date of hospital discharge and medical cost in Japan: retrospective and descriptive study." *Bmj* 317 (7174): 1680–1683.

Hirshleifer, David, Ming Jian, and Huai Zhang. 2018. "Superstition and financial decision making." *Management Science* 64 (1): 235–252.

Huang, Cheng, Shiying Zhang, Qingguo Zhao, and Yan Lin. 2021. "Dragon year superstition, birth timing, and neonatal health outcomes." *China Economic Review* 66:101594.

Jena, Anupam B, Vinay Prasad, Dana P Goldman, and John Romley. 2015. "Mortality and treatment patterns among patients hospitalized with acute cardiovascular conditions during dates of national cardiology meetings." *JAMA internal medicine* 175 (2): 237–244.

Jin, Lawrence, Rui Tang, Han Ye, Junjian Yi, and Songfa Zhong. 2023. "Path dependency in physician decisions." *Review of Economic Studies,* rdad096.

Johnson, Noel D, and John VC Nye. 2011. "Does fortune favor dragons?" *Journal of Economic Behavior & Organization* 78 (1-2): 85–97.

Kessler, Daniel, and Mark McClellan. 1996. "Do doctors practice defensive medicine?" *The Quarterly Journal of Economics* 111 (2): 353–390.

Li, Jiarong, Jie Michael Guo, Nan Hu, and Ke Tang. 2021. "Do corporate managers believe in luck? Evidence of the Chinese zodiac effect." *International Review of Financial Analysis* 77:101861.

Lien, H. 2008. "How to Use National Health Insurance Data to Conduct Health Economics Research." *Taiwan Economic Review* 36 (1): 115.

Lien, Hsien-Ming, Shin-Yi Chou, and Jin-Tan Liu. 2008. "Hospital ownership and performance: evidence from stroke and cardiac treatment in Taiwan." *Journal of health economics* 27 (5): 1208–1223.

Quan, Hude, Vijaya Sundararajan, Patricia Halfon, Andrew Fong, Bernard Burnand, Jean-Christophe Luthi, L Duncan Saunders, Cynthia A Beck, Thomas E Feasby, and William A Ghali. 2005. "Coding algorithms for defining comorbidities in ICD-9-CM and ICD-10 administrative data." *Medical care,* 1130–1139.

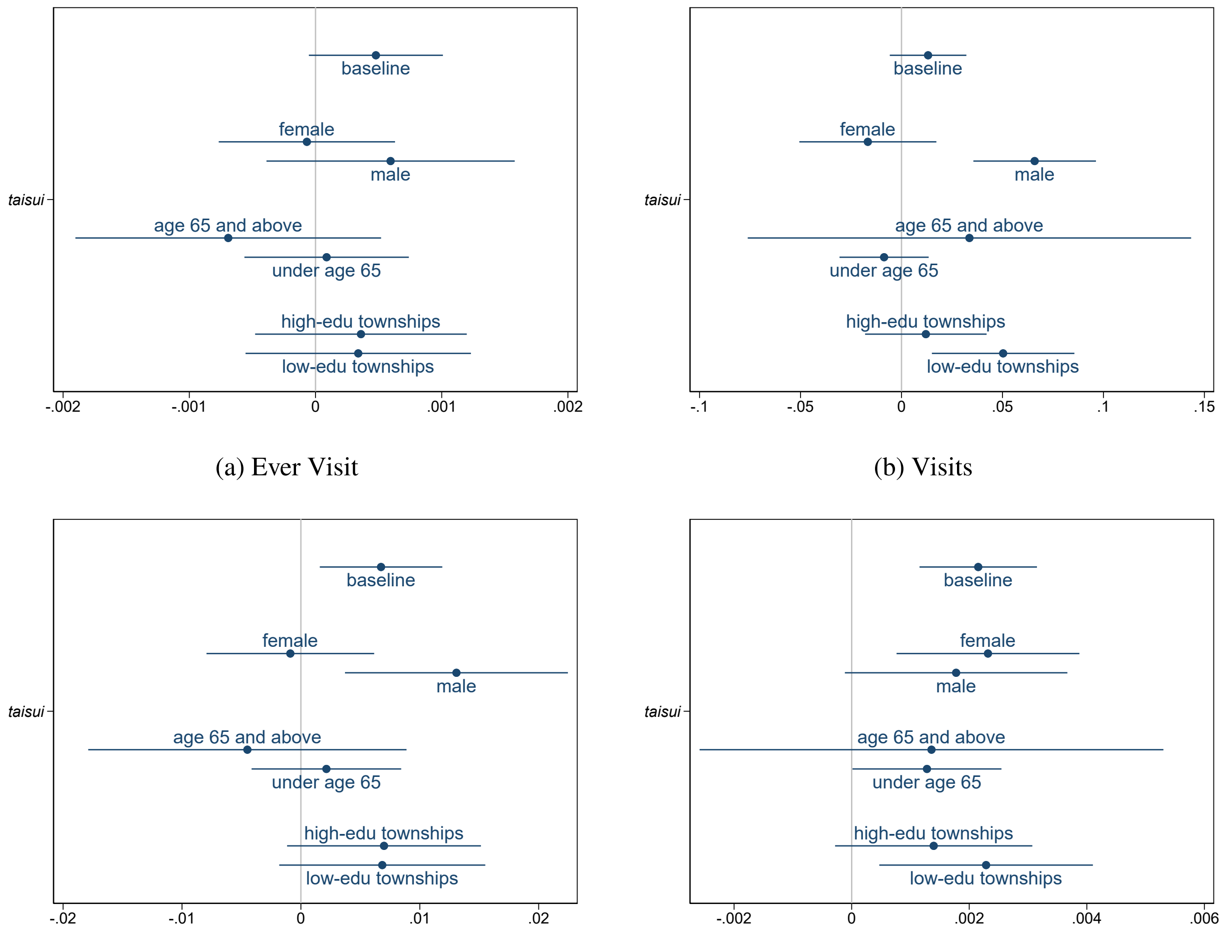
Schoenfeld, Elizabeth M, Hemal K Kanzaria, Denise D Quigley, Peter St Marie, Nikita Nayyar, Sarah H Sabbagh, Kyle L Gress, and Marc A Probst. 2018. "Patient preferences regarding shared decision making in the emergency department: findings from a multisite survey." *Academic emergency medicine* 25 (10): 1118–1128.

Wu, Nan, Xiaomeng Zhang, and Wenyu Zhou. 2023. "The impacts of superstition on risk preferences and beliefs: Evidence from the Chinese zodiac year." *China Economic Review* 81:102043.

Zhang, Haifeng, and Yumeng Pang. 2022. "Spiritual Traditional Supernatural Beliefs and Risk Aversion Behavior: New Evidence from Chinese Numerology." *Available at SSRN 4161540.*

Figures and Tables

Figure 1: The Effect of *Taisui* on Outpatient Visits, Estimated with Subsamples



(a) Ever Visit

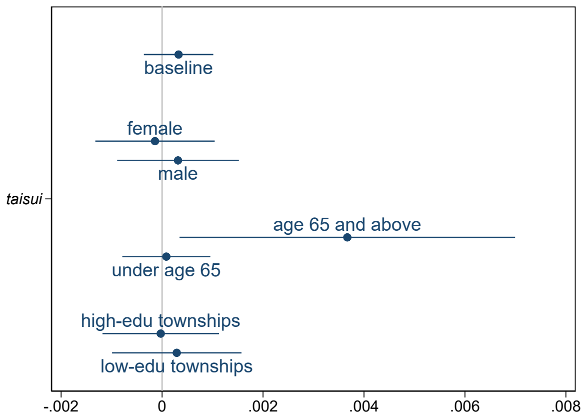
(b) Visits

(c) $log(\text{cost})$

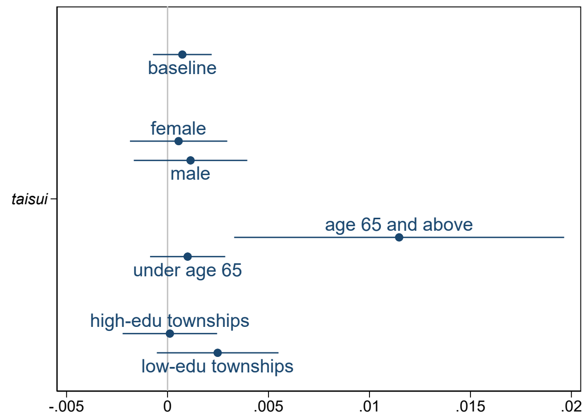
(d) $log(\text{cost per Visit})$

Note: The figures shows the estimates of *taisui* effects in Equation (1) and the 90% confidence intervals on regarding outcomes of the subsample labeled. Each estimation is controlled for Charlson Comorbidity Index based on last year's claim data and excluding the age factors, age in the sex-specific quadratic form, individual fixed effects, and county-year fixed effects The robust standard errors are clustered by lunar birth cohorts. The baseline is the estimate with the whole sample and the same as results in Table 2 Panel A. The high-edu (low-) townships subsample contains individuals living in the township where the share of high-school graduates is above (below) the medium in the 2010 Taiwan population Census. Other subsample tags are self-explanatory.

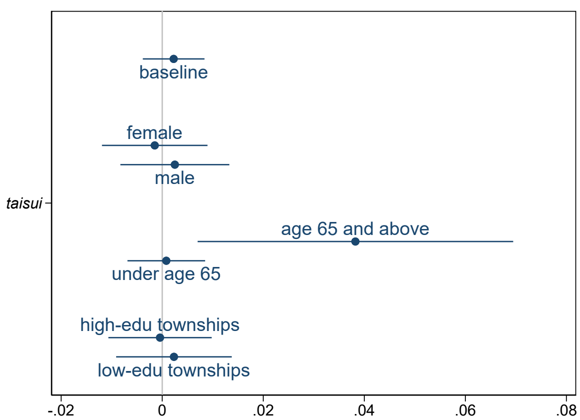
Figure 2: The Effect of *Taisui* on Emergency Department Visits, Estimated with Subsamples



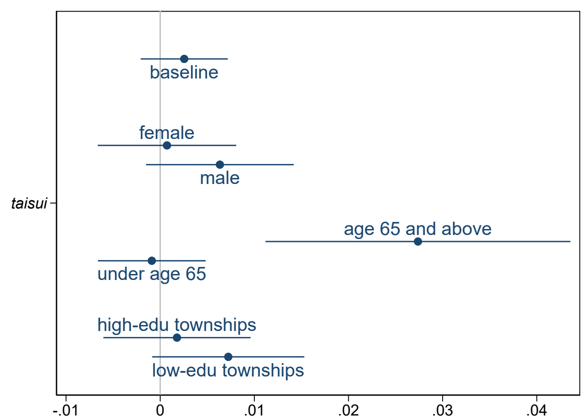
(a) Ever Visit



(b) Visits



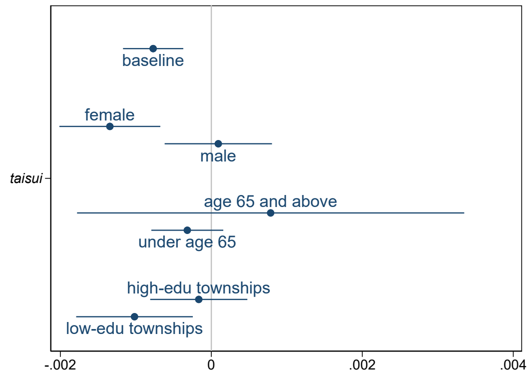
(c) $log(\text{cost})$



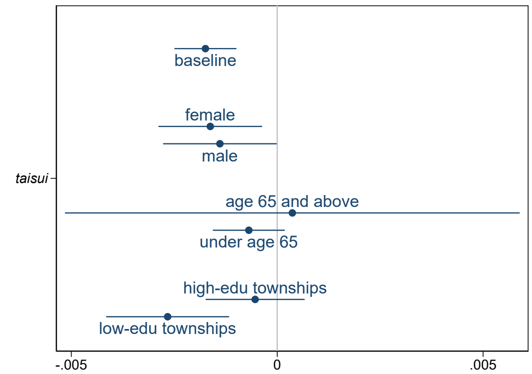
(d) $log(\text{cost per Visit})$

Note: The figures shows the estimates of *taisui* effects in Equation (1) and the 90% confidence intervals on regarding outcomes of the subsample labeled. Each estimation is controlled for Charlson Comorbidity Index based on last year's claim data and excluding the age factors, age in the sex-specific quadratic form, individual fixed effects, and county-year fixed effects The robust standard errors are clustered by lunar birth cohorts. The baseline is the estimate with the whole sample and the same as results in Table 2 Panel B. The high-edu (low-) townships subsample contains individuals living in the township where the share of high-school graduates is above (below) the medium in the 2010 Taiwan population Census. Other subsample tags are self-explanatory.

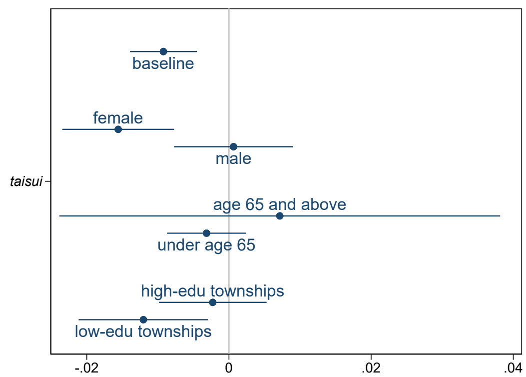
Figure 3: The Effect of *Taisui* on Inpatient Admissions, Estimated with Subsamples



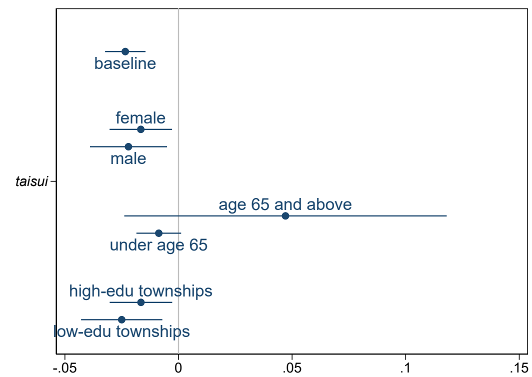
(a) Ever Admitted



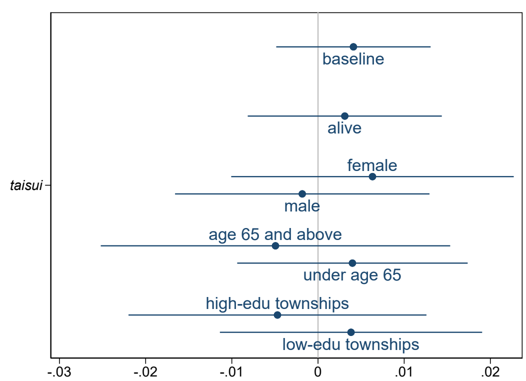
(b) Admissions



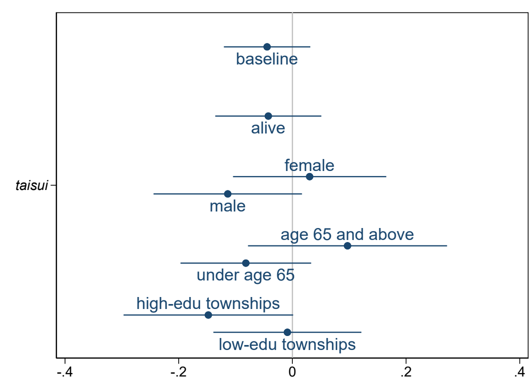
(c) $log(\text{cost})$



(d) Days in Hospitals



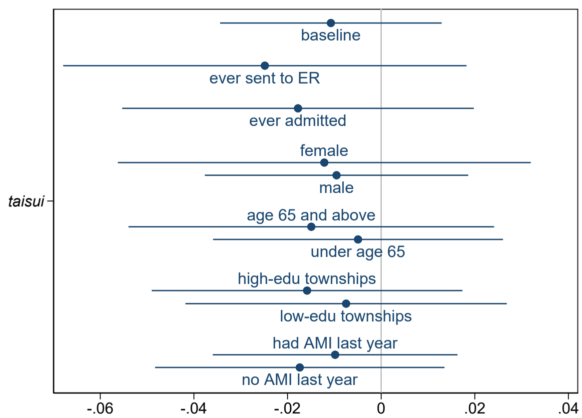
(e) $log(\text{cost per Visit})$



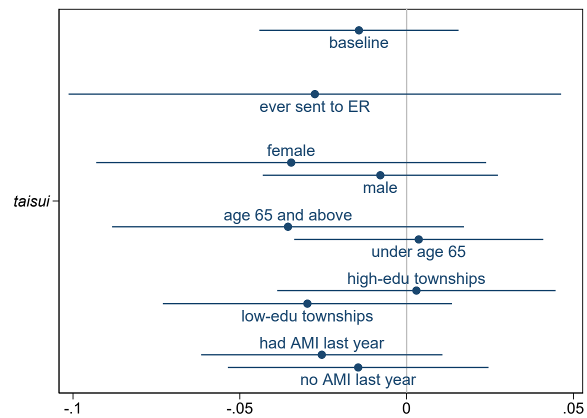
(f) Days in Hospitals per Admission

Note: The figures shows the estimates of *taisui* effects in Equation (1) and the 90% confidence intervals on regarding outcomes of the subsample labeled. Each estimation is controlled for Charlson Comorbidity Index based on last year's claim data and excluding the age factors, age in the sex-specific quadratic form, individual fixed effects, and county-year fixed effects The robust standard errors are clustered by lunar birth cohorts. The baseline is the estimate with the whole sample and the same as results in Table 2. The alive subsample is conditional on individuals being alive at the end of that year. The high-edu (low-) townships subsample contains individuals living in the township where the share of high-school graduates is above (below) the medium in the 2010 Taiwan population Census. Other subsample tags are self-explanatory.

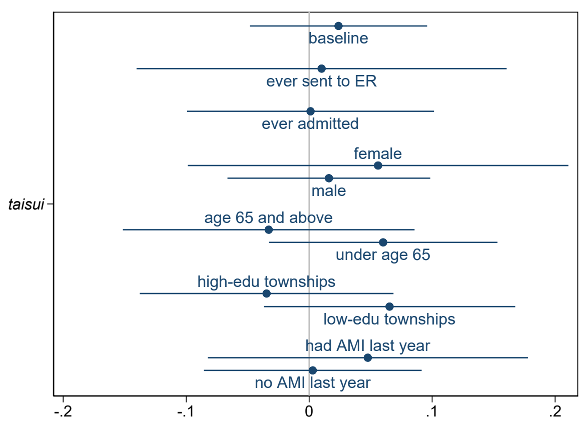
Figure 4: The Effect of *Taisui* on AMI Patients, Estimated with Subsamples



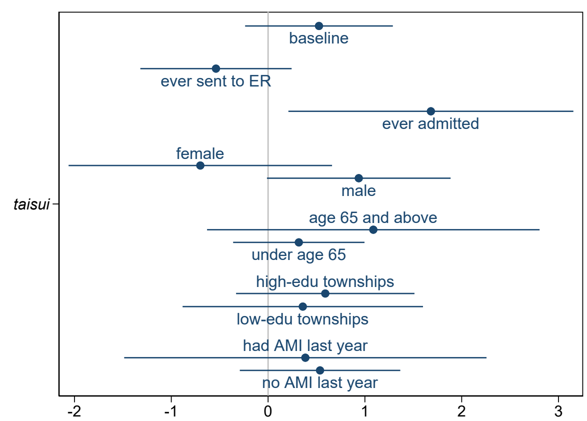
(a) Had Invasive Surgeries



(b) Ever Admitted due to AMI



(c) log(cost on AMI)



(d) Day in Hospital due to AMI

Note: The figures shows the estimates of *taisui* effects in Equation (3) and the 90% confidence intervals on regarding outcomes of the subsample labeled. Each estimation is controlled for adjusted Charlson Comorbidity Index based on last year's claim data and excluding the acute myocardial infarction (AMI) component and the age factors, age in the sex-specific quadratic form, individual fixed effects, and county-year fixed effects. The robust standard errors are clustered by lunar birth cohorts. The baseline is the estimate with the whole sample and the same as results in Table 9. The ever sent to ER (admitted) subsample is conditional on individuals who have ever sent to ER (been admitted) due to AMI at that year. The high-edu (low-) townships subsample contains individuals living in the township where the share of high-school graduates is above (below) the medium in the 2010 Taiwan population Census. Other subsample tags are self-explanatory.

Table 1: Summary Statistics

Variable	N	Mean	S.D.
Panel A: Individual Characteristics			
in *taisui* years	7,774,934	0.08	0.28
female	7,774,934	0.50	0.50
age	7,774,934	43.41	15.28
at high education-level townships	7,773,849	0.54	0.50
CCI	7,774,934	0.42	0.99
$= 0$	7,774,934	0.76	0.43
$= 1$	7,774,934	0.14	0.35
≥ 2	7,774,934	0.10	0.30
Panel B: Outpatient Outcomes (excluding ED)			
ever visit	7,774,934	0.88	0.32
# of visits	7,774,934	14.13	15.83
costs (2011 USD)	7,774,934	485.57	1,766.58
costs per visit	6,865,189	29.26	61.13
Panel C: Emergency Department Outcomes			
ever visit	7,774,934	0.15	0.36
# of visits	7,774,934	0.23	0.84
costs (2011 USD)	7,774,934	20.39	225.87
costs per visit	1,181,257	83.25	119.12
Panel D: Inpatient Outcomes			
ever admitted	7,774,934	0.07	0.25
# of admissions	7,774,934	0.11	0.52
costs (2011 USD)	7,774,934	209.31	1,773.20
days in hospital	7,774,934	0.85	6.21
costs per admission	536,877	1,839.87	3,256.15
days in hospital per admission	536,877	7.23	8.47

Note: Observations are in individual-year level. The sample is restricted to individuals aged 20-80 in years 2001-2011. All costs are converted to 2011 US dollars and adjusted for the healthcare CPI in Taiwan. Hospital admissions related to pregnancy and childbirth (ICD-9-CM: 630-679) are excluded when measuring inpatient outcomes. High education-level townships are defined as townships where the share of high school graduates is higher than the national median in the 2010 Taiwan population census. CCI is the Charlson comorbidity index based on last year's claim data and excluding the age factors.

Table 2: The Effect of *Taisui* on Healthcare Usage

	per individual-year				per visit/admission	
	(1) Ever Visit/ Admitted	(2) # Visits/ # Admissions	(3) log(cost)	(4) Days in Hospitals	(5) log(cost)	(6) Days in Hospitals
Panel A: Outpatient Visits (excluding ED)						
taisui	0.0003	0.0254**	0.0063**		0.0021***	
	(0.0003)	(0.0116)	(0.0030)		(0.0006)	
Observations	7,749,541	7,749,541	7,749,541		6,833,182	
Adjusted R^2	0.459	0.673	0.555		0.431	
Dep. var. Mean	0.88	14.13	485.57		29.26	
Panel B: Emergency Department Visits						
taisui	0.0001	0.0008	0.0006		0.0035	
	(0.0004)	(0.0009)	(0.0038)		(0.0027)	
Observations	7,749,541	7,749,541	7,749,541		962,611	
Adjusted R^2	0.154	0.281	0.167		0.270	
Dep. Mean	0.15	0.23	20.39		83.25	
Panel C: Inpatient Admissions						
taisui	-0.0006**	-0.0015***	-0.0074**	-0.0192***	0.0013	-0.0523
	(0.0003)	(0.0006)	(0.0035)	(0.0066)	(0.0067)	(0.0573)
Observations	7,749,541	7,749,541	7,749,541	7,749,541	365,949	365,949
Adjusted R^2	0.164	0.244	0.177	0.260	0.279	0.414
Dep. Mean	0.07	0.11	209.31	0.85	1,839.87	7.23

Note: Each column shows the estimation of Equation 1 with the outcome listed. Columns (1)-(4) contain the estimations of *taisui* effect on outcomes measured at the individual-year level, and Columns (5)-(6) contain the estimations of *taisui* effect on outcomes measured at the admission level. Panels A, B, C contains the estimations on inpatient, outpatient (excluding ED), and emergency department outcomes. In all columns, the samples are restricted to individuals aged 20-80 in years 2001-2011. In Columns (5)-(6), the samples are further restricted to individuals having at least one admission in the year. All regressions are controlled for medical history (in CCI groups), age in the sex-specific quadratic form, individual fixed effects, and county-year fixed effects. Dep. Mean represent the means of dependent variables in each column, and the costs are restored to the numeric terms. Robust standard errors clustered at individual level are in parentheses. ***: $p<0.01$; **: $p<0.05$; *: $p<0.1$.

Table 3: The Effect of *Taisui* on Outpatient and Emergency Department Visits, by Health Status

	(1)	(2)	(3)	(4)
	per individual-year			per visit
	Ever Visit	Visits	log(cost)	log(cost)
Panel A: Outpatient Visits (excluding ED)				
taisui effects on:				
CCI$=0$ (β_1)	-0.0000	0.0100	0.0022	0.0017**
	(0.0004)	(0.0113)	(0.0038)	(0.0007)
CCI$=1$ ($\beta_1+\beta_4$)	0.0009***	-0.0102	0.0107**	0.0035**
	(0.0003)	(0.0383)	(0.0042)	(0.0015)
CCI≥ 2 ($\beta_1+\beta_5$)	0.0019***	0.2108***	0.0331***	0.0025
	(0.0004)	(0.0631)	(0.0055)	(0.0021)
Observations	7,749,541	7,749,541	7,749,541	6,833,182
Adjusted R^2	0.4589	0.6729	0.5551	0.4310
Dep. var. Mean	0.88	14.13	485.57	29.26
Panel B: Emergency Department Visits				
taisui effects on:				
CCI$=0$ (β_1)	0.0004	0.0008	0.0032	0.0012
	(0.0005)	(0.0008)	(0.0041)	(0.0034)
CCI$=1$ ($\beta_1+\beta_4$)	-0.0007	0.0013	-0.0075	-0.0015
	(0.0013)	(0.0029)	(0.0116)	(0.0064)
CCI≥ 2 ($\beta_1+\beta_5$)	-0.0010	0.0002	-0.0092	0.0160**
	(0.0017)	(0.0063)	(0.0164)	(0.0069)
Observations	7,749,541	7,749,541	7,749,541	962,611
Adjusted R^2	0.1543	0.2806	0.1673	0.2695
Dep. Mean	0.15	0.23	20.39	83.25

Note: Each column shows the total *taisui* effects on the outcomes of individuals with listed levels of the Charlson Comorbidity Index (CCI). The coefficients are regarding Equation 2. Columns (1)-(3) show the estimations with outcomes measured at the individual-year level, and Column (4) shows the estimation with the outcome measured at the admission level. Panel A contains the outcomes of outpatient (excluding emergency department (ED) visits), and Panel B contains the ED outcomes. In all columns, the samples are restricted to individuals aged 20-80 in years 2001-2011. In Column (4), the sample is further restricted to individuals having at least one outpatient/ED visit in the year. CCI is based on last year's claim data and excludes the age factors. All regressions are controlled for age in the sex-specific quadratic form, individual fixed effects, and county-year fixed effects. Dep. Mean by CCI represent the means of dependent variables in each column conditional on each group of CCI levels, and the costs are restored to the numeric terms. Robust standard errors clustered at individual level are in parentheses.

Table 4: The Effect of *Taisui* on Inpatient Admissions, by Health Status

	(1)	(2)	(3)	(4)	(5)	(6)
	per individual-year				per admission	
	Ever Admitted	Admissions	log(cost)	Days in Hospitals	log(cost)	Days in Hospitals
taisui effects on:						
CCI= 0 (β_1)	-0.0003	-0.0001	-0.0031	0.0001	-0.0050	-0.1082
	(0.0003)	(0.0005)	(0.0034)	(0.0053)	(0.0109)	(0.0983)
CCI= 1 ($\beta_1 + \beta_4$)	-0.0016*	-0.0016	-0.0201*	-0.0562***	-0.0255*	-0.1833
	(0.0010)	(0.0017)	(0.0114)	(0.0196)	(0.0147)	(0.1236)
CCI$\geq$ 2 ($\beta_1 + \beta_5$)	-0.0018	-0.0131***	-0.0247	-0.1247**	0.0160	0.0360
	(0.0016)	(0.0042)	(0.0191)	(0.0505)	(0.0104)	(0.0877)
Observations	7,749,541	7,749,541	7,749,541	7,749,541	365,949	365,949
Adjusted R^2	0.1638	0.2440	0.1773	0.2599	0.2788	0.4138
Dep. Mean	0.07	0.11	209.31	0.85	1,839.87	7.23

Note: Each column shows the total *taisui* effects on the outcomes of individuals with listed levels of the Charlson Comorbidity Index (CCI). The coefficients are regarding Equation 2. Columns (1)-(4) show the estimations with outcomes measured at the individual-year level, and Columns (5)-(6) show the estimation with the outcome measured at the admission level. In all columns, the samples are restricted to individuals aged 20-80 in years 2001-2011. In Columns (5)-(6), the samples are further restricted to individuals having at least one admission in the year. CCI is based on last year's claim data and excludes the age factors. All regressions are controlled for age in the sex-specific quadratic form, individual fixed effects, and county-year fixed effects. Dep. Mean by CCI represent the means of dependent variables in each column conditional on each group of CCI levels, and the costs are restored to the numeric terms. Robust standard errors clustered at individual level are in parentheses.

Table 5: The Effect of *Taisui* on Outpatient Admissions, Robustness Checks

	(1)	(2)	(3)	(4)
Age Control	quadratic	cubic	quadratic	quadratic
Years to *Taisui*	all	all	[-3,3]	[-2,2]
	Outcome: Ever Visit			
taisui	0.0003	0.0001	-0.0000	-0.0000
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Observations	7,749,541	7,749,541	4,590,826	3,272,716
	Outcome: Visits			
taisui	0.0254**	0.0251**	0.0315***	0.0205*
	(0.0116)	(0.0116)	(0.0107)	(0.0105)
Observations	7,749,541	7,749,541	4,590,826	3,272,716
	Outcome: log(**cost**)			
taisui	0.0063**	0.0040	0.0032	0.0015
	(0.0030)	(0.0030)	(0.0029)	(0.0029)
Observations	7,749,541	7,749,541	4,590,826	3,272,716
	Outcome: log(**cost per visit**)			
taisui	0.0021***	0.0019***	0.0007	0.0001
	(0.0006)	(0.0006)	(0.0006)	(0.0006)
Observations	6,833,182	6,833,182	4,040,423	2,870,057

Note: Each column shows the estimation of Equation 1 with the age control and subsample listed. Column (1) shows the same estimations as in Table 2 Panel A. Each panel shows the estimates of the effect of *taisui* on each outpatient outcome. Panels 1-3 contain the estimations with outcomes measured at the individual-year level, and Panel 4 contains the estimation with the outcome measured at the visit level. In all estimations, the samples are restricted to individuals aged 20-80 in years 2001-2011. In Columns (3)-(4), the samples are also restricted to individuals whose ages are within three or two years around each *taisui* ages. In Panel 4, the sample is further restricted to individuals having at least one outpatient visit in the year. All regressions are controlled for Charlson Comorbidity Index based on last year's claim data and excluding the age factors, individual fixed effects, and county-year fixed effects. Robust standard errors clustered at individual level are in parentheses. ***: p<0.01; **: p<0.05; *: p<0.1.

Table 6: The Effect of *Taisui* on Emergency Department Visits, Robustness Checks

	(1)	(2)	(3)	(4)
Age Control	quadratic	cubic	quadratic	quadratic
Years to *Taisui*	all	all	[-3,3]	[-2,2]
	Outcome: Ever Visit			
taisui	0.0001	0.0002	0.0008*	0.0007
	(0.0004)	(0.0004)	(0.0004)	(0.0005)
Observations	7,749,541	7,749,541	4,590,826	3,272,716
	Outcome: Visits			
taisui	0.0008	0.0014	0.0026***	0.0024***
	(0.0009)	(0.0009)	(0.0009)	(0.0009)
Observations	7,749,541	7,749,541	4,590,826	3,272,716
	Outcome: $log($**cost**$)$			
taisui	0.0006	0.0025	0.0077**	0.0066
	(0.0038)	(0.0038)	(0.0039)	(0.0040)
Observations	7,749,541	7,749,541	4,590,826	3,272,716
	Outcome: $log($**cost per visit**$)$			
taisui	0.0035	0.0035	0.0049	0.0047
	(0.0027)	(0.0027)	(0.0030)	(0.0033)
Observations	962,611	962,611	481,298	295,539

Note: Each column shows the estimation of Equation 1 with the age control and subsample listed. Column (1) shows the same estimations as in Table 2 Panel B. Each panel shows the estimates of the effect of *taisui* on each emergency department (ED) outcome. Panels 1-3 contain the estimations with outcomes measured at the individual-year level, and Panel 4 contains the estimation with the outcome measured at the visit level. In all estimations, the samples are restricted to individuals aged 20-80 in years 2001-2011. In Columns (3)-(4), the samples are also restricted to individuals whose ages are within three or two years around each *taisui* ages. In Panel 4, the sample is further restricted to individuals having at least one ED visit in the year. All regressions are controlled for Charlson Comorbidity Index based on last year's claim data and excluding the age factors, individual fixed effects, and county-year fixed effects. Robust standard errors clustered at individual level are in parentheses. ***: $p<0.01$; **: $p<0.05$; *: $p<0.1$.

Table 7: The Effect of *Taisui* on Inpatient Admissions, Robustness Checks

	(1)	(2)	(3)	(4)
Age Control	quadratic	cubic	quadratic	quadratic
Years to *Taisui*	all	all	[-3,3]	[-2,2]
	Outcome: Ever Admitted			
taisui	-0.0006**	-0.0004	0.0002	0.0004
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Observations	7,749,541	7,749,541	4,590,826	3,272,716
	Outcome: Admissions			
taisui	-0.0015***	-0.0010*	0.0005	0.0009
	(0.0006)	(0.0006)	(0.0006)	(0.0006)
Observations	7,749,541	7,749,541	4,590,826	3,272,716
	Outcome: log(**cost**)			
taisui	-0.0074**	-0.0045	0.0028	0.0060
	(0.0035)	(0.0035)	(0.0035)	(0.0036)
Observations	7,749,541	7,749,541	4,590,826	3,272,716
	Outcome: Days in Hospitals			
taisui	-0.0192***	-0.0110*	0.0062	0.0112*
	(0.0066)	(0.0066)	(0.0065)	(0.0066)
Observations	7,749,541	7,749,541	4,590,826	3,272,716
	Outcome: log(**cost per admission**)			
taisui	0.0013	0.0023	0.0045	0.0048
	(0.0067)	(0.0067)	(0.0073)	(0.0080)
Observations	365,949	365,949	164,777	100,073
	Outcome: Days in Hospitals per Admission			
taisui	0.0013	0.0023	0.0045	0.0048
	(0.0067)	(0.0067)	(0.0073)	(0.0080)
Observations	365,949	365,949	164,777	100,073

Note: Each column shows the estimation of Equation 1 with the age control and subsample listed. Column (1) shows the same estimations as in Table 2 Panel C. Each panel shows the estimates of the effect of *taisui* on each inpatient outcome. Panels 1-4 contain the estimations with outcomes measured at the individual-year level, and Panels 5-6 contain the estimations with the outcomes measured at the admission level. In all estimations, the samples are restricted to individuals aged 20-80 in years 2001-2011. In Columns (3)-(4), the samples are also restricted to individuals whose ages are within three or two years around each *taisui* ages. In Panels 5-6, the samples are further restricted to individuals having at least one admission in the year. All regressions are controlled for Charlson Comorbidity Index based on last year's claim data and excluding the age factors, individual fixed effects, and county-year fixed effects. Robust standard errors clustered at individual level are in parentheses. ***: p<0.01; **: p<0.05; *: p<0.1.

Table 8: Summary Statistics of AMI Patients

Variable	N	Mean	S.D.
Panel A: Individual Characteristics			
in *taisui* years	11,532	0.08	0.28
female	11,532	0.30	0.46
age	11,532	63.09	11.79
at high education-level townships	11,532	0.49	0.50
ever sent to ER	11,532	0.14	0.34
ever admitted	11,532	0.49	0.50
previous AMI	11,532	0.28	0.45
Adjusted CCI	11,532	1.71	1.97
$= 0$	11,532	0.34	0.47
$= 1$	11,532	0.25	0.43
≥ 2	11,532	0.41	0.49
Panel B: Outcomes			
had invasive surgeries	11,532	0.30	0.46
# of admissions	11,532	0.55	0.62
total costs (USD)	11,532	12,392.55	18,427.65
days in hospital	11,532	5.52	12.56

Note: Observations are in individual-year level. The sample is restricted to individuals aged 20-80 who have at least one claim with the acute myocardial infarction (AMI, ICD-9-CM: 410.xx) diagnosis in years 2001-2011. All costs are converted to 2011 US dollars and adjusted for the healthcare CPI in Taiwan. High education-level townships are defined as townships where the share of high school graduates is higher than the national median in the 2010 Taiwan population census. Adjusted CCI is the Charlson comorbidity index based on the claims in the previous year and excluding the AMI component and the age factors.

Table 9: The Effect of *Taisui* on AMI Patients

	(1) Had Invasive Surgeries	(2) Admissions	(3) log(cost)	(4) Days in Hospitals
taisui	-0.0107	-0.0143	0.0239	0.5257
	(0.0144)	(0.0182)	(0.0438)	(0.4639)
Observations	11,531	11,531	11,531	11,531
Adjusted R^2	0.159	0.217	0.122	0.072
Dep. Mean	0.30	0.55	12,392.55	5.52

Note: Each column shows the estimation of Equation 3 with the outcome listed. Outcomes are measured at the individual-year level and considering claims with acute myocardial infarction (AMI, ICD-9-CM: 410.xx) diagnosis only. In all estimations, the samples are restricted to AMI patients aged 20-80 in years 2001-2011. Adjusted CCI is the individual's Charlson Comorbidity Index based on last year's claim data, excluding the AMI component and the age factors. All regressions are controlled for biological sex, age in the sex-specific quadratic form, and county-year fixed effects. Dep. Mean represent the means of dependent variables in each column, and the costs are restored to the numeric terms. Robust standard errors clustered at individual level are in parentheses. ***: p<0.01; **: p<0.05; *: p<0.1.

Table 10: The Effect of *Taisui* on AMI Patients, by Health Status

	(1) Had Invasive Surgeries	(2) Admissions	(3) log(cost)	(4) Days in Hospitals
taisui effects on:				
CCI$=0$ (β_1)	0.0111	0.0352	0.0624	0.6826
	(0.0259)	(0.0316)	(0.0768)	(0.5422)
CCI$=1$ ($\beta_1+\beta_4$)	-0.0023	-0.0045	-0.0132	0.5709
	(0.0258)	(0.0307)	(0.0823)	(0.6575)
CCI≥ 2 ($\beta_1+\beta_5$)	-0.0364	-0.0654**	0.0179	0.3532
	(0.0230)	(0.0305)	(0.0717)	(1.0390)
Observations	11,531	11,531	11,531	11,531
Adjusted R^2	0.1591	0.2170	0.1217	0.0715
Dep. Mean	0.30	0.55	12,392.55	5.52

Note: Each column shows the total *taisui* effects on the outcomes of individuals with listed levels of the Charlson Comorbidity Index (CCI). The coefficients are regarding Equation 4. In all columns, the samples are restricted to acute myocardial infarction (AMI, ICD-9-CM: 410.xx) aged 20-80 in years 2001-2011. CCI is based on last year's claim data and excludes the AMI component and the age factors. All regressions are controlled for biological sex, age in the sex-specific quadratic form, and county-year fixed effects. Dep. Mean by CCI represent the means of dependent variables in each column conditional on each group of CCI levels, and the costs are restored to the numeric terms. Robust standard errors clustered at individual level are in parentheses. ***: p<0.01; **: p<0.05; *: p<0.1.