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Income and Substitution Effects
in Physician-induced Demand:
Empirical Evidence Based on Reviews of Medical Bills*

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* "Physician-induced demand exits when the physician influences a patient's demand for care against the physician's interpretation of the best interest of the patient (McGuire, 2000)."

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Abstract

This paper examines the factors of physician-induced demand (PID) and the effects of inducement on medical expenditure by using the data pertaining to the reviews of medical bills for fraudulent or incorrect claims. In Japan, public third-party payers and municipal insurers independently scrutinize the bills they receive from medical institutes to ascertain the validity of the treatments listed in them. Thus, the data on the amounts of fraudulent and incorrect claims found in the double-check review process can be considered to directly reveal the magnitude of inducement.

The empirical results of the fixed effects estimations, which are based on the McGuire-Pauly theoretical model, suggest that the main factor of PID is the negative income effect and that the income effect in areas with a large number of physicians are slightly higher than those of the entire sample. However, it is found that medical supply densities have little effect on inducement and medical expenditure. On the other hand, although per capita inducement does not have a significant effect on medical expenditure, per bill inducement has a significantly positive impact on expenditure. This indicates that there exists a slight substitution effect due to the disutility of inducement.

Keywords: Physician-induced demand, Japanese National Health Insurance,

revierw data of medical bills, McGuire-Pauly model

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1. Introduction

The physician-induced demand (PID) hypothesis is one of the most debated issues in health economics because investigating the existence of inducement will enable us to obtain extremely important policy implications for medical care systems.

The existence of PID has mainly been tested by evaluating the responses to two environmental changes that influence the supply of medical services by physicians. The first involves changes in the physician-population ratio (physician density) across areas. Specifically, if an increase in physician density in a particular area reduces the income of the existing physicians, they may recommend unnecessary medical treatments and tests to patients in order to compensate for the loss of income. In this case, policy makers should design medical systems taking into consideration the social optimal level of physician density. For instance, the Japanese government currently regulates the number of hospital beds by region and limits the number of medical school graduates in order to prevent an increase in medical expenditure due to inducement. In fact, the Organization for Economic Co-operation and Development (OECD) (2007) reports that in Japan, there are only 2 physicians per 1000 people, which is the fourth lowest ratio among the OECD countries. However, Japan's Ministry of Health, Labour and Welfare (MHLW) (2008) has recently committed to a policy shift that aims to increase the number of physicians in order to resolve the problems arising from a shortage of physicians. The second response concerns fee reduction policies and health insurance reforms. For instance, while the governments of many developed countries have recently regulated and reviewed their countries' medical fee schemes in order to control medical expenditure, these price regulations have little effect if inducement exists.

However, many of the previous studies on PID have experienced certain analytical problems. At first glance, the significantly positive effect of physician density on medical care supply or medical expenditure per capita appears to be the evidence of existence of inducement (Evans, 1974; Birch, 1988; Grytten et al., 1990; Carlsen and Grytten, 2000). However, this positive relationship is also observed in cases where inducement is not found to exist. There are three possible reasons that explain this positive relationship as follows. First, it could be the result of reverse causality: physicians tend to locate in areas with high medical expenditure. In particular, PID is readily observed owing to this reverse causality when cross-section data are employed. Previous studies such as Fuchs (1978), Cromwell and Mitchell (1986), Sorensen and Grytten (1999), and Richardson et al. (2006) use instrumental variable (IV) regression models or simultaneous equations models to solve this problem. However, three additional analytical problems are pointed out with respect to these studies. The first problem involves the identification of the estimated equations. For instance, Auster and Oaxaca (1981) points out that a certain amount of variations in factor prices, which are used as the instruments, is necessary to econometrically identify the effect of inducement, however, Fuchs (1978) does not adequately consider this issue. The second problem concerns the existence of omitted variable bias. As Phelps (1986) and Gruber and Owing (1996) point out, there remains a possibility that some areas will have both high medical expenditure and a large number of physicians without the existence of inducement if there are present certain unobserved local characteristics correlated with preferences for intervention. The third problem pertains to the validity of estimation strategies. Dranove and Wehner (1994) applies the IV approach and tests inducement with respect to childbirth services. They find evidence of inducement, leading them to suspect the validity of Fuchs's approach.

The second possible explanation of the positive relationship is that an increase in physician density improves patients' access to medical institutes. Thus, medical expenditure is raised in the area due to the demand increase in ambulatory care. To distinguish between inducement and the effect of improved accessibility, a two-part model that divides the total demand for medical treatments into patient-initiated demand and physician-initiated demand is applied generically. In this model, a significantly positive effect of physician density on physician-initiated demand can be regarded as evidence of inducement (Rossiter and Wilensky, 1983, 1984; Folland and Stano, 1989; Manning et al., 1987; Escarse, 1992; Pohlmeier and Ulrich, 1995; Deb and Trivedi, 2002). However, as Mullahy (1998) points out, it is necessary for all the covariates to satisfy strict exogeneity in order to estimate the parameters consistently when using two-part model. In any case, all the parameters are not necessarily estimated consistently in the model because it is usually difficult to control the endogeneity of physician density, as mentioned above.

Finally, the third possible explanation is that depending on the level of physician density, a positive relationship is observed for reasons other than inducement. In fact, in low supply areas, an increase in the number of physicians reduces the excess demand (rationing), which, in turn, raises the medical expenditure in the area. To distinguish between inducement and the excess demand effect, the estimation sample is divided into two groups: areas with high physician density and ones with low physician density. A significantly positive effect of physician density on medical supply in the high density areas can be regarded as evidence of inducement (Grytten and Sorensen, 2001; Grytten et al., 2001; Delattre and Dormont, 2003).

In light of the above problems, it seems extremely difficult to estimate parameters consistently because of the difficulty in identifying the various causalities. In addition, it appears as though investigations of PID based solely on physician density are not sufficient.

Another approach adopted in studies on PID involves the use of natural experiments, for instance, analyses of specific fee reduction policies and medical policy reforms. This approach is better than the physician density approach because of precluding the above mentioned identification problems (Rice, 1983; Rochaix, 1993; Hurley and Labbele, 1995; Nguyen and Derrick, 1997; Yip, 1998; Giuffrida and Gravelle, 2001; Iverson, 2004; Lein et al., 2004; Madden et al., 2005). However, when using such exogenous environmental changes, there is a possibility that the causality of PID is incorrectly identified. For instance, in a health insurance system with a constant copayment rate, fee reduction reforms decrease both physicians' income and the copayments of patients. Therefore, it is difficult to determine whether the increase in medical services resulting from fee reductions reflects the existence of inducement or a rise in the true demand of patients due to the income effect. In addition, applying the natural experiments to identify PID causes another identification problem: the income and the substitution effects go in opposite directions[1]. Consequently, when a reform has little or no effect on the medical supply, it is difficult to determine whether it can be because physicians are inducing demand or simply because the income and substitution effects offset each other. However, most of the previous empirical analyses either do not consider these two effects or assume that the income effect dominates the substitution effect. In this regard, Gruber and Owing (1996) use socioeconomic environmental changes relating to declining fertility rates in order to avoid the identification problem, while Yip (1998) identifies these effects by expressly considering the spillover effect from the Medicare sector to the private sector in the United States.

This paper examines the factors of PID and the effects of inducement on medical expenditure by using data pertaining to the review of medical bills performed by municipal

[1] Section 3.2 presents a simple overview of this model.

insurers in the Japanese National Health Insurance (NHI) system and public third-party payers. Specifically, public third-party payers and municipal insurers independently verify the validity of the medical treatments listed in the bills they receive from medical institutes. They then remand any suspect bills to the medical institutes and correct and clear the remaining bills for reimbursement. Thus, data on the amounts of fraudulent and incorrect claims found in the double-check review process can be considered to directly reveal the magnitude of inducement. To the best of my knowledge, this is the first attempt to examine PID on the basis of such data[2]. In addition, using this data can model the mechanism of PID more clearly than before and overcome many of the above-mentioned analytical problems. Further, examining PID using Japanese data provides another advantage. Generally, since the medical fee scheme in Japan is the fee-for-service reimbursement system, which is determined by the central government, physicians are considered to be easy to induce unnecessary treatments. This paper is organized as follows. Section 2 briefly summarizes the recent previous studies on PID. Section 3 presents the analytic strategies and data employed in this study. Section 4 provides the estimation results. Section 5 discusses the results and their policy implications.

[2] Labbele et al. (1994) and Carlsen and Grytten (2000) discuss the existence of inducement from another perspective. They point out that if inducement exists and contributes to improving patients' health, then it benefits the entire society. They thereby conclude that we should be careful when evaluating or interpreting the existence of inducement.

2. Recent Previous Studies on PID

Since McGuire (2000) comprehensively surveys the previous studies on PID published in the last century, this paper summarizes the studies published in this century[3]. The recent studies can be classified into three main groups according to the approach they employ: (1) studies that examine responses to changes in physician density, (2) studies that investigate responses to medical system reforms, and (3) studies that consider inducement from a variety of perspectives.

In the first group, Carlsen and Grytten (2000), Grytten and Sorensen (2001), Delattre and Dormont (2003), and Richardson *et al*. (2006) examine responses to changes in physician density. Carlsen and Grytten (2000) examines the relationship between the supply and quality of primary care physicians and measures consumer satisfaction with respect to primary care physician services in Norway. The empirical results, which are based on large-scale survey data, reveal that an increase in the number of physicians leads to improved consumer satisfaction, and that the relationship between consumer satisfaction and physician density exhibits diminishing returns to scale. Grytten and Sorensen (2001) divides physicians into two groups -contract physicians who have financial incentives to induce and salaried physicians who do not have such incentives -to examine whether or not inducement exists for primary care services in Norway. The empirical results, which are based on data obtained from a 1998 survey of physicians, suggest that neither of the two groups increased their output as a response to an increase in physician density. Delattre and Dormont (2003) investigates the effect of changes in the physician-population ratio on the

[3] In Japan, several studies have conducted empirical analyses on PID by applying Fuchs's approach, employing the two-part model, or examining the 2002 fee reduction reform as a natural experiment. However, the conclusions drawn by these studies have been controversial.

behaviors of French general practitioners (GPs) and specialists by using the general method of moments (GMM) estimation approach. Their estimation results, which are based on data from *Caisse Nationale d'Assurance Maladie des Travailleurs Salaries*, indicate that an increase in the physician-population ratio leads to a decline in the number of both consultations and physicians. Moreover, they suggest that the decrease in the number of consultations can be counterbalanced by increasing the volume of care delivered during each consultation. Richardson *et al*. (2006), using aggregate cross-section data from 1995, examines how GP fees are established in the Australian market. The IV estimation results show that a 1% increase in the doctor-population ratio raises the medical expenditures of GPs and specialists by 5.7% and 8.6%, respectively.

In the second group, Giuffrida and Gravelle (2001), Iverson (2004), Lein *et al*. (2004), and Madden *et al*. (2005) investigate responses to the introduction and reform of medical systems. Giuffrida and Gravelle (2001) analyzes the effect of introducing differential payments on night visits to GPs for primary care in United Kingdom's National Health Service (NHS). The results of fixed effects estimations based on *Health Service Indicators* from FY1984 to FY1994 suggest that the reform has led GPs to increase their own night visits and reduce the number of visits by their deputies. They also find that the fee change led to lower demand when GPs sent deputies and to demand inducement when GPs paid visits themselves. Iverson (2004) investigates whether physicians who faced a decline in the number of patients due to the introduction of capitation trial payments increase the treatment intensity to maintain their income. The empirical results, which are based on 5-year panel data pertaining to GPs, suggest that the GPs who experience a shortage of patients have a higher income per listed person than those who do not face a shortage. Lein *et al*. (2004) tests for the presence of the three provider-client interactions that influence the quantity of health care use, namely, rationing, effort, and persuasion. Using the data of patients who received outpatient treatment for alcohol abuse in *the Maine Addiction Treatment System* in the United States, they find evidence of rationing and persuasion but not effort. Madden *et al*. (2005) examines the effect of the change in the reimbursement system that was established in 1989 in Ireland in terms of physician behavior. Using a difference-in-difference approach on pooled micro-data from 1987, 1995, and 2000, they find that medical card eligibility has a consistently positive and significant effect on the utilization of GP services.

Finally, in the third group, Grytten *et al*. (2001) and Van de Voorde *et al*. (2001) examine the existence of PID from a variety of perspectives. Grytten *et al*. (2001) examines the relationship between non-practice income and the supply of primary care physician services in Norway. They find that non-practice income has effects on neither the number of consultations per physician nor the number of treatment items per consultation. Van de Voorde *et al*. (2001) estimates out-of-pocket price elasticity in a non-experimental real-world context and compares it with the results of the RAND Health Insurance Experiment[4]. Their fixed effects estimation results suggest that in the short run, the non-experimental utilization effects of cost sharing are very similar to the experimental evidence.

[4] See Newhouse *et al*. (1993).

3. Models and Data

3.1 Theoretical Background

The theoretical background of this study is based on McGuire-Pauly's one-payer/one-service model (McGuire and Pauly, 1991). As Yip (1998) points out, this is the general model of physician behavior with a subjective inducement cost that encompasses benchmark cases of both profit maximization and target income. In addition, this simplest model can adequately describe the physician's supply behavior in Japan, because medical expenditure is determined on the basis of a single medical fee scheme regardless of the patient's insurance plan.

Formally, the physician maximizes the following utility subject to constraints on time and income.

$$\max \quad U(Y, L, I) \tag{1}$$

$$s.t. \quad 24 = L + c \cdot S(I) \tag{2}$$

$$Y = p \cdot S(I), \tag{3}$$

where Y is income, L is leisure, and I is the amount of inducement. Moreover, c is the time cost per unit of inducement effort, p is the price of medical care, and S is the supply of medical care. The utility function has the following characteristics.

$$\begin{array}{lll} U_Y > 0 & U_L > 0 & U_I < 0 \\ U_{YY} < 0 & U_{LL} < 0 & U_{II} < 0 \end{array}$$

By solving the utility maximization problem, the following optimal induced-demand function and supply function for medical care can be derived.

$$I^* = I(p,c) \tag{4}$$

$$S = S(I^*) \ (= S(p,c)) \tag{5}$$

In this model, the physician's income effect is defined such that the demand for medical care is induced in response to a fee reduction ($\partial I / \partial p < 0$). On the other hand, the substitution effect is defined such that inducement is either reduced or substituted because it causes disutility or is unprofitable ($dS / dI < 0$).

3.2 The Data

The main data used in this paper are sourced from the prefectural *Report on National Health Insurance* (RNHI) for FY1999 to FY2003, which is annually published by each prefecture in Japan. This report contains detailed summaries of the compositions of the insured, the fiscal climate, and the medical care benefits of each insurer in the prefecture. The present paper uses information pertaining to the municipal insurers in six prefectures where the results of the review of medical bills are disclosed, namely, Chiba, Ibaraki, Iwate, Kanagawa, Nagano, and Tochigi[5].

[5] This information is collected and disclosed independently by each insurer, and not all prefectures disclose this information. In addition, each prefectural library must be visited independently to gather these statistics because the RNHI has yet to be computerized. Therefore, owing to financial and time constraints, the author only collected data for eastern Japan.

Figure 1 is a general illustration of the Japanese NHI payment system[6]. As is evident, medical institutes do not directly charge health insurers for payments; rather, they send their medical bills to the public third-party payers established by each prefecture. Third-party payers examine the bills received from medical institutes in order to ascertain that the medical treatments listed in them are appropriate and valid. They then remand any suspect bills to the medical institutes and send the remaining bills to insurers after correcting and clearing them for reimbursement. The insurers, upon receiving the bills, also closely scrutinize each bill to ascertain that none of the claims are fraudulent or incorrect. Finally, health insurance payments are defrayed from the insurers to the medical institutes through public third-party payers.

<Figure 1 is inserted here.>

In this paper, the proxy for inducement is the total amount of fraudulent and incorrect claims found in the above process. In other words, the magnitude of inducement is defined as the difference between medical institutes' total claim amount and the actual amount of reimbursements paid after the medical bills are verified through the double-check system[7].

However, the estimation results should be interpreted with caution because of the following reasons. First, since the data for the variables are annual aggregate data at the municipal level, the individual characteristics of patients, physicians, and medical institutes are not taken into account. This causes the estimators to be biased, while this paper applies

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[6] The details of the Japanese NHI system can be accessed through the following URL: http://www.kokuho.or.jp/english/kokuho/index.htm

[7] Appendix A presents the procedure for calculating the magnitude of inducement.

the fixed effects model in an attempt to reduce the effects of the omitted variables bias. Moreover, the border crossing problem (Dranove and Wehner, 1994) is also not taken into consideration for the same reason. In this regard, I calculate the clustering-robust standard errors using the local secondary medical districts[8] as the level of clustering. Third, the magnitude of inducement and medical expenditure disclosed in the RNHI include the sum of inpatient, outpatient, and dental treatments provided to all insured working-age and retired people. Note that it is difficult to exactly identify the categories in which inducement really exists, if found. Fourth, we cannot distinguish between inducement and the incorrect claims that were not found by the adjudicators. Therefore, the magnitude of inducement may well be slightly overvalued. Finally, it should be acknowledged that the use of annual variables somewhat limits the examination of the mechanisms of inducement. Nevertheless, although medical institutes charge public third-party payers on a monthly basis, this paper is compelled to use the annual data because monthly data are not published.

3.3 Econometric Models

The econometric models based on both equations (4) and (5) are given by the following structural induced-demand equation and medical care supply equation.

$$I_{it} = \alpha_0 + \alpha_1 p_{it} + \boldsymbol{\alpha}_2^{'}\mathbf{Density_{it}} + \boldsymbol{\alpha}_3^{'}\mathbf{X_{it}} + \boldsymbol{\alpha}_4^{'}\mathbf{D_{it}} + \boldsymbol{\alpha}_5^{'}\mathbf{Z_{it}} + v_{1,i} + u_{1,it} \tag{6}$$

$$S_{it} = \beta_0 + \beta_1 I_{it} + \boldsymbol{\beta}_2^{'}\mathbf{Density_{it}} + \boldsymbol{\beta}_3^{'}\mathbf{X_{it}} + \boldsymbol{\beta}_4^{'}\mathbf{D_{it}} + v_{2,i} + u_{2,it} \tag{7}$$

8 The Medical Care Law defines the local secondary medical districts as the areas where most medical treatments beyond primary care are completed, and they consist of several municipalities.

where I is the proxy for the magnitude of inducement, which is the amount of inducement per capita or the amount of inducement per bill[9] of insurer i in year t. The per capita inducement represents the macro-level inducement, while the per bill inducement represents inducement at the medical intensity level because the number of bills indicates the actual number of patients[10]. In addition, p is the increase rate of the consumer price index for health insurance treatments. In particular, the Japanese government lowered the medical treatment fees by 1.3% for the first time ever in 2002. Thus if α_1 is negatively and significantly estimated, there is inducement due to the negative income effect of fee reduction. **Density** denotes the medical supply densities, which comprise the physician density and bed density (i.e., the number of beds per 10,000 people) for general patients. If $\boldsymbol{\alpha_2}$ is positively and significantly estimated for either physician density or bed density, or for both, it can be regarded as evidence of existing inducement due to intensifying competition in the area. By adding several densities that respond to the respective medical services (outpatient and inpatient[11]), we can identify the categories in which the effects of inducement notably occur. **X** includes the year effects and the medical practitioner ratios of hospitals and clinics, which is defined as the ratio of the total number of practitioners to the sum of the number of practitioners and salaried physicians. As Grytten and Sorensen (2001) discuss, salaried physicians do not have the incentive to induce because they receive a fixed

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9 Appendix B presents the procedure for calculating the number of bills.

10 Strictly speaking, there are several cases where more than one bill can be generated for a patient. For instance, when (1) a patient visits more than one medical institute within a month or (2) a patient who initially visits the outpatient department is admitted in the hospital.

11 This paper does not consider the factors of dental treatments because such expenditures account for a mere fraction of a percent of the total medical cost. In addition, the results including the covariates for dentistry are more or less similar to those presented in this paper.

salary that is independent of output, while practitioners (contract physicians) have the incentive to compensate for the lack of patients by inducing demand. This is because they receive their income from fee-for-item payments. In fact, in a given area, the inducement and medical expenditures will increase as the practitioner ratios increase. **D** is a vector of independent variables of demand factors that includes the mortality rate, the aging population rate, total population, and the taxable income per taxpayer of insurer *i*. These variables also represent the local characteristics and affect the medical supply. In addition, adding these demand factors provides another advantage. Specifically, since these factors are considered to affect the physician's location choice, adding these variables can reduce the simultaneous bias due to the reverse causality. Further, **Z** is a vector of exogenous variables that reflect the financial conditions of municipal insurers. Specifically, **Z** consists of their premium payment rate and an indicator of the receipt of the local allocation tax (LAT). Note that this special account of the NHI consists of insurance revenue, national treasury disbursement (NTD) from the national government, and public funds from the local government. Since the amount of NTD is determined by governmental or ministerial ordinances, the share of the NHI account not adjusted by the NTD is financed by raising the municipal premium rate. In fact, since the budget climates of insurers with a low premium payment rate are considered to be stringent, such insurers may tend to be strict in assessing bills in order to control their benefit expenditure[12]. On the other hand, contributions from municipalities' general budgets to the NHI account are allowed, while the amount of transfer is entirely funded by the LAT. In other words, LAT-receiving municipalities are

[12] Since 2000, municipalities in Japan have concurrently served as public insurers to provide the public long-term care insurance. Hayashi and Kazama (2008) find that on average, municipalities with stringent fiscal climates tend to reject applications more often in order to contain their benefit expenditure.

indirectly subsidized through the LAT. Econometrically, since the covariates included in **Z** are not considered to affect the medical supply, **Z** and p sufficiently satisfy the conditions of the instrumental variables (relevance and exogeneity). Finally, v is the fixed effect of each insurer[13], and u is the idiosyncratic error that satisfies the ordinary assumptions for estimations of consistent parameters.

In equation (7), S is the medical expenditure per capita or per bill. The former expenditure, which is defined as the total medical care expenditure of insured working-age and retired people divided by the total number of people, allows us to examine the effect of inducement on the macro-level medical expenditure. On the other hand, the latter expenditure allows us to examine the effect of inducement on the medical intensity[14].If β_1 is positively and significantly estimated, then inducement is one of the significant factors of the swelling medical expenditure. Otherwise, there is the substitution effect due to the disutility of inducement. In addition, if $\boldsymbol{\beta}_2$ is positively and significantly estimated for either physician density or bed density, or for both, it would indicate that an improvement in patients' accessibility to medical institutes increases medical expenditure, since the effect of inducement on medical supply is already considered with I. The summary statistics of the main variables are provided in table 1.

<Table 1 is inserted here.>

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[13] Note that v includes the effect of c because of the unavailability of data.
[14] In fact, this estimation is proper for the second-part regression in the two-part model.

4. Estimation Results

4.1 Results of the Induced-demand Equations

The estimation results of the induced-demand equations (equation (6)) are shown in table 2. To control the effects of border crossing, standard errors are the clustering-robust standard errors, using the local secondary medical districts as the level of clustering.

Since the coefficients of the increase rate for fees (α_1) are negatively and significantly estimated, it is found that the main factor of inducement is a negative income effect due to fee reduction. Moreover, the elasticities evaluated at sample mean are estimated to be -0.037 and -0.039, which imply that a 1% reduction in medical fees increases the per capita inducement by 3.7% and the per bill inducement by 3.9%. On the other hand, the coefficients of medical supply densities ($\boldsymbol{\alpha_2}$) are not significant at all. In fact, the existence of inducement due to the negative income shock of intensifying competition is not found. In addition, since the fiscal variables are not significantly estimated, the fiscal climate of insurers does not affect the severity of medical bill assessments unlike in the case of public long-term care insurance (Hayashi and Kazama, 2008). Finally, the hospital practitioner ratio has a positively significant effect on inducement, and its elasticities are estimated to be 3.1% and 3.3%.

<Table 2 is inserted here.>

4.2 Results of the Supply Equations for Medical Treatments

The estimation results of the medical care supply equation (equation (7)) are shown in table 3. The first and third columns show the unitary fixed effects estimation results, and the second and fourth columns display the results of the fixed effects instrumental variable (FEIV) estimations of both equations (6) and (7). First, the first-stage F-statistics in the two regressions are 10.05 and 11.61, respectively. These values, which are larger than the Staiger and Stock (1997) critical value of 10, indicate that the instruments are not weak with respect to inducement. On the other hand, χ^2-statistics of the test for overidentifying restrictions are 2.546 (P = 0.2801) and 2.195 (P = 0.3338), respectively, and they imply that the instruments are exogenous. Therefore, the instruments are valid, and the results of the FEIV estimations are more appropriate than those of the FE estimations.

The coefficient of inducement (β_1) is not significantly but negatively estimated in the per capita expenditure equation, which indicates that there is a slight substitution effect due to the disutility of inducement. On the other hand, β_1 in the per bill expenditure equation is significantly and positively estimated and its elasticity is 7.1%. Although this result seems to conflict with that of the per capita expenditure equation, it is interpreted that physicians might have induced demand by increasing in care intensity in order to maintain their income. However, this did not affect the total medical expenditure. In addition, the elastisities of *Population Aging Rate* are more largely estimated than those of other covariates. These results reflect the fact that the average age of the Japanese NHI is higher than that of the other employee's public health insurance.

<Table 3 is inserted here.>

4.3 Inducement versus Excess Demand

As mentioned in the introduction, depending on the level of density, a positive relationship between medical expenditure and physician density is observed even when inducement does not exist. In this subsection, the estimation sample is divided into two groups -high density areas and low density areas- according to the areas' physician or bed densities. The high density areas are those where the density is higher than that of the sample mean in 1999, while the remaining areas are grouped as low density areas. Table 4 presents the summary statistics of the two sample groups and the results of the mean comparison tests (Welch's test) on the main variables.

<Table 4 is inserted here.>

While there are no statistically significant differences between the two groups in terms of medical expenditures, inducement in the high physician density areas ranges from 30 yen to 83 yen more than that in the low density areas, which is significantly higher. In addition, the hospital practitioner ratio, the mortality rate, the population aging rate, the premium payment rate, and the ratio indicating the receipt of LAT are higher in the low density areas, while the clinic practitioner ratio, total population, and taxable income are higher in the high density areas. These results indicate that inducement exists in highly competitive areas and in areas with a higher number of clinic practitioners who have profit motivation.

The estimation results of the induced-demand equations for the high and low density areas are shown in table 5. In most of the econometric results, the increase rates of fees (α_1) have significantly negative effects on the magnitude of inducement. Their elasticities in the high density areas range between -4.5% and -2.9%, which are slightly higher than those of the entire sample, while their elasticities in the low density areas range between -3.6% and -2.9%. These results suggest that physicians tend to respond to fee reduction policies regardless of the densities and that they especially tend to respond strongly to it in high density areas. On the other hand, the coefficients of medical supply densities ($\boldsymbol{\alpha_2}$) are not significant at all, which indicates that there is no inducement due to the negative income shock of intensifying competition.

<Table 5 is inserted here.>

The results of the estimations of the medical supply equations are shown in table 6. In all the estimation results, although the tests for overidentifying restrictions are passed, the first-stage F-statistics are less than the required level. In other words, instruments are exogenous but weak with respect to inducement. These statistical results imply that the estimates of the FEIV are not consistent and are less reliable than those of FE.

Consequently, the coefficients of inducement (β_1) are not significant and their elasticities are close to zero in all the results of the unitary fixed effects estimation, which indicates that the scale of inducement has little effect on medical expenditure. In addition, the coefficients of each medical supply density ($\boldsymbol{\beta_2}$) that responds to expenditure are not significant at all. Thus, the evidence of an increase in expenditure due to improvement in patients' accessibility is not found.

<Table 6 is inserted here.>

5. Conclusions

This paper examines the factors of PID and the effects of inducement on medical expenditure by using data pertaining to the review of medical bills performed by municipal insurers in the Japanese NHI and public third-party payers. Public third-party payers and municipal insurers independently scrutinize medical bills to verify of the medical treatments listed in them. Therefore, data on the total claim amounts of fraudulent and incorrect claims found in the double-check review process can be considered to directly reveal the magnitude of inducement. To the best of my knowledge, this is the first attempt to examine PID on the basis of such data. Further, the use of such data can help us model the mechanism of inducement more clearly than before, and this study overcomes many of the analytical problems present in previous studies.

The empirical results of the fixed effects estimations, which are based on the McGuire-Pauly theoretical model, suggest that the main factor of inducement is a negative income effect due to fee reduction policies: a 1% reduction in medical fees increases per capita inducement by 3.7% and per bill inducement by 3.9%. In addition, regardless of the competitive environment, the income effects exist, while, the elasticities of the income effect in areas with high physician density are higher than those of the entire sample and this implies that physicians in areas of increased competition tend to respond strongly to fee reduction policies. On the other hand, it is found that medical supply densities have little effect on inducement and medical expenditure. These results also indicate that inducement due to the negative income shock of increasing competition does not exist and that the positive relationship between medical expenditure and physician density, which has been discussed for several decades, can be regarded as a result of improvements in patients' accessibility. Therefore, it can be concluded that Japan's supply control policies of the

1980s, which were geared toward reducing medical expenditure due to inducement, have had little effect on expenditure. Consequently, the reversal policy of the MHLW (MHLW, 2008) is commendable from the perspective of improving Japan's medical care systems, and it needs to be implemented without delay.

On the other hand, although per capita inducement does not have the significant effect on medical expenditure, per bill inducement has the significantly positive impacts on expenditure. These results seems conflicting, while they are interpreted that physicians might have induced demand by increasing in care intensity in order to maintain their income, but they are enough to keep from affecting the medical expenditure. In fact, the substitution effect due to the disutility of inducement slightly exists. Thus, the existence of both income and substitution effects suggest that while physicians certainly have financial incentives, they do not selfishly induce demand but rather work under the constraints of their moral and professional responsibilities. In fact, these results highly support the argument that physicians' behavior conforms to that predicted by the PID hypothesis and suggest the necessity of designing medical policies that take PID into account.

Finally, the remaining tasks of this study are summarized in this paragraph. First, using annual aggregate data at the municipal level allow us to neither consider the detailed characteristics of patients, physicians, and medical institutes nor examine their effects on the magnitude of inducement and medical expenditure. Second, this paper could not examine and report the fields in which inducement most notably occurs. One of the ways to overcome these analytical problems is to use micro data, which provide considerably more detailed information on patients, physicians, and medical institutes. In doing so, we can more concretely and minutely assess the effects of various medical policies and environmental changes on inducement and medical supply. In addition, such studies will enable us to obtain extremely important policy implications for medical care systems.

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Appendix A. The procedure for calculating the magnitude of inducement

As shown in figure 1, the validity check of the treatments listed in medical bills is conducted in two stages. Thus, the total magnitude of inducement per capita is shown as follows:

$$I_{it} = I_{it}^{P} + I_{it}^{I}, \tag{A1}$$

where I_{it}^{P} is the amount of inducement per capita found in the first screening conducted by the public third-party payers and I_{it}^{I} is that found in the second screening conducted by the insurers. With regard to I_{it}^{I}, we can obtain the adjusted claim per capita in insurer i from the RNHI, while no such data are available with respect to I_{it}^{P}. Therefore, I calculated I_{it}^{P} according to the following procedure. First, for prefecture j, the difference between the amounts claimed ($CEXP_{it}$) and reimbursed ($REXP_{it}$), which is the total amount of inducement of prefecture j (I_{jt}^{P}), is obtained through the *Operation Statistics on Review and Payment*.

$$I_{jt}^{P} = CEXP_{jt}^{P} - REXP_{jt}^{P} \tag{A2}$$

Next, the total amount of inducement per insurer (TI_{it}^{P}) is obtained by multiplying I_{jt}^{P} by the ratio of the number of insured of insurer i to that of prefecture j.

$$TI_{it}^{P} = I_{jt}^{P} \times \left(\frac{Insured_{it}}{Insured_{jt}} \right) \tag{A3}$$

Finally, I_{it}^{P} is calculated as follows:

$$I_{it}^{P} = TI_{it}^{P} \big/ Insured_{it} \tag{A4}$$

Appendix B. The procedure for calculating the number of bills

We can obtain municipal insurers' medical expenditure per bill ($MEXPPB_{it}$) from the RNHI, while the number of bills of inducement is not disclosed in any statistics database. Thus, I mechanically calculate it according to the following procedure. After obtaining the total medical expenditure in insurer i ($TMEXP_{it}$) by multiplying medical expenditure per capita ($MEXPPC_{it}$) by the number of insured, the number of bills in insurer i ($NBill_{it}$) is calculated by dividing $TMEXP_{it}$ by $MEXPPB_{it}$.

$$TMEXP_{it} = MEXPPC_{it} \times Insured_{it} \tag{B1}$$

$$NBill_{it} = TMEXP_{it} / MEXPPB_{it} \tag{B2}$$

Finally, the inducement per bill (IPB_{it}) is calculated as follows.

$$IPB_{it} = (I_{it} \times Insured_{it}) / Nbill_{it} \tag{B3}$$

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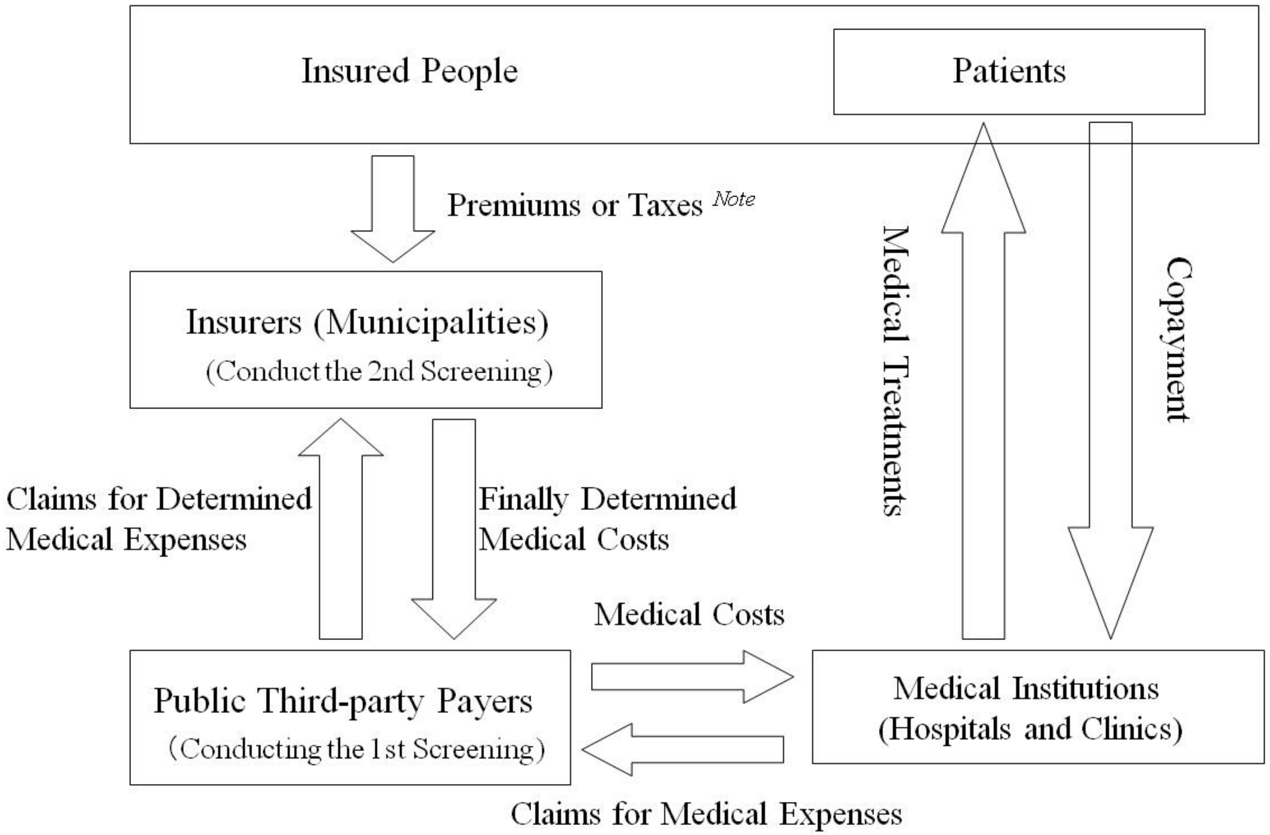
Figure 1 General illustration of the payment system for the Japanese National Health Insurance



Note: Approximately 90% of the municipal insurers collect insurance premiums not as the national health insurance "premium" but as the national health insurance "tax". This tax was introduced in 1951 to strengthen premium collection in the initial period of the Japanese NHI's establishment. While there are several legal differences whereby the extinctive prescription on the collection of the tax is longer, there is little difference between the substantial functions of the premium and the tax (All-Japan Federation of National Health Insurance Organizations, 2007).

Table 1 Summary statistics of the main variables

Endogenous Variables		Mean	Std.Dev	Sources
S:	Medical Expenditure Per Capita (thousand yen)	172.320	27.892	[1]
	Medical Expenditure Per Bill (thousand yen)	267.665	29.328	[1]
I:	Inducement Per Capita (thousand yen)	0.596	0.378	[1], [2]
	Inducement Per Bill (thousand yen)	0.932	0.587	[1], [2]
Exogenous variables				
Dens:	Physician Density	11.255	17.800	[3]
	Bed Density	60.270	71.459	[3]
X:	Hospital Practitioner Ratio	0.060	0.103	[3]
	Clinic Practitioner Ratio	0.691	0.300	[3]
D:	Mortality Rate	0.010	0.004	[4]
	Population Aging Rate	0.286	0.080	[1]
	Total Population (ten thousand person)	5.531	19.690	[1]
	Taxable Income Per Taxpayer (ten thousand yen)	322.889	47.231	[4]
p:	Fee Increase Rate	1.792	4.047	[5]
Z:	Premium Payment Rate	93.494	3.826	[1]
	LAT-receiving Indicator	0.946	0.227	[6]
Number of Insurers		413		
Number of Observations		2065		

Sources:

[1] each prefecture, *Report on National Health Insurance* (Kokumin kenko hoken jigyo joukyo).

[2] All-Japan Federation of National Health Insurance Organizations, *Operation Statistics on Review and Payment* (Kokuhoren shinsa shiharai gyomu tokei).

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[4] Toyokeizai Shinposya, *Comprehensive Database of Regional Economy* (Chiiki keizai souran).

[5] Ministry of Interior and Communications, *Annual Report on the Consumer Price Index* (Syohisya bukka shisuu nenpou) .

[6] Ministry of Interior and Communications, *Annual Report on Municipal Budgets* (Shichoson kessan jokyo shirabe) .

Table 2 Fixed effects (FE) estimation results for the induced-demand equations

Dependent Variable	Inducement Per Capita			Inducement Per Bill		
	Coefficient	Std. Err	Elasticity	Coefficient	Std. Err	Elasticity
Physician Density	- 0.005	(0.004)	- 0.093	- 0.010	(0.006)	- 0.121
Bed Density	0.000	(0.001)	0.010	0.000	(0.001)	0.023
Hospital Practitioner Ratio	0.314**	(0.156)	0.031	0.513**	(0.250)	0.033
Clinic Practitioner Ratio	0.007	(0.051)	0.008	0.025	(0.076)	0.019
Mortality Rate	1.133	(1.178)	0.019	1.556	(1.883)	0.016
Population Aging Rate	0.345	(0.700)	0.166	0.479	(1.077)	0.147
Total Population	0.014	(0.014)	0.126	0.010	(0.022)	0.057
Taxable Income Per Taxpayer	0.000	(0.001)	0.063	0.000	(0.001)	0.086
Fee Increasing Rate	- 0.012***	(0.004)	- 0.037	- 0.020***	(0.007)	- 0.039
Premium Payment Rate	- 0.006	(0.006)	- 0.869	- 0.011	(0.009)	- 1.110
LAT-receiving Indicator	0.045	(0.043)	0.072	0.101	(0.074)	0.102
Constant	0.907	(0.664)		1.683	(1.070)	
σv		0.360			0.474	
σu		0.264			0.408	
R-squared		0.036			0.041	
F-test (H_0: all coefficients = 0)		$F(14,2051) = 8.88$***			$F(14,2051) = 9.16$***	
F-test (H_0: Fixed Effects = 0)		$F(412,1638) = 4.63$***			$F(412,1638) = 4.50$***	

Notes: (1) All standard errors enclosed in parentheses are clustering-robust standard errors, using the local secondary medical districts as level of clustering.
(2) ***, **, and * represent statistical significance at the1%, 5%, and 10% levels, respectively.
(3) Elasticities are evaluated at sample mean.
(4) Variables in the model in addition to year effects.

Table 3 FE estimation results for the medical care supply equations

Dependent Variable	Medical Expenditure Per Capita		Medical Expenditure Per Bill	
Estimation Model	FE	FEIV	FE	FEIV
Inducement Per Capita/ Inducement Per Bill	0.918	- 8.951	1.426	20.522***
	(1.264)	(8.507)	(1.115)	(7.669)
(Elasticity)	0.003	- 0.031	0.005	0.071
Physician Density	0.187	0.092	- 0.247	0.094
	(0.219)	(0.223)	(0.314)	(0.338)
(Elasticity)	0.012	0.006	- 0.010	0.004
Bed Density	- 0.014	- 0.009	0.017	- 0.003
	(0.016)	(0.017)	(0.027)	(0.026)
(Elasticity)	- 0.005	- 0.003	0.004	- 0.001
Hospital Practitioner Ratio	2.992	5.934	5.460	- 3.922
	(6.435)	(9.364)	(8.963)	(13.988)
(Elasticity)	0.001	0.002	0.001	- 0.001
Clinic Practitioner Ratio	4.178	4.302	7.595	6.924
	(4.445)	(3.152)	(5.718)	(4.716)
(Elasticity)	0.017	0.017	0.020	0.018
Mortality Rate	107.009	111.229	66.067	58.267
	(114.755)	(102.816)	(132.873)	(153.594)
(Elasticity)	0.006	0.006	0.002	0.002
Population Aging Rate	131.322	121.988***	126.556	157.650***
	(94.506)	(39.974)	(101.302)	(59.836)
(Elasticity)	0.218	0.203	0.135	0.169
Total Population	0.526*	0.547	- 0.947*	- 0.762
	(0.310)	(0.999)	(0.501)	(1.495)
(Elasticity)	0.017	0.018	- 0.020	- 0.016
Taxable Income Per Taxpayer	- 0.041	- 0.022	0.023	- 0.039

	(0.031)	(0.035)	(0.050)	(0.052)
(Elasticity)	- 0.078	- 0.042	0.028	- 0.047
Constant	140.985***	143.409***	224.934***	216.438***
	(29.710)	(17.250)	(35.704)	(25.817)
σv	22.662	23.489	28.963	27.130
σu	12.064	12.348	16.694	18.454
R-squared	0.196	0.149	0.052	0.068
F-test (H_0: all coefficients = 0)	F(12,2053) = 25.29***	F(425,1640) = 5.45***	F(12,2053) = 19.50***	F(425,1640) = 4.43***
F-test (H_0: Fixed Effects = 0)	F(412,1640) = 12.08***	F(412,1640) = 11.28***	F(412,1640) = 8.55***	F(412,1640) = 6.99***
F-test for weak instruments		F(3,1638) = 10.05***		F(3,1638) = 11.61***
Hansen J statistic for overidentifying restrictions and its P-value		χ^2(2) = 2.546 (P = 0.2801)		χ^2 (2) = 2.195 (P = 0.3338)

Notes: (1) See *Notes* to Table 2.

Table 4 Results of Welch's test

Category	Physician Density			Bed Density		
Variable	High Density Areas	Low Density Areas	Mean Difference	High Density Areas	Low Density Areas	Mean Difference
Medical Expenditure Per Capita	173.481	171.805	1.676	172.231	172.394	- 0.163
	(27.356)	(28.121)	[1.316]	(24.301)	(30.557)	[1.207]
Medical Expenditure Per Bill	267.239	267.855	- 0.615	268.534	266.947	1.587
	(30.421)	(28.838)	[1.428]	(24.259)	(32.931)	[1.261]
Inducement Per Capita	0.641	0.576	0.065***	0.613	0.583	0.030*
	(0.413)	(0.359)	[0.019]	(0.367)	(0.386)	[0.017]
Inducement Per Bill	0.990	0.907	0.083***	0.957	0.912	0.045*
	(0.633)	(0.564)	[0.029]	(0.562)	(0.606)	[0.026]
Hospital Practitioner Ratio	0.045	0.066	- 0.021***	0.062	0.058	0.004
	(0.053)	(0.118)	[0.004]	(0.082)	(0.117)	[0.004]
Clinic Practitioner Ratio	0.754	0.662	0.092***	0.759	0.634	0.125***
	(0.236)	(0.321)	[0.013]	(0.215)	(0.346)	[0.012]
Mortality Rate	0.009	0.010	- 0.002***	0.009	0.010	- 0.001***
	(0.003)	(0.004)	[0.000]	(0.004)	(0.004)	[0.000]
Population Aging Rate	0.284	0.287	- 0.004	0.273	0.297	- 0.024***
	(0.078)	(0.081)	[0.004]	(0.070)	(0.086)	[0.003]
Total Population	12.360	2.499	9.861***	9.517	2.233	7.284***
	(33.782)	(4.873)	[1.347]	(28.232)	(5.038)	[0.935]
Taxable Income Per Taxpayer	340.711	314.974	25.737***	329.854	317.125	12.729***
	(48.196)	(44.583)	[2.247]	(49.633)	(44.348)	[2.092]
Premium Payment Rate	92.348	94.003	- 1.656***	92.293	94.488	- 2.194***
	(3.629)	(3.803)	[0.176]	(3.837)	(3.522)	[0.163]
LAT-receiving Indicator	0.926	0.955	- 0.029**	0.927	0.961	- 0.034***
	(0.262)	(0.208)	[0.012]	(0.260)	(0.194)	[0.010]
Number of Insurers	635	1430		935	1130	

Number of Observations	127	286		187	226

Notes:

(1) The standard deviations are in parentheses and the standard errors are in square brackets.

(2) ***, **, and * represent statistical significance at the1%, 5%, and 10% levels, respectively.

(3) *High density areas* include those areas where the density is more than that of the sample mean in 1999; and *low density areas* include the remaining areas in the estimation sample.

Table 5 Fixed effects estimation result of induced demand equations (by area)

Dependent Variable	Inducement Per Capita				Inducement Per Bill			
Category	Physician Density		Bed Density		Physician Density		Bed Density	
Density	High	Low	High	Low	High	Low	High	Low
Physician Density	- 0.001	- 0.012	- 0.001	- 0.010	- 0.004	- 0.023	- 0.004	- 0.019
	(0.005)	(0.010)	(0.005)	(0.008)	(0.008)	(0.015)	(0.007)	(0.013)
(Elasticity)	- 0.053	- 0.119	- 0.030	- 0.100	- 0.097	- 0.149	- 0.069	- 0.121
Bed Density	0.000	0.000	0.000	- 0.001	0.000	0.000	0.000	- 0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
(Elasticity)	0.024	0.002	- 0.028	- 0.033	0.049	0.007	- 0.003	- 0.031
Hospital Practitioner Ratio	0.475	0.288*	0.404	0.284*	0.944	0.457*	0.743	0.446*
	(0.592)	(0.156)	(0.530)	(0.152)	(0.983)	(0.249)	(0.824)	(0.252)
(Elasticity)	0.034	0.033	0.041	0.028	0.043	0.033	0.048	0.028
Clinic Practitioner Ratio	0.112	- 0.017	- 0.009	0.021	0.177	- 0.010	0.008	0.044
	(0.193)	(0.049)	(0.134)	(0.072)	(0.292)	(0.071)	(0.198)	(0.107)
(Elasticity)	0.132	- 0.020	- 0.012	0.023	0.135	- 0.007	0.006	0.030
Mortality Rate	- 13.367	2.003*	1.891	0.340	- 19.177	2.742	3.341*	- 0.176
	(8.293)	(1.059)	(1.240)	(1.643)	(12.353)	(1.663)	(1.743)	(2.501)
(Elasticity)	- 0.181	0.036	0.028	0.006	- 0.169	0.031	0.032	- 0.002
Population Aging Rate	- 1.321	0.684	- 3.524	0.932	- 2.053	0.995	- 5.494	1.370
	(3.419)	(0.727)	(2.777)	(0.739)	(5.074)	(1.143)	(4.291)	(1.171)
(Elasticity)	- 0.585	0.341	- 1.573	0.475	- 0.588	0.315	- 1.569	0.446
Total Population	0.012	0.035	0.024*	- 0.190	0.009	0.038	0.026	- 0.335
	(0.015)	(0.037)	(0.014)	(0.170)	(0.024)	(0.054)	(0.020)	(0.275)
(Elasticity)	0.238	0.151	0.371	- 0.728	0.113	0.105	0.262	- 0.820
Taxable Income Per Taxpayer	0.003**	0.000	0.000	0.000	0.005**	- 0.001	0.000	0.001
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)
(Elasticity)	1.741	- 0.255	- 0.053	0.147	1.712	- 0.219	- 0.083	0.219

Fee Increasing Rate	- 0.009	- 0.012**	- 0.015***	- 0.009	- 0.016*	- 0.019**	- 0.024***	- 0.015*
	(0.006)	(0.005)	(0.005)	(0.006)	(0.009)	(0.007)	(0.007)	(0.009)
(Elasticity)	- 0.026	- 0.036	- 0.044	- 0.028	- 0.029	- 0.038	- 0.045	- 0.030
Premium Payment Rate	- 0.013	- 0.002	- 0.006	- 0.002	- 0.021	- 0.007	- 0.011	- 0.008
	(0.012)	(0.006)	(0.007)	(0.010)	(0.019)	(0.010)	(0.012)	(0.014)
(Elasticity)	- 1.914	- 0.346	- 0.970	- 0.297	- 1.912	- 0.687	- 1.073	- 0.799
LAT-receiving Indicator	0.041	0.041	- 0.029	0.151**	0.102	0.091*	- 0.018	0.273**
	(0.087)	(0.030)	(0.039)	(0.059)	(0.145)	(0.046)	(0.061)	(0.107)
(Elasticity)	0.060	0.068	- 0.044	0.249	0.095	0.095	- 0.017	0.287
Constant	0.975	0.672	2.026*	0.731	1.627	1.390	3.357*	1.635
	(1.675)	(0.717)	(1.055)	(1.174)	(2.483)	(1.182)	(1.680)	(1.745)
σv	0.558	0.297	0.755	1.121	0.600	0.449	0.897	1.931
σu	0.279	0.258	0.254	0.271	0.424	0.401	0.391	0.419
R-squared	0.098	0.019	0.040	0.043	0.147	0.020	0.059	0.043
F-test (H_0: all coefficients = 0)								
High Density	F(14,621) = 19.41***		F(14,921) = 10.98***		F(14,621) = 20.99***		F(14,921) = 12.31***	
Low Density	F(14,1416) = 8.78***		F(14,1116) = 8.01***		F(14,1416) = 9.70***		F(14,1116) = 8.19***	
F-test (H_0: Fixed Effects = 0)								
High Density	F(126,494) = 4.52***		F(186,734) = 4.89***		F(126,494) = 4.32***		F(186,734) = 4.62***	
Low Density	F(285,1130) = 4.56***		F(225,890) = 4.12***		F(285,1130) = 4.46***		F(225,890) = 4.14***	

Notes: (1) See *Notes* to Table 2.

Table 6 FE estimation results for the medical care supply equations (by area)

Dependent Variable	Medical Expenditure Per Capita							
Category	Physician Density				Bed Density			
Density	High		Low		High		Low	
Estimation Model	FE	FEIV	FE	FEIV	FE	FEIV	FE	FEIV
Inducement Per Capita	2.777	1.493	0.197	- 14.512	1.843	10.287	- 0.174	- 26.012
	(3.074)	(21.252)	(1.614)	(10.656)	(1.616)	(8.236)	(1.724)	(16.813)
(Elasticity)	0.010	0.006	0.001	- 0.049	0.007	0.037	- 0.001	- 0.088
Physician Density	- 0.084	- 0.089	0.907	0.655	0.610***	0.666***	- 0.708	- 1.054*
	(0.209)	(0.242)	(0.611)	(0.486)	(0.191)	(0.181)	(0.432)	(0.566)
(Elasticity)	- 0.011	- 0.012	0.031	0.023	0.064	0.070	- 0.023	- 0.035
Bed Density	- 0.031**	- 0.031	0.020	0.031	- 0.030**	- 0.032**	0.003	- 0.013
	(0.012)	(0.019)	(0.029)	(0.035)	(0.012)	(0.013)	(0.050)	(0.075)
(Elasticity)	- 0.022	- 0.022	0.004	0.006	- 0.019	- 0.021	0.000	- 0.001
Hospital Practitioner Ratio	- 42.272	- 41.729	6.888	10.851	- 21.701	- 23.909	7.484	15.332
	(30.790)	(33.470)	(6.373)	(10.170)	(14.126)	(15.320)	(6.441)	(13.837)
(Elasticity)	- 0.011	-0.011	0.003	0.004	- 0.008	- 0.009	0.003	0.005
Clinic Practitioner Ratio	- 3.059	- 2.866	5.247	4.982	2.500	2.411	4.637	5.154
	(5.828)	(8.607)	(4.874)	(3.545)	(13.443)	(3.765)	(4.145)	(5.092)
(Elasticity)	- 0.013	- 0.012	0.020	0.019	0.011	0.011	0.017	0.019
Mortality Rate	999.960***	981.159*	81.138	103.023	- 162.245	- 175.204	290.539	283.715
	(276.875)	(524.121)	(110.480)	(111.794)	(135.235)	(111.273)	(206.787)	(177.804)
(Elasticity)	0.050	0.049	0.005	0.006	- 0.009	- 0.009	0.017	0.017
Population Aging Rate	- 44.687	- 47.876	160.026	153.118***	61.699	119.345	148.473	154.256***
	(72.936)	(107.673)	(115.766)	(44.816)	(174.855)	(85.148)	(110.724)	(56.427)
(Elasticity)	- 0.073	- 0.078	0.268	0.256	0.098	0.189	0.256	0.266
Total Population	0.344	0.352	1.786	2.013	0.852**	0.751	- 0.123	- 4.964
	(0.347)	(0.984)	(1.607)	(3.588)	(0.391)	(0.729)	(2.207)	(8.105)

(Elasticity)	0.025	0.025	0.026	0.029	0.047	0.041	- 0.002	- 0.064
Taxable Income Per Taxpayer	- 0.075	- 0.069	- 0.026	- 0.011	0.019	0.003	- 0.092***	- 0.045
	(0.079)	(0.129)	(0.037)	(0.037)	(0.030)	(0.035)	(0.046)	(0.063)
(Elasticity)	- 0.148	- 0.135	- 0.047	- 0.020	0.036	0.005	- 0.169	- 0.083
Constant	207.301***	206.676***	120.544***	126.325***	134.477**	119.787***	157.354***	167.538***
	(26.428)	(42.862)	(42.939)	(21.379)	(61.358)	(27.227)	(38.277)	(32.176)
Σv	28.641	29.045	21.908	23.375	36.485	33.193	22.244	37.745
Σu	11.397	11.402	12.313	12.896	8.474	8.747	14.294	15.940
R-squared	0.000	0.001	0.243	0.158	0.000	0.017	0.302	0.094
F-test (H_0: all coefficients = 0)								
FE	F(12,623) = 10.47***		F(12,1418) = 24.92***		F(12,1418) = 24.92***		F(12,1118) = 17.55***	
FEIV	F(139,496) = 2.00**		F(298,1132) = 4.73***		F(199,736) = 6.23***		F(238,892) = 2.74***	
F-test (H_0: Fixed Effects = 0)								
FE	F(126,496) = 14.18***		F(285,1132) = 10.94***		F(186,736) = 16.95***		F(225,892) = 10.55***	
FEIV	F(126,496) = 13.97***		F(285,1132) = 9.69***		F(186,736) = 15.60***		F(225,892) = 8.27***	
F-test for weak instruments	F(3,494) = 1.24		F(3,1130) = 7.31***		F(3,734) = 5.83***		F(3,890) = 4.07***	
Hansen J statistic for overidentifying restrictions and its P-value	χ^2 (2) = 1.512 (P = 0.4696)		χ^2 (2) = 1.469 (P = 0.4797)		χ^2 (2) = 3.153 (P = 0.2067)		χ^2 (2) = 1.212 (P = 0.5455)	

Table 6 *Continued*

Dependent Variable	Medical Expenditure Per Capita							
Category	Physician Density				Bed Density			
Density	High		Low		High		Low	
Estimation Model	FE	FEIV	FE	FEIV	FE	FEIV	FE	FEIV
Inducement Per Bill	0.370	20.556	1.871	16.590*	1.155	33.220***	1.048	7.682
	(2.576)	(18.989)	(1.388)	(9.176)	(1.580)	(9.891)	(1.451)	(12.493)
(Elasticity)	0.001	0.076	0.006	0.056	0.004	0.118	0.004	0.026
Physician Density	- 0.339	- 0.171	0.053	0.527	0.397	0.809**	- 1.552**	- 1.386*
	(0.373)	(0.385)	(0.778)	(0.702)	(0.246)	(0.359)	(0.651)	(0.726)
(Elasticity)	- 0.029	- 0.015	0.001	0.012	0.027	0.054	- 0.033	- 0.029
Bed Density	- 0.018	- 0.031	0.086*	0.065	- 0.016	- 0.036	0.075	0.081
	(0.021)	(0.031)	(0.047)	(0.049)	(0.020)	(0.025)	(0.069)	(0.095)
(Elasticity)	- 0.008	- 0.014	0.010	0.008	- 0.006	- 0.015	0.005	0.005
Hospital Practitioner Ratio	- 55.426*	- 72.809	8.862	2.516	- 32.961	- 49.453*	12.628	9.423
	(31.311)	(52.301)	(9.158)	(14.361)	(24.293)	(29.891)	(8.889)	(17.331)
(Elasticity)	- 0.009	- 0.012	0.002	0.001	- 0.008	- 0.011	0.003	0.002
Clinic Practitioner Ratio	1.125	- 3.737	8.741	8.906*	5.043	3.729	8.350	8.067
	(9.459)	(13.142)	(6.183)	(5.010)	(15.728)	(7.320)	(5.584)	(6.441)
(Elasticity)	0.003	- 0.011	0.022	0.022	0.014	0.011	0.020	0.019
Mortality Rate	1062.021**	1493.084*	38.660	10.479	- 258.899	- 347.808	290.050	297.988
	(406.444)	(766.105)	(133.964)	(157.577)	(158.053)	(216.429)	(224.744)	(225.030)
(Elasticity)	0.035	0.049	0.001	0.000	- 0.009	- 0.012	0.011	0.011
Population Aging Rate	69.306	151.542	140.793	153.637**	- 133.431	214.813	182.920	181.544**
	(212.424)	(164.015)	(98.117)	(63.527)	(175.962)	(164.184)	(116.322)	(71.168)
(Elasticity)	0.074	0.161	0.151	0.165	- 0.136	0.219	0.203	0.202
Total Population	- 0.855	- 0.807	- 0.706	- 0.808	- 0.305	- 0.509	- 7.263*	- 5.086
	(0.574)	(1.504)	(2.002)	(5.073)	(0.366)	(1.405)	(4.247)	(10.286)

(Elasticity)	- 0.040	- 0.037	- 0.007	- 0.008	- 0.011	- 0.018	- 0.061	- 0.043
Taxable Income Per Taxpayer	0.184***	0.014	- 0.001	- 0.026	0.109	0.014	- 0.053	- 0.074
	(0.087)	(0.189)	(0.061)	(0.053)	(0.068)	(0.067)	(0.081)	(0.080)
(Elasticity)	0.235	0.018	- 0.001	- 0.031	0.134	0.017	- 0.063	- 0.088
Constant	198.803***	212.190***	219.454***	209.708***	265.791***	173.831***	245.229***	240.909***
	(43.135)	(65.320)	(45.653)	(30.282)	(69.257)	(53.157)	(54.984)	(40.597)
σv	37.048	36.148	22.271	22.613	33.124	32.494	46.563	37.337
σu	15.329	17.570	17.247	18.249	11.287	16.985	19.939	20.135
R-squared	0.018	0.063	0.125	0.105	0.114	0.035	0.049	0.061
F-test (H_0: all coefficients = 0)								
FE	F(12,623) = 5.14***		F(12,1418) = 18.64***		F(12,1418) = 18.64***		F(12,1118) = 14.30***	
FEIV	F(139,496) = 1.44		F(298,1132) = 3.88***		F(199,736) = 4.26***		F(238,892) = 2.72***	
F-test (H_0: Fixed Effects = 0)								
FE	F(126,496) = 10.38***		F(285,1132) = 7.62***		F(186,736) = 11.79***		F(225,892) = 7.77***	
FEIV	F(126,496) = 7.89***		F(285,1132) = 6.77***		F(186,736) = 5.25***		F(225,892) = 7.56***	
F-test for weak instruments	F(3,494) = 1.59		F(3,1130) = 8.19***		F(3,734) = 6.42***		F(3,890) = 4.93***	
Hansen J statistic for overidentifying restrictions and its P-value	χ^2 (2) = 3.529 (P = 0.1713)		χ^2 (2) = 0.229 (P = 0.8920)		χ^2 (2) = 4.230 (P = 0.1206)		χ^2 (2) = 0.102 (P = 0.9502)	

Notes: *Notes*: See *Notes* to Table 2.