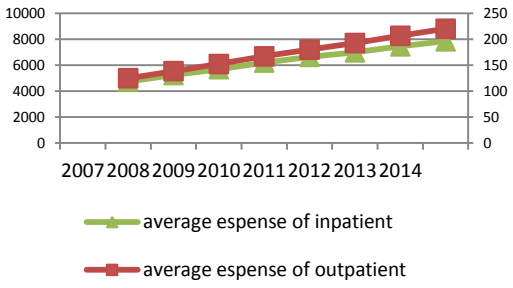
Excess Demand, Supplier-Induced Demand in Social Health Insurance: Evidence from China

1. Introduction

China has undergone one of the most drastic reforms of social health insurance, beginning in 2009. Now, Urban Employee Basic Medical Insurance (UEBMI), Urban Residents Basic Medical Insurance (URBMI), and the New Rural Cooperative Medical System (NRCMS) constitute the basic medical insurance system in China. The reform particularly aims at increasing coverage and controlling medical expenditure. Since 2009, social health insurance has covered everyone, urban and rural (Human Resources and Social Security Development Statistics Bulletin, 2013). Medical supplies have also shown a slight but steady growth trend. Improvement of coverage and increased medical supplies bring outpatients and hospitalization (Figure 1), along with rapid growth in medical expenses. Medical expenses increased by 45 times from 2007 to 2014 (Figure 2), excluding the factors of price growth.

Finkelstein and McKnight (2008) found that Medicare is the main reason in the US for dramatically increasing health care expense. The question is whether China's rapid rise of medical expenses is due to the implementation of social health insurance or to excess and supplier-induced demand in the social health insurance.



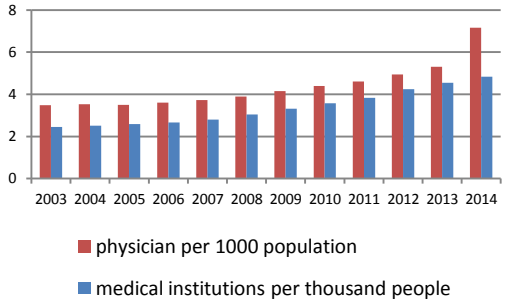


Fig. 1. Visits and Hospitalization Rates in the region surveyed in 2008
Fig. 2. Health Supply and Expenses from 1989-2012
Source: China Health Statistical Yearbook, China Health and Family Development Statistical Bulletin, WHO Statistical Data

Health insurance involves three parties: healthcare providers, the insured and health insurance organizations. The health insurance market has significant information asymmetry (Phelps, 1986), and the supply

side and demand side use their own information advantages to take the best action strategy (Bates, 2010). Chenchen (2013) separated the moral hazard in health insurance into insured moral risk and supplier moral hazard; the insured has low health insurance cost and creates excess demand (ED) (Feldstein, 1973; Feldman and Dowd, 1991). The excess demand is reflected in two aspects: consumption quantity and price are above the optimal level when consumers purchase health insurance (Rebitzer and Rege, 2008). Cheng et al. (1997) also found that individuals face lower marginal costs for health insurance under healthcare, resulting in excess demand. Riphahn (2003) found that people without health insurance have lower frequency of medical care, proving moral hazard. Second, healthcare is above the optimal level because of copayment reduction. The most famous experiment is the one by Rand, which verified the existence of moral hazard through the design of different payment ratios (Manning, 1978). Chandra (2010) found that copayments influenced the number of visits and the use of prescription drugs, which is excess demand. Some research with China's data also found the effect of health insurance on health care expenditure (Zang, 2012; Zheng, 2014), and different copayments on medical expenses (Huang and Gan, 2012; Li et al., 2014).

Moral hazard of healthcare providers refers to providers with information superiority as the double agent of the insured and the insurer; healthcare providers overuse the principal-agent relationship for personal interests is supply-induced demand (Fuchs, 1978; Pauly, 1980; McGuire, 2000), also Supply-induced reflected in the increase of the number of suppliers in relation to the increase of healthcare (Rice, 1983; Hay, 1982). Fuchs (1975) found that an increase in surgeons by 10% will lead to an increase of surgical procedures by 3%, which indicates that a doctor has the ability to induce patients' needs. Scholars have analyzed about the relationship of the increase in healthcare and price to the number of healthcare providers (Li and He, 2014; Li et al., 2014). As a result, supply-induced demand is reflected in the positive correlation of provider and demand, which contradicts the market competition law (Feldstein, 1970), also is raising the amount of healthcare per capita (Delattre and Dormont, 2003).

Scholars analyze the moral risk of health insurance from different angles, and found some evidence of moral hazard in health insurance, which provides a useful reference for our study. This paper is based on the social health insurance market in China, then we build a utility model of insured and providers. Through solving the optimization model, we propose the hypothesis of excess and supply-induced demand from the supply and demand quantity of healthcare, and do the empirical test using

data from the China Health and Nutrition Survey (CHNS). We also give some suggestions for China's social health insurance reform.

First, we test excess and supply-induced demand from the perspective of demand and supply variables, using different variables in the same model, and including the four part model; Second, we set different characteristic variables of health insurance according to the different types of social health insurance in China, which is compared with dummy variables in the existing literature. Third, we distinguish the excess demand and release of demand in medical expenditure, and also distinguish induced supply and accessibility effect, which make our conclusions more robust.

This paper is organized as follows: The next section introduces the theory model and analysis. Section 3 is the data, variables and empirical model design. Section 4 is the empirical test and analysis. Section 4 is the conclusion and policy suggestions.

2. The Model and Theoretical Analysis

We built a social health insurance model, composed of three party, social health insurance organization, insured and healthcare providers. We refer to a health demand model by Grossman (1972) and a supplier-induced model by Ellis and McGuire (1986).

China’s government provides social health insurance to most of residents, so we do not consider adverse selection.

The insured are rational and homogeneous except for the likelihood of illness. The insured's income are Y; the number of healthcare providers are q; the system includes j healthcare providers; r is the price of healthcare and exogenous; healthcare providers can decide the number of healthcare, not the price of healthcare.

The utility function of insured is continuous, differentiable, increasing and strictly concave, namely $U^{'}>0$， $U^{"}<0$, which can ensure insured is risk averse; the probability of illness is π. The utility function of healthcare providers is V, and $V'>0$， $V"<0$.

The insurance contract is (p,θ), θ is the copayment of social health insurance, p is the premium.

Final wealth of the insured amounts to $W_1 = Y - p - rq + \theta rq$ in the illness state and $W_1 = Y - p$ in the health state. The risk utility function therefore reads:

$$EU(w) = \pi U(Y - p - rq + \theta rq) + (1-\pi)U(Y - p)$$

Health care providers are concerned about the profits and the patients’ benefits. The utility function therefore reads:

$$EV(q)=V\left[\frac{1}{j}rq-c(q)\right]+V\left[B(q)\right]$$

with $c(q)$ denoting the cost of health care providers，$\frac{1}{j}rq-c(q)$ denoting the profits of a single healthcare provider, $B(q)$ denoting the patient's benefit function.

The rational choice of the insured is to maximize their own utility.

$$\max EU(W)=\pi U(Y-p-rq+\theta rq)+(1-\pi)(Y-p) \quad (3)$$

To find the solution of maximizing the expected utility function, we establish Lagrange function:

The first-order condition for the optimum value of p is given by:

$$\frac{dEU}{dq}=-\pi U_1^{'}(-r+\theta r)=0 \quad （4）$$

With $U_1^{'}$ denoting the marginal utility of risky wealth in the illness state. A solution $q^*=q^*(\theta)$ implicitly defines the quantity of healthcare as a function of θ. In order to obtain additional information about this function, comparative statics analysis will be performed. It consists in subjecting the optimum condition (4) to an exogenous shock $d\theta$. This will entail an optimal adjustment dp^*, resulting in the objective function EU attaining its maximum somewhere else. However, the new maximum still must satisfy the condition $dEU/dq=0$. Therefore, the equality to zero must hold before and after adjustment, resulting in the comparative-static equation.

$$\frac{\partial^2 EU}{\partial q^2}\cdot dq+\frac{\partial^2 EU}{\partial q\partial\theta}\cdot d\theta=0 \quad (5)$$

The second term on the left-hand side shows the impact of the shock on expected utility, and the first term, the impact of the induced adjustment of q. This can be solved to obtain:

$$\frac{dq}{d\theta}=-\frac{\partial^2 EU/\partial q\partial\theta}{\partial^2 EU/\partial q^2} \quad （6）$$

Since $U^{"}<0$ is regularly assumed, the denominator is negative ($\partial^2 EU/\partial q^2<0$, amounting to the sufficient condition for a maximum). Therefore, the sign of the numerator determines the sign of $\frac{dq}{d\theta}$.

Differentiating (3) w.r.t. q，one obtains

$$\partial^2 EU/\partial q\partial\theta=\pi U_1^{'}r+\pi(\theta-1)rU_1^{"}rq \quad （6）$$

$U_1^{'}>0$， $U_1^{"}<0$, and $0<\theta<1$, so（6）>0, then

$$\frac{dq}{d\theta} > 0$$

Conclusion 1: Copayment will affect healthcare consumption of the insured. The more θ, the more healthcare demand from the insured.

From the perspective of healthcare providers, the price of healthcare is constrained by the government, so healthcare providers cannot feel free to set the price. But healthcare providers have the ability to influence the quantity q. Healthcare providers maximize their utility (Stano, 1987):

$$\max_{q} EV \qquad (6)$$

The first-order condition for the optimum value of p is given by,

$$\frac{dEV}{dq} = V_1^{'}\left[\frac{1}{j}r - c^{'}(q)\right] + V_2^{'} \cdot B^{'}(q) = 0 \qquad (7)$$

$$\left[\frac{r}{j} - c^{'}(q)\right]V_1^{'} = -V_2^{'}B^{'}(q) \qquad (8)$$

With $\left[\frac{r}{j} - c^{'}(q)\right]V_1^{'}$ denoting the marginal utility from marginal profit, which can be a marginal benefit of supply-induced demand. $-V_2^{'}B^{'}(q)$ denoting marginal benefit for the insured from healthcare, which can be marginal cost, including the time cost of persuading people to buy more healthcare and the healthcare providers' psychological cost (Cromwell and Mitchell, 1986). The healthcare provider may balance the marginal profit and the insured's benefit. When the marginal profit is equal to the marginal benefit of the insured, healthcare provider will maximize his utility.

A solution $q^{*} = q^{*}(j)$ implicitly defines the quantity for healthcare as a function of j. In order to obtain additional information about this function, comparative statistics analysis will be performed. It consists in subjecting the optimum condition (7) to an exogenous shock dj. This will entail an optimal adjustment dp^{*}, resulting in the objective function EV attaining its maximum somewhere else. However, the new maximum still must satisfy the condition $dEV/dq = 0$. Therefore, the equality to zero must hold before and after adjustment, resulting in the comparative-static equation.

$$\frac{\partial^2 EV}{\partial q^2} \cdot dq + \frac{\partial^2 EV}{\partial q \partial j} \cdot dj = 0 \qquad (9)$$

The second term on the left hand side shows the impact of the shock on expected utility, and the first term, the impact of the induced adjustment of q. This can be solved to obtain:

$$\frac{dq}{dj} = -\frac{\partial^2 EV/\partial q \partial j}{\partial^2 EV/\partial q^2} \quad (10)$$

Since $V^{"} < 0$ is regularly assumed, the denominator is negative ($\partial^2 EU/\partial q^2 < 0$, amounting to the sufficient condition for a maximum). Therefore, the sign of the numerator determines the sign of $\frac{dq}{d\theta}$.

Differentiating (3) w.r.t. q，one obtains

$$\partial^2 EV/\partial q \partial j = V_1^{"}\left[\frac{1}{j}r - c^{'}(q)\right] + \frac{1}{j^2} r V_1^{'} \quad (11)$$

Since $V_1^{'} > 0$， and $\frac{1}{j^2} > 0$， so（11）$\frac{1}{j^2} r V_1^{'} > 0$。And $V_1^{"} < 0$， so the sign of （11）decided by $\frac{1}{j}r - c^{'}(q)$。three cases can be distinguished.：

1. $\frac{1}{j}r - c^{'}(q) = 0$， this means market equilibrium，then $\frac{dq}{dj} > 0$， This constitutes the normal response since healthcare is increased when there are healthcare providers.

2. $\frac{r}{j} - c'(q) < 0$， then $\frac{dq}{dj} > 0$，

3. $\frac{r}{j} - c^{'}(q) > 0$， then $V_1^{"}\left[\frac{1}{j}r - c^{'}(q)\right] < 0$。The sign of（11）is unambiguous，The following two subcases can be distinguished: firstly, marginal profit is much more than marginal cost, which make marginal utility to become positive and dominant, so $\frac{dq}{dj} > 0$; secondly, if marginal profit is little more than marginal cost, marginal cost will become positive and dominant, so $\frac{dq}{dj} < 0$。

In the case of perfect competition, existing healthcare providers will withdraw from the market, or new healthcare providers will enter the market, and ultimately reach the market equilibrium.
Conclusion 2: In the case of perfect competition, healthcare providers tend to provide more healthcares services in response to an increase in number of providers.

3. Data, Variables and Model Design

3.1 Data sources

Our data comes from the “China Health and Nutrition Survey Database (CHNS)” from 1989 to 2011, which covers 12 provinces and nine years. Among them, the "healthcares" sub-database consists of 113446 samples, in association with the "personal information" sub database, and "education" and "work" sub database data; all the data is the original sample.

In order to observe the behavior of the sample, we used the following principles of sample selection: excluding samples under the the age of 18; excluding samples where the description of a person’s health and medical expenditure were missing; excluding samples who purchased commercial insurance; deleting samples with other missing observed variables; removing the samples with some abnormal values. Finally, we got 10018 observations.

3.2 Variables

Our dependent variables are medical expenditure, outpatient expenditure and inpatient expenditure in answer to, “Are you sick or injured in the past or how much money has been spent”, “Outpatient expenditure” and “Inpatient expenditure”. We use these variables to measure consumption.

According to the previous theoretical analysis, the moral risk of health insurance includes excess demand and supply-induced demand, which were reflected in the medical consumption increasing with copayment decreasing, and medical consumption increasing with the number of medical institutions increasing. We designed variables from the demand and supply aspects. Variables about excess demand are outpatient and inpatient copayment, and variables about supply-induced demand are the number of health institutions per one hundred thousand of the population of different regions and health providers per thousand population. Because there are different types of social health insurance in China, we designed four characteristic variables according to the answer to the question of "the type of health insurance".

Our model also includes a series of control variables which influence medical expenditure. Injury and illness or severity are the main factors; also individual characteristics variables, so the status of the individual characteristics such as age, sex, ethnicity, education level, marital status, urban or rural area, job control variables; and area and time dummy variables.

Table 1. Variables Description

variables	type	description
Expenditure	continuous	TREATMENT COSTS
Outpatient	continuous	OUTPATIENT costs
Inpatient	continuous	INPATIENT costs
Insurance	dummy	DO YOU HAVE MEDICAL INSURANCE?
Covered%	continuous	% OF COST COVERED BY INSURANCE

Outpatient%	continuous	% FEES OUTPATIENT CARE COVERED
Inpatient%	continuous	% FEES INPATIENT CARE COVERED
Service	continuous	Density of health institutions in which the province is located
Physician	continuous	Density of medical service personnel in which the province is located
Illness	dummy	BEEN SICK OR INJURED IN LAST 4 WEEKS?
Severe	continuous	1 not severe, 2 somewhat severe, 3 quite severe
Description	continuous	Description of person's health: 1 excellent; 2 good; 3 fair; 4 poor
Age	continuous	
Gender	dummy	1 female; 0 male
Nationality	dummy	
Urban or Rural	dummy	1=URBAN 2=RURAL
Marital	dummy	1=URBAN 2=RURAL
Education	dummy	1College degree or above, 0 others
Job	dummy	1 employment, 0 unemployment
Type	dummy	FFMC, UEBMI, URBM, NRCMS
Province	dummy	Beijing, Liaoning, Heilongjiang, Shanghai, Jiangsu. Shandong, Henan, Hubei, Hunan, Guangxi, Guizhou, Chongqing,
Year	dummy	1989,1991,1993,1997,2000,2004,2006、2009,2011

3.3 Model Design

A large number of zero medical expenditures will destroy the assumption of normality. For correcting this problem, we reference the four-part model proposed by Manning (1987) and Duan (1983, 1984). The first part uses a probit model to estimate whether the sample has t medical expenditure:

$$I_i = 1(\beta_1 Insurance_i + \sum_l \beta_l Z_{il} + \varepsilon_i > 0)$$

The dependent variable is dummy variables which represent medical expenses. If the medical expenditure is more than 0, $I_i = 1$; otherwise, $I_i = 0$. The independent variables are also dummy variables which represent participation in the social health insurance. Z_{il} is a set of control variables, which include individual characteristics variables, city and year dummy variables and the social health insurance characteristic variable; ε_i is random disturbance. β_1 reflects the impact of health insurance on health care expenditures.

In the second part, the probit model is used to estimate whether there is inpatient expenditure when the personal medical expenditure is greater than zero:

$$J_i = 1(\beta_1 Insurance_i + \sum_l \beta_l Z_{il} + \varepsilon_i > 0 \,|\, I_i = 1)$$

The dependent variable is dummy variables which representative of inpatient medical expenses, and if inpatient expenses are more than 0, $J_i = 1$; otherwise, $J_i = 0$. The independent variables are dummy variables which representative of participate in the social health insurance. Z_{il} is a set of control variables which include individual characteristics variables, city and year dummy variables and the social health insurance characteristic variable; ε_i is random disturbance. β_1 reflects the impact of health insurance on health care expenditures.

In the third and fourth part, the linear model is used to describe the positive outpatient expenditure and inpatient expenditure:

$$\log(E_{oi} \mid I_i = 1) / \log(D_{oi} \mid I_i = 1) = \alpha + \alpha_1 Outpatient\%_i + \sum_j \alpha_j Demand_{ij} + \sum_k \alpha_k Supply_{ik} + \sum_l \alpha_l Z_{il} + \mu_i$$

$$\log(E_{ii} \mid J_i = 1) / \log(D_{ii} \mid J_i = 1) = \alpha + \alpha_1 Inpatient\%_i + \sum_j \alpha_j Demand_{ij} + \sum_k \alpha_k Supply_{ik} + \sum_l \alpha_l Z_{il} + \mu_i$$

The dependent variable of equation 3 is the logarithm of outpatient medical expenditure. The dependent variables of equation 4 are the logarithm of inpatient medical expenses. The independent variables include demand $Demand_{ij}$ and supply variables $Supply_{ik}$. $Supply_{ik}$ reflects the demand for outpatient medical expenditures and inpatient medical expenditures. α_k reflects the supply for outpatient medical expenditures and inpatient medical expenditures. μ_i is random disturbance. $Cov(\varepsilon_i, \mu_i) = 0$.

3.4. Empirical Test

(1) Data Description

Sample distribution and characteristics

Table 2 shows that the sample data began in 1989, and the survey sample was distributed in seven provinces before 2000, Liaoning and Heilongjiang are included after 2000, and three more provinces joined since 2011, Beijing, Shanghai, Chongqing. The data covers a total of 12 Chinese provinces in eastern and western China. The survey time covers the process of the reform of China's health care system. Therefore, the sample has a wide range of representation.

Table 2. Year of sample data and distribution of provinces

	1989	1991	1993	1997	2000	2004	2006	2009	2011
Beijing	-	-	-	-	-	-	-	-	221
Liaoning	-	-	-	-	51	133	100	107	90
Helongjiang	-	-	-	-	33	74	103	66	63
Shanghai	-	-	-	-	-	-	-	-	298
Jiangsu	89	105	76	80	110	226	130	244	173
Shandong	58	69	34	172	60	139	125	105	145
Henan	154	158	127	29	132	207	197	252	208
Hubei	118	130	64	56	82	170	172	123	107
Hunan	67	96	35	49	77	129	158	122	162

Guangxi	147	209	77	76	108	182	245	336	267
Guizhou	97	96	73	63	87	140	134	145	133
Chongqinq	-	-	-	-	-	-	-	-	239

Medical expenditure is an important independent variable. Figure 3 is the mean of medical expenditures in different provinces.

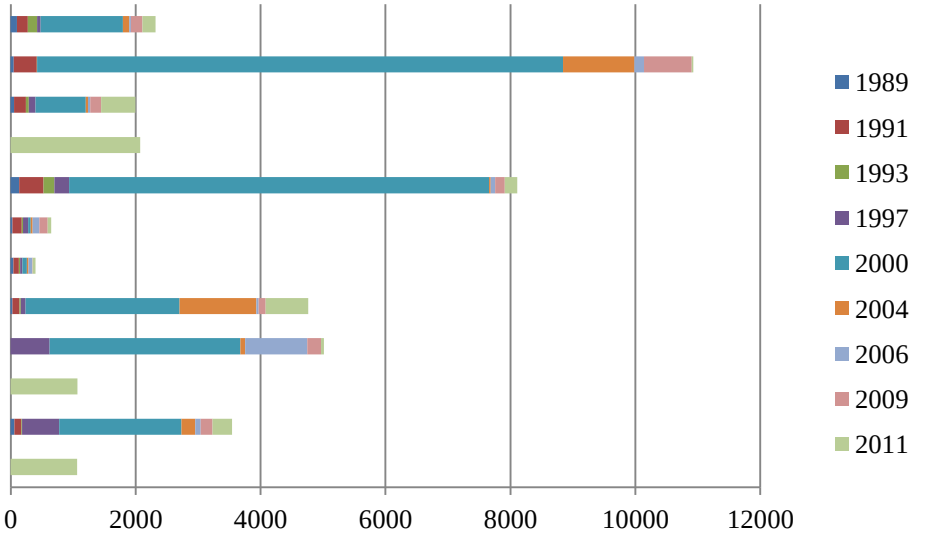


Fig. 3. Average annual expenditure on health care in different provinces

The data show that Liaoning has the highest medical expenditure per capita (2101.006), and Guizhou has the lowest (44.234). The highest expenditure is 2000 (2763.766), and the lowest in 1989 (62.578).

(2) Univariate Tests

Table 2 presents the descriptive statistics of all the variables. We find that the standard deviation of medical expenses, outpatient medical expenses and inpatient medical expenses is particularly large, which implies that the degree of dispersion is very high, so we use logarithmic transformation to correct the non-normality of the data. We find a statistically significant difference in medical expenses between samples with health insurance (1167.552) and samples without health insurance (897.844). On the other hand, probability of illness, severity of illness and description of sample with health insurance are higher than sample without health insurance, average age, education and occupation state. The number of medical institutions and physicians is significantly different in both samples. There are more medical institutions and less physicians in provinces with health insurance. The results of univariate tests show significant differences between the two groups, but we need to further investigate the relationship between two groups after exclusion of other observable interference factors.

Table 3 Descriptive statistics and T tests

	All N=10018		Insurance=1 N=4637 (1)		Insurance=0 N=5381 (2)		Difference (3)=(1)-(2)	p-value	95% Confidence Interval of the Difference	
									Lower	Lower
Variable	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev				
Expenditure	968.054	401.584	1167.55	470.462	897.844	374.225	269.708***	0.003	98.291	476.490
Expenditure $\neq 0$	978.993	403.878	1178.84	472.734	908.505	376.088	270.338***	0.002	73.287	395.183
Outpatient $\neq 0$	46.435	586.046	46.435	586.046	0	0	46.435	-	-	-
Inpatient $\neq 0$	2829.7	859.399	2829.7	859.399	0	0	2829.7	-	-	-
Covered%	63.404	37.390	63.404	37.390	0	0	63.404	-	-	-
Outpatient%	18.801	36.541	18.801	36.541	0	0	18.801	-	-	-
Inpatient%	22.639	38.535	14.599	30.445	0	0	14.599	-	-	-
Illness	0.841	0.438	0.816	0.556	0.850	0.384	-0.034**	0.026	-0.072	-0.036
Severe	1.757	0.672	1.739	0.637	1.763	0.683	-0.024**	0.039	0.050	0.103
Description	0.024	0.154	0.866	1.210	1.685	1.248	-0.819**	0.032	-0.810	-0.714
Age	1.290	1.296	58.042	35.364	58.114	56.793	-0.072	0.906	-2.046	1.814
Gender	58.079	47.662	1.530	0.499	1.563	0.496	-0.033	0.213	-0.049	-0.010
Nationality	1.547	0.498	1.710	2.939	2.031	3.403	-0.321	0.143	-0.418	-0.165
Urban or Rural	1.876	3.192	1.510	0.500	1.721	0.449	-0.211***	0.000	-0.208	-0.171
Marital	1.619	0.486	0.735	0.441	0.675	0.469	0.06*	0.063	0.043	0.079
Education	0.704	0.457	0.578	0.494	0.808	0.394	-0.23**	0.037	-0.224	-0.190
Job	0.697	0.460	0.535	0.499	0.678	0.467	-0.143**	0.043	-0.150	-0.113
Service	7.570	1.667	7.187	1.847	7.927	1.388	-0.74***	0.000	-0.767	-0.641
Physician	4.619	2.164	5.237	2.851	4.042	0.880	1.195***	0.000	0.905	1.050

Note: * imply 10% significant level, ** imply 5% significant level, *** imply 1% significant level

(3) Basic Results

The 4409 samples of the 10018 sample have medical expenses within four weeks. Table 4 is the result of four parts, and the first two columns the probit estimates of equation (9); columns 3 and 4 are probit estimates of equation (10); columns 5 and 6 are OLS estimates of equation (10); the last two columns are OLS estimation of equation (11).

Table 4 Four part test

	(1)		(2)		(3)		(4)	
	B	Sig.	B	Sig.	B	Sig.	B	Sig.
constant	0.939***	0.000	0.939***	0.000	2.036***	0.000	-0.044	0.694
Insurance	0.001	0.101	0.012	0.131	0.444***	0.000	0.622*	0.089
Covered%	0.101**	0.012	0.146**	0.027				
Outpatient%					0.119***	0.000		
Inpatient%							0.128*	0.090
Service	0.075	0.246	0.045	0.342	0.104***	0.000	0.005**	0.038
Physician	0.001	0.128	0.001	0.128	0.090***	0.000	0.002**	0.018
Illness	0.011***	0.000	0.013***	0.000	-0.241***	0.000	0.116***	0.000
Severe	0.007***	0.000	0.013***	0.000	0.729***	0.000	0.190***	0.000
Age	0.021	0.540	0.021	0.540	0.041**	0.032	0.000	0.290
Gender	0.004*	0.092	0.006*	0.092	-0.013	0.299	-0.032	0.212
Nationality	0.015	0.637	0.000	0.343	0.032***	0.000	0.005**	0.033
Urban or Rural	0.006**	0.028	0.005**	0.046	0.287***	0.000	0.072***	0.008

Marital	0.001	0.172	0.001	0.137	0.570***	0.000	0.068**	0.040
Educato n	-0.002	0.107	-0.002	0.153	-0.518***	0.000	-0.150***	0.000
Job	0.001	0.193	0.001	0.174	0.190***	0.003	0.105***	0.001
Type	included		included		included		included	
Provinc e	included		included		included		included	
Year	included		included		included		included	
R^2	0.217		0.483		0.479		0.322	
Adjuste d R^2	0.163		0.372		0.416		0.320	

Note: * imply 10% significant level, ** imply 5% significant level, *** imply 1% significant level

The first part of the model results show that copayment significantly influences medical expenditure by 10.1% at the 5% confidence level, which implies that medical expenditure increase by 10.1% with the rise of copayment by 1%, which is higher than the 9.2% in Manning (1987) based on the Rand experiment. Illness and severity influence medical expenses at a 1% confidence level, medical expenses of men are significantly higher than women's, and medical expenditures of the urban population are significantly higher than the rural population by 0.6%.

The second part shows that copayment significantly affects the probability of inpatients at 5% confidence level. We find a positive association between illness, the severity of illness and medical expenditure on disease by 14.6%.

The third part shows that outpatient expenditures have a significantly positive relationship with copayment by 11.9%. The supply variables are significantly positive with medical expenditure, implying medical expenditures increased by 10.4% with medical institutions per thousand people increasing by 1%; outpatient expenditures increased by 9% with physician per 1000 population increasing by 1%. Our findings are consistent with Fuchs (1978), who found that when the surgeon-to-population ratio increased by 10%, the average utilization of surgical rates will increase by 3%. So we find evidence consistent with the hypothesis that increasing medical supply will induce demand and increase medical expenditure.

The fourth part shows that there is a positive relationship between inpatient expenditures and inpatient copayment at 10% confidence level, and when inpatient copayment increased by 1%, the inpatient expenditure will significantly increase by 12.8%. On the other hand, the supply variables reflect that the number of medical institutions is significantly positive correlation with medical expenditure at 5% confidence level, indicating inpatient expenses increased by 5% with the number of medical institutions per one hundred thousand people increasing by 1%; and the inpatient expenditure increased by 0.2% with physicians per 1000 population increasing by 1%.

Most of the control variables are statistically significant and have the expected sign. Illness and severity of illness influence outpatient and inpatient medical expenditure at 1% and 5% confidence level. In common sense, illness samples and serious illness samples should have more medical expenditure. Age has significant effect on outpatient expenditures, the older sample has greater expenditure, which is consistent with previous research. Nations have a significant impact on outpatient and inpatient medical expenses, which may be affected by the different characteristics of different nationalities. Rural or urban affected outpatient and inpatient medical expenditure accounts under at 1% confidence level, and the urban sample has more outpatient medical expense (28.7%) and more inpatient expenditure (7.2%) relative to rural samples, which may be due to medical accessibility. Marital status has a significant influence on outpatient and inpatient medical expenditure, and the married sample's outpatient medical expenses is 57% higher than unmarried sample's, and inpatient expenditure is 6.8% higher than unmarried sample, which may be due to family responsibilities of the married sample, preferring to avoid the influence on the family brought by illness, so they consume more healthcares to eliminate the possible risks. Education degree significantly affected the outpatient and inpatient medical expenditure at 1% confidence level, compared with the low education level in the sample, the higher level of education, the lower outpatient and inpatient medical expense (51.8% and 15% respectively), which may be due to the high levels sample having more efficient use of healthcare and can saving the healthcare investment. Job state significantly affected outpatient and inpatient medical expenses at 1% confidence level, where samples "with job" have 19% higher outpatient expense and 10.5% more inpatient expenditure, which may be due to higher income leading to more medical expenditure.

(4) further Examination of the Conclusion

(i) Further Test of Excessive Demand

The fourth part of the model test shows that health insurance brought an increase in medical expenses, but it still needs to be tested whether this increase is due to excessive demand or to the release of medical demand. Next, we designed a model to test if medical expenses of the insured of different abilities to pay would ill influence other living expenses, and if the medical expenditures crowded out the cost of living, implying that medical expenses are within their pay ability, so if the release of medical demand is not a major factor, then increase of medical expenditure is more due to excessive demand.

The model is as follows:

$$expense_i = \eta_0 + \eta_1 Covered_i + \sum_l \eta_l Z_{il} + \mu_i \qquad (13)$$

The dependent variable $expense_i$ is the other expenditure besides medical expenditures. $Covered_i$ is insurance copayment. Z_{il} is a set of control variables. μ_i is a random disturbance term. Our model is based on samples of all medical expenses. We include income variables to distinguish insured of different abilities to pay. The answers to "how much is the general monthly salary including subsidies?" are used as measure of income. We divided the proportion of self-paid medical expenses to income into four sections according to the 10%, 20% and 40%. $expense_i$ is other spending besides medical expenditure, and we used food consumption expenditure as a substitute due to data availability, which was based on actual total consumption of food in three days of a family in the CHNS database, combined with "food price" information in the community level database to calculate the amount of household food consumption (Jia et al, 2011).

Table 5. Further Test of Excess Demand

	self paid medical expenses as a percentage of income <10% (1)		self paid medical expenses as a percentage of income 10%-20% (2)		self paid medical expenses as a percentage of income 40% (3)		self paid medical expenses as a percentage of income >40% (4)	
	B	Sig.	B	Sig.	B	Sig.	B	Sig.
constant	0.345***	0.000	0.454***	0.000	0.473***	0.000	0.645	0.135
Covered %	0.101	0.012	0.146	0.027	0.034	0.231	0.064*	0.067
Insurance	0.081**	0.032	0.035**	0.031	0.124	0.283	0.327	0.273
Illness	-0.463**	0.020	-0.182**	0.034	-0.382**	0.028	0.321**	0.038
Severe	-0.007***	0.000	-0.013***	0.000	-0.729***	0.000	=0.190***	0.000
Age	-0.021	0.764	-0.021	0.450	-0.041	0.343	-0.451	0.632
Gender	0.004	0.382	0.005	0.192	-0.003	0.382	-0.002	0.182
Nationality	0.024	0.637	0.001	0.343	0.032	0.832	0.005	0.372
Urban or Rural	0.006**	0.038	0.005*	0.074	0.197*	0.082	0.036*	0.058
Marital	0.001	0.172	0.001	0.137	0.378	0.289	0.039	0.168
Education	0.010	0.103	0.219*	0.089	0.371***	0.000	0.193***	0.000
Job	0.094*	0.093	0.082*	0.074	0.372***	0.003	0.283***	0.001
Type	included		included		included		included	
province	included		included		included		included	
year	included		included		included		included	
R^2	0.403		0.398		0.392		0.419	
adjusted R^2	0.387		0.219		0.293		0.402	

Note: * imply 10% significant level, ** imply 5% significant level, *** imply 1% significant level

The test shows that individuals' own medical expenses have significantly positive relation with food consumption when self-paid medical expenses as a percentage of income is less than 10%, between 10%

and 20%, between 20% and 40%, at a confidence level of 1%, 5% and 5% respectively. On the other hand, we do not find significant a relationship between copayment and food consumption. indicating that the insurance payments have no significant effect on food consumption, but health insurance can promote medical spending. We can conclude that it is because of excessive demand rather than release of medical demand, because the healthcare is in the ability to afford, so there is no release of medical demand. Our results are in accordance with Xie Mingming (2016), who found that health insurance effect on increasing of medical costs is more ex-post moral hazard factors rather than the release of medical demand.

When self-paid medical expenses as a percentage of income is above 40%, the insurance copayment ratio has significant positive impact on food consumption expenditure at 10% confidence level, implying that the reduction of copayment ratio squeezes food expenditure significantly, and self-paid medical expenditure has affected the basic life of these populations, so growth of medical expenditure is more a release of the demand. At the same time, when self-paid medical expenses as a percentage of income is above 40%, health insurance has no significant effect on the increase of medical expenditure, implying that the existing social health insurance has little effect on the insured when they suffer from critical illnesses, so government needs to further improve the security level of the social health insurance for critical illnesses.

(ii) Further Testing for SID

The four-part model shows that with the increase of medical supplies, medical expenditure of outpatient and inpatient also increased, but we need to know if this increase is due to the supply-induced demand or to the increase in accessibility (Sorenson and Grytten, 1999), which refers to increase of the medical expenditure with reduction of waiting time for patients' medical treatment, and improvement of the quality of health care, along with the increase in medical supplies. Therefore, we divide the sample according to the average number of health institutions per one hundred thousand population, defined areas of shortage in medical resources, or areas of adequate medical resources. In the shortage areas, insured' medical needs are not satisfied, so when medical supply increases, demand increases also, which is called accessibility increased. In the area of sufficient medical resources, medical supply is far beyond the actual needs of the insured, demand increasing with the increase of medical supplies, which is supplier-induced demand.

Table 5. Further Test of SID

	$Service \geq 7.31$	Service<7.31
	medical expenses ≠ 0 (1)	medical expenses ≠ 0 (2)

	B	Sig.	B	Sig.
constant	0.268	0.555	2.855***	0.000
Insurance	0.451***	0.000	0.322***	0.004
Covered%	0.112***	0.000	0.107***	0.000
Service	0.263***	0.000	0.133	0.507
Physician	0.091***	0.000	0.054*	0.099
Illness	-0.189**	0.015	-0.007	0.931
Severe	0.935***	0.000	0.866***	0.000
Age	0.001**	0.016	0.001	0.378
Gender	0.002	0.978	-0.118	0.116
Nationality	-0.023***	0.002	0.046	0.167
Urban	0.275***	0.000	0.529***	0.000
Marital	0.634***	0.000	0.583***	0.000
Education	0.460***	0.000	0.108	0.333
Job	-0.233***	0.002	-0.451***	0.000
Type	included		included	
province	included		included	
year	included		included	
R^2	0.213		0.117	
Adjusted R^2	0.212		0.163	

Note: * imply 10% significant level, ** imply 5% significant level, *** imply 1% significant level

Table 9 shows that the number of health institutions per one hundred thousand people and the number of health physician per thousand population is positively related to medical expenditure at 1% confidence level in resource-rich provinces. Medical expenses increased by 26.3% when number of health institutions per one hundred thousand people increased by 1%. Medical expenses increased by 9.1% when medical physician per thousand population increased by 1%, which implies that in medical resource-rich provinces, medical institutions have high density and hot competition, so healthcare providers induce medical needs of patients in order to maximize their own utility by using their medical information superiority. In the medical resource-poor provinces, in addition to the number of health physicians per thousand population being positively related to medical expenditure at 10% confidence level, implying that health spending increased by 5.4% when the number of health physician per thousand population increased by 1%, other results are not significant, which indicates supply-induced demand in the poor medical resources area is lower than the rich medical resource area to a certain extent.

5. Conclusions and Recommendations

This article examines ED and SID in 10018 samples. We examine whether sample with health insurance have more moral hazard. Using medical expenses as an approximation for demand and medical institute

as well as physician as an approximation for SID, we find significant evidence that insurance copayment ratios significantly affect medical expenditure. Medical expenses increased by 10.1% when health insurance copayment ratio increased by 1%, the degree for outpatient is 11.9% and inpatient is 12.8%. Outpatient medical expenditure per capita increased by 10.4% and inpatient medical expenditure per capita increased by 5% when health institutions per one hundred thousand increase by 1% per capita. Outpatient medical expenditure per capita increased by 9% and inpatient health expenditure per capita increased by 0.2% in relation to health physician per thousand population increasing.

Further test on excess demand shows that there is excess demand caused by medical insurance when self-paid medical expenses as a percentage of income is lower than 40%. While when self-paid medical expenses as a percentage of income is higher than 40%, the growth in health spending is more the release of demand. Further test on SID shows that there is SID in the rich medical resource regions, while accessibility demand is in the poor medical resource regions.

Our results are consistent with theories and provide some evidence for further deepening the medical insurance system reform. Firstly, health insurance copayment has a significant impact on excess demand, so we should set a reasonable copayment ratio. On the other hand, we find that excess demand is influenced by the proportion of self-paid medical expenditure to income, so government should count medical expenses and compensation degree in different income level populations, improving the security level of the low income population on the basis of scientific statistics, in order to release of low income group’s medical needs and appropriately increase the high income group’s copayment to control excessive demand.

Secondly, SID has a significant impact on medical expenditure, so we should affect the supply-induced demand by designing the policy to influence medical provider's behavior, such as the use of charges (DRGs). The United States’ inpatient expenses covered by Medicare decreased from 18.5% to 5.7% and the average inpatient days decreased from 10.4 days to 8.7 days after the implementation of DRG; at the same time you can see uneven distribution. We also find that uneven distribution of medical resources in China, the increase of the medical expenditure by supply of health care in rich medical resource areas are affected by the supply-induced demand, so the medical insurance reform in China should proceed from the overall situation, making a reasonable design and planning for medical resources.

Lastly, medical insurance institutions play an important role in reform. China's medical insurance institutions have little effect on controlling medical expenditure, which is mainly due to the low management level of

medical insurance institutions in China, so their information is not enough. Our government should not only strengthen the construction of the medical insurance institutions, and realize their information and deterrent function in the health care market, but also improve the negotiation mechanism of health insurance. Medical insurance institutions should explore establishing negotiation mechanisms with the healthcare providers, to control medical costs.

In short, the social health insurance system originating from third party payment is the institutional factor of excessive demand and supply-induced demand. The negative impact of excessive demand and supply-induced demand reduced to a minimum will improve the social health insurance system and deepen the reform of the medical system, so that the basic medical system of China truly achieves the goals of maintenance and promotion of health of all citizens.

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