

Regression Analysis of Health Insurance Cost Affecting Factors

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Abstract

The paper selected the relevant data of 1999-2009 basic medical insurance for urban residents in China as object. By setting the relevant indicators, build multiple linear regression models and analysis the factors which affect the health care costs of China from two perspectives, that is, both sides of supply and demand. To put forward strategies and suggestions for controlling the health insurance costs in China.

Keywords: Health care costs; Influencing factors; Both sides of supply and demand; Multiple regression

Since in 1970s, the rapid growth of health care costs and how to control the rapid growth of medical cost has become one of the most important economic and social problems of modern society.^[1] In recent decades, cost control has been a enormous challenge of medical insurance system, medical insurance cost overruns is a common problems of the vast majority city, is also one of the biggest potential crises of the medical insurance system.^[2]

1 Objects and Methods

1.1 Object

"2010 China Health Statistics Yearbook" and "2010 China Statistical Yearbook" are selected as the object of study. Six kinds of factors which can affect the cost of health insurance are selected from both the supply-side and demand-side. The factors are per capita disposable income of urban residents, the price level, hospital costs, the number of hospitals, per capita income of hospitals, financial investment.

1.2 Research Methods

Use the methods of literature research and logical reasoning, to qualitatively analysis the related factors which impact China's medical insurance costs. Use the methods of multiple linear regressions to build a model, to quantitatively analysis the related factors which impact China's medical insurance costs.

1.3 Data Analysis

First, analysis the Pearson correlation coefficient of the selected data by the statistical software SPSS 17.0, to research the interrelationship and closeness between the various factors and total medical insurance costs. Then, Import the data of the relevant factors into the multiple linear regression models.

2. Qualitative Analysis of Cost Factors

To control the medical insurance cost involves many factors. Therefore, choosing the right breakthrough is very important. Currently, the strategy of control medical insurance costs goes through three parties: demand-side, supply-side, insurance agencies.

2.1 The Controlling Factors of the Demand-side

Modern medical insurance are usually constituted of three parties: medical service providers, patients, insurance agencies. And in this tripartite relationship, the first thing is to control the use of medical insurance of the demand-side. In China, because of the cost been paid by a third party, it makes that the insured person has the motives of excessive consumption, the main problem is: excessive use of high-end medical resources; misrepresent the condition, minor illness care, one person insured and more personal benefit.

Currently, the study of consumer controlling of demand-side is the world's most famous health insurance experiment which conducted in the United States in 1974. The experimental results show that: in the case of free medical care, the insured person's spending and health service utilization are the highest. After setting a certain cost-sharing measures, medical costs are significantly reduced, that is, raising the co-payment rate can reduce consumers' medical needs, thereby reducing the cost of health insurance payments. Therefore, on the demand-side, the most important thing of controlling health care costs is to control the insured person's spending power.

2.2 The Controlling Factors of the Supply-side

Extensive literature and the practice of many countries proved that the insured person burden part of the cost does not fundamentally eradicate controlling medical costs continue to grow. Many countries have to shifted focus from the demand-side to supply-side to control health care costs. By changing the consciousness of health care providers to control and reduce the cost, to achieve the purpose of reducing health care costs. And on the supply-side, the greatest impact of controlling cost is that the health care providers use its information advantage to induce patient consumer behavior.

Medical induced demand is proposed by Evans, there are two meanings: First, if the medical services provide by the doctor does not meet the patient's best interests, we think that there is some degree of induced demand, Second, if the patient demand for medical

services under the influence of a doctor than their actual demand, there is also the medical side induced demand.^[3] The main reason of inducing behavior is the information asymmetry between patients and doctors, it allows doctors lack intrinsic cost constraints and incentive mechanisms, and health care providers will seek to maximize their own economic interests. The result is excessive medical services provided, and the trend of rising health care costs cannot be restrained. Therefore, on supply-side, the most important of controlling health care costs is that health care providers' incentives.

3 Model Building

3.1 The Selection of Model Variables and Descriptions

In the factors that affect health care costs, some variables were trade-offs according to the desirability and its internal relations of the data. Three indicators of demand-side factors were selected; it is disposable income, price index and the per capita cost of hospitalization. Four indicators of supply-side factors were selected; it is number of hospitals, hospital average income, financial investment and per capita hospitalization charges.^[4]

(1) Per capita Disposable Income:

According to the economic theory, per capita disposable income is the most stable and the most important factor of Consumption.^[4]

(2) Price Index:

In the case of residents' nominal income without changing, the rise of the price level will make residents' real disposable income declined, and it make residents medical expenses resulting two situations: Under the

circumstances of the absence of health insurance, health care spending and health care costs will be reduced; In the case of a Medical insurance worked, the resident medical spending still goes up.

(3) The Price of Medical Services:

The price of medical services mainly include the per capita cost of outpatient and the per capita cost of inpatient costs, and China's social medical insurance system for the outpatient payment paid from the personal account, while hospitalization expenses paid from the pooling account. Therefore, the payments of social health insurance cost is mainly inpatient medical costs, reduce the cost of hospitalization is an important issue to control medical costs.

(4) Number of Hospitals:

With the number of hospitals and doctors increasing, the hospital has the intrinsic motivation to improve the total cost of medical services for maintaining and increasing their income.

(5) Average Income of Hospital:

In the case of number of hospitals and doctors as well as the number of medical devices were in certain, after participating in the health insurance, residents' sensitivity of medical care price greatly reduced, so the health care costs also will grow significantly.

(6) Financial Investment:

Government's financial investment in public health is low in general, though it is increasing year by year. The main source of income of the hospitals is medical services fees and income of pharmaceuticals, in case of financial investment in rare, the hospitals have to survive and increase revenue through these means.

Specific data is in Table 1.

Table 1: Related factors of health insurance costs

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Medical	69.10	124.50	244.10	409.40	653.90	862.20	1078.70	1276.70	1561.80	2083.60	2797.40
Per	5854.00	6280.00	6859.60	7702.80	8472.20	9356.80	10493.00	11759.50	13785.8	15780.8	17174.70
Price	98.60	100.40	100.70	99.20	101.20	103.90	101.80	101.50	104.80	105.90	99.30
Number	16678.0	16318.0	16197.0	17844.0	17764.00	18396.00	18703.00	19246.00	19852.0	19712.0	20291.00
Hospital	2858.26	3242.38	3537.92	3715.09	3969.40	5111.83	5575.63	6163.80	7506.50	9283.10	11494.90
Per	2891.10	3083.70	3245.50	3597.70	3910.70	4284.80	4661.50	4668.90	4973.80	5463.80	5951.80
Financial	602.80	709.50	800.60	908.51	1116.94	1293.58	1552.53	1778.86	2581.58	3593.94	4685.60

Source: "2010 China Health Statistics Yearbook"; "2010 China Statistical Yearbook". Medical insurance spending (hundred million CNY); Per capita disposable income (CNY); Hospital average income (ten thousand CNY); Per capita hospital costs (CNY); financial investment (hundred million CNY)

3.2 Medical Insurance Spending and Each Factor Correlation Analysis

This paper based on the data characteristics, its use of the correlation coefficient is Pearson's correlation

coefficient. The data in Table 2-1 was processed by the software SPSS 19.0 for Pearson correlation coefficient. The results were shown in Table 2.

Table 2: Pearson correlation of Medical insurance Expenditures

	Medical insurance Expenditures	Per capita disposable income	Price Index	Hospital expenses per capita	Number of hospitals	Hospital average income	Financial investment
Pearson correlation	1	0.990	0.957	0.979**	0.923	0.994	0.983

Confidence interval: 95%. These data illustrate $\alpha = 0.05$ confidence interval, all selected factors are highly associated with health care expenditures, which was statistically significant.

3.3 Establish the Model of Demand-side Factors of Social Health Insurance cost.

Establish the model of demand-side factors of social health insurance cost. Wherein: Z represents

social health insurance spending (hundred million CNY), X_1 representative disposable income (CNY), X_2 represents price index, X_3 represents per capita hospital expenses (CNY).

The form of the demand-side regression model:
 $Z=p+p_1X_1+p_2X_2+p_3X_3,.....$

Considering that medical and health system reform start from the second half of 2005, the change in policy would affect the data correspondingly, so, 1999-2005 as a time period 2005-2009 as a period of time, disposable income, price index, per capita hospital expenses as independent variables, total Medical insurance expenditures as the dependent variable, to do multiple linear regression analysis.

Establish demand-side 1999-2005 linear regression model. Result is:

$$Z_{1999-2005}=-2084.244+0.048X_1+5.279X_2+0.455X_3...$$

As shown in Table 3, the test model $F = 239.485$,

the value of P less than 0.05, and the model is reasonable. Model correlation coefficient $R = 0.998$, the model coefficient of determination $R^2 = 0.996$, that is, variables introduced in the model can explain 99.6% of total Medical insurance expenditures.

Establish demand-side 2005-2009 linear regression model. Result is:

$$Z_{2005-2009}=1125.977+0.133X_1-40.053X_2+0.566X_3...$$

As shown in Table 4, the test model $F=1554.216$, the value of P less than 0.05, and the model is reasonable. Model correlation coefficient $R=0.999$, the model coefficient of determination $R^2=0.998$, that is, variables introduced in the model can explain 99.8% of total Medical insurance expenditures.

Table 3: The Correlation Coefficient of the Demand-side From Year 1999-2005

Model	Nonstandard coefficient (B)	Standard Error of Mean	Standard coefficient	F test	The correlation coefficients of model (R)	The model coefficient of determination (R)
Per capita disposable income	0.048	0.254	0.209	239.485	0.998	0.996
Price Index	5.279	14.859	0.024			
Per capita hospital costs	0.455	0.675	0.771			

Dependent Variable: Medical insurance spending (hundred million CNY)

Table 4: The Correlation Coefficient of the Demand-side From Year 2005-2009

Model	Nonstandard coefficient (B)	Standard Error of Mean	Standard coefficient	F test	The correlation coefficients of model (R)	The model coefficient of determination (R)
Per capita disposable income	0.133	0.254	0.209	1554.216	0.999	0.998
Price Index	-40.053	14.859	5.442			
Per capita hospital costs	0.566	0.675	0.098			

Dependent Variable: Medical insurance spending (hundred million CNY)

3.4 Establish The Model of Supply-side Factors of Social Health Insurance Cost.

Establish multiple linear regression models, in which: Z represents social health insurance spending (hundred million CNY), Y_1 represents the number of hospitals, Y_2 represents the hospital average income (CNY), and Y_3 represents financial investment (hundred million CNY).

The form of the supply-side regression model:
 $Z=p+p_1Y_1+p_2Y_2+p_3Y_3+.....$

Considering that medical and health system reform start from the second half of 2005, the change in policy would affect the data correspondingly, so, 1999-2005 as a time period 2005-2009 as a period of time, hospital average income, financial investment as independent variables, total Medical insurance expenditures as the dependent variable, to do multiple linear regression analysis.

Establish supply-side 1999-2005 linear regression

model. Result is:

$$Z_{1999-2005}=-1420.077+0.054Y_1-0.010Y_2+1.011Y_3,.....$$

As shown in Table 5, the test model $F=272.587$, the value of P less than 0.05, and the model is reasonable. Model correlation coefficient $R=0.998$, the model coefficient of determination $R^2=0.996$, that is, variables introduced in the model can explain 99.6% of total Medical insurance expenditures.

Establish supply-side 2005-2009 linear regression model. Result is:

$$Z_{2005-2009}=202.992-0.113Y_1+0.775Y_2-0.858Y_3,.....$$

As shown in Table 6, the test model $F=123078.748$, the value of P less than 0.05, and the model is reasonable. Model correlation coefficient $R=0.999$, the model coefficient of determination $R^2=0.998$, that is, variables introduced in the model can explain 99.8% of total Medical insurance expenditures.

Table 5: The Correlation Coefficient of Supply-side From Year 1999-2005

Model	Nonstandard coefficient (B)	Standard Error of Mean	standard coefficient	F test	The correlation coefficients of model (R)	The model coefficient of determination (R)
Number of hospitals	0.054	0.030	0.143	272.587	0.998	0.996
Hospital average income\ten thousand CNY)	-0.010	0.070	-0.026			
Financial investment (hundred million CNY)	1.011	0.230	0.894			

Dependent Variable: Medical insurance spending (hundred million CNY)

Table 6: The Correlation Coefficient of Supply-side From Year 2005-2009

Model	Nonstandard coefficient (B)	Standard Error of Mean	standard coefficient	F test	The correlation coefficients of model (R)	The model coefficient of determination (R)
Number of hospitals	-0.113	0.004	-0.099	123078.748	0.999	0.998
Hospital average income(ten thousand CNY)	0.775	0.013	2.704			
Financial investment (hundred million CNY)	-0.858	0.023	-1.619			

Dependent Variable: *Medical insurance spending (hundred million CNY)*

4. Discussion and Analysis

4.1 The Medical Insurance System in China

The system implemented in China's urban social medical insurance is mainly the medical insurance for urban workers and the medical insurance for urban residents carried out in 2006. In cost control, it is mainly aimed at the insured. The insured have personal account and the social pooling account. But these two kinds of payment can only be used to pay the medical expenses that the insured spend in the designated medical institutions or designated retail drugstore and these medical expenses must meet the basic medical insurance drug list, the scope of the diagnosis project, and the provision of medical services and facilities standards project scope.

The pay line fixed by China's urban social medical insurance is about 10% of local workers' annual wages. The top line is 6 times of the local workers' annual wages, and payment rate is about 40% in general. However, due to the different level of medical hospital where the insured go and the different standard of pay line, the up pay line of the higher level of the hospital is also higher.

China's urban social medical insurance is the designated medical institutions, including the fixed point hospital and designated retail drugstore. The treatment project scope formulated in China's urban social medical insurance, is not to pay and pay treatment and scope of the project provided exclusive method respectively. At the same time, it also formulated the basic medical insurance drug list, both medical institutions and the insured in the pharmacy to buy medicine should be in the directory within the scope of social medical insurance to pay the account.

4.2 The Defects in Medical Insurance Cost Control in China

4.2.1 Method of Payment

China's medical insurance system is fee for service. The phenomenon of the excessive use of medical resources that is mainly featured in the suppliers' induced demand is quite serious. Because the insured patients' pay level of medical expenses is low, and basically do not have to spend their own money, they will homeopathy utilizes medical insurance "minor illness raised", "one person insured, many people benefited", and even deceive the medical insurance institutions together with the doctors. This payment method can lead to general hospitals' excessive supply of medical services, rather than provide services in the most effective way, which is an important reason resulting in health care costs' increasing in our country in recent years.

4.2.2 Hospital Equipment

China's medical equipment belongs to the

hospitals, and the hospital standard graded hardware conditions and is the important sign for hospitals to establish their hospital brands, and because the government treat for the conventional medical treatment fees strictly, but they allow medical institutions to develop standards for fees according to the cost, in some new equipment and new development of the medical treatment service projects, all kinds of medical institutions at all levels (including those small hospital) has been purchasing the advanced equipment. But in fact, a large part of the hospital equipment and high-tech equipment has exceeded the actual demand, and insufficient utilization rate causes the waste of medical resources.

4.2.3 The Price and Use of Drugs

According to statistics, 80% drugs in our country are from the pharmacy of the hospital to the patient, the price of drugs in the pharmacy of the hospital is usually higher than that in the retail pharmacy. A large part of the medical service provider revenue from drug profits, according to researchers: the drug income accounted for about 80% of the total income of the hospital, and the phenomenon "to drugs to support medical" still exists. Medical service providers in China tend to use new, expensive medicine, imported drugs, but do not use.

4.2.4 Incentive Mechanism

In our country, the insured patients to the hospital always require more drugs treatment, and prescribe expensive drugs, which seriously neglects the value of the doctor technology labor, although the doctor's mental and physical labor is cheap, the fees of using auxiliary examination are much higher than the doctor's mental and physical labor price, making doctors more equipment utilization. So, some doctors will induce the patient to do over treatment, in order to increase his personal income.

So the main problems in our current medical insurance are highlighted in the following three points: (1) The costs of health insurance are continuing to rise, and medical supplier control is not enough.^[4] (2) Patients with uncontrolled medical behavior and excessive use of high-grade medical resources. (3) Assessment system is not sound, management supervision does not reach the designated position.

4.3 The Buyer Influence Factors Analysis

Buyer's social medical insurance model showed that per capita disposable income, price index and per capita hospitalization all have an impact on social medical insurance.

Per capita disposable income spending has great influence on social medical insurance. Per capita disposable income growth per \$1, 1999-2005, during the period of social medical insurance will be an increase of 4.8 million CNY, and social medical

insurance during 2005-2009 will be an increase of 13.3 million CNY. Followed by the buyer's spending power has obvious enhancement, the data show that the national income growth rate is very high for these years, including very fast growth of household disposable income, which indirectly influence the social medical insurance in our country.

Price level of social health spending seems a lot from the model, the influence of each price index increased one percent, health-care spending will increase 527.9 million CNY during 1999-2005, health-care spending will reduce 4.0053 billion during 2005-2009. This is because in reality, since 2006, because of economic fluctuations in China and China's price level growth rate is too high, which lead to insured people reduce the demand for health care products, indirectly reduce the social medical insurance in our country.

Average per capita hospitalization cost also has a great influence in social medical insurance expenses, because in terms of social medical insurance reimbursement is mainly on the hospitalization expense. 1 CNY per capita hospitalization cost increase, health-care spending will increase 45.5 million CNY during 1999-2005, and health-care spending will increase 56.6 million CNY during 2005-2009. On the surface, coefficient changes compared to the rest of the factors is small, but in recent years our country's per capita medical expenses average annual growth rate is 18%.

4.4 The Supply-side Influence Factors Analysis

Supply-side model of social health insurance costs indicates that the number of hospitals, average income of hospitals and financial investment have an impact on social health insurance spending. And the impact on social health insurance expenses changes with related policies and the degree of saturation of social demands. From 1999-2005, each addition from one hospital social health insurance spending will result to a rise of 5.4 million. From 2005-2009, each additional one hospital social health insurance spending could lead to a decline of 11.3 million, which demonstrates that the number of hospitals during the period 1999-2005 did not meet the market demand, that the increase in the number of hospitals makes more patients receive medical services, and that the increased number of Medicare hospital spending is due to the increase in the number of patients increases. There is an increase in the number of hospitals during the period 2005-2009 while the social medical insurance costs decreased, indicating that competitions between hospitals can effectively reduce the social medical insurance costs.

Hospital average income has a smaller impact on social health insurance costs. From 1999-2005, with the hospital average income increasing by 1 CNY, the medicine spending would reduce 180 CNY. By contrast, from 2005-2009, the medical care spending would increase 7670 CNY, which means that the increase of the average income of the hospitals is unreasonable, while the increase of income is based on rising medical costs, indicating the unreasonable charge of medical institutions and medical staff's induced behavior in

patients still exist.

The influence of Fiscal support to the social medical insurance is more outstanding. The period 1999-2005 fiscal investment of per 100 million CNY, an increase of 62.1 million CNY of social medical insurance spending. The period of 2005-2009 fiscal investment of per 100 million CNY, social medical insurance can reduce 88.2 million CNY. Fiscal spending on medical department from the point of view of model during 1999-2005 not only failed to reduce social cost of medical treatment insurance, but also increases the social medical insurance expenses. And during 2005-2009, fiscally input for reducing has obvious effect, which stated the relevant policies of the health reform and government financial input received a positive response.

5. Strategies and Suggestions

5.1 Controlling the Consumer's Spending Power

5.1.1 Define the Consumer's Demand-side Areas Rationally

As the per capita disposable income of urban residents increased, spending power in the growth of demand-side also increased. Defining areas of basic medical insurance for the control for the consumers' spending power has an important and positive impact. About demand-side factors, it is not difficult to find demand-side economic situation to some extent decide the demand for medical services. So insurance institutions cope with disease directories, medical instruments and testing equipment for unified development.

5.1.2 Controlling the Demand-side's Medical Consumption Behavior

Due to differences in rank of hospitals, demand-side consumer price index is not the same in the process. The higher rank of hospital, the price index higher. According to the State Department of Chinese provincial and municipal hospitals 1450 outpatient and 1100 cases of hospitalization cases studies show that 64.8% outpatient can be resolved at the community grass-roots, 76.8% of hospitalized patients with chronic diseases can be resolved at the community grass-roots or family health care. If achieve rational triage of patients, then will save 40% for medical expenses. In clinic manage patients is also the primary means of controlling medicate spending.

5.1.3 Reduce Hospital Stays

Hospital costs are an important factor affecting Medicare spending and reducing hospital stays are the most direct way to control medicare spending. Before the provision of medical services to be used to assess the suitability of the service to prevent unnecessary or inappropriate hospitalization; after the patient through rigorous evaluation of synchronization to limit patient days and a discharge plan, strict control of the patient's hospital stay. Recovery of patients cannot be confined to the hospital within the healing process, extending the medical process that requires hospitals to communities and families. Eventually hospitals for subject, patient-centered, family-oriented, community wide network of medical services. ^[5]

5.2 Control the Behavior of Medical Service

5.2.1 Increase the Proportion of Private Hospital the Basic Medical Insurance Institutions

Competition is the effective means to reduce price and improve the service quality. Nowadays, administrators of hospitals in our country a little sense of competition. Self-discipline of medical establishments is short of power which is an important factor to cause soaring medical costs. Thus, when we execute the categorized management on the medical establishments, we are supposed to treat all hospitals alike. At the same time, we should bring the private medical institutions which provide quality and cheap services for patients into the fixed-point range of basic medical insurance. Also, we should encourage the competition between medical establishments to achieve the aim to control the costs, improve the quality of services and the efficiency of services.

5.2.2 Strengthen the Medical Behavior of the Internal Supervision

To establish the information systems of medical service. Through the information systems of medical service, Insurance institutions can monitoring the medical expenses in real time, call the information of the patients and examine the rationality of the treatment. The establishment of the electronic medical records is in favor of checking or controlling the problems of repetitive inspection. Also, it is more continent to make horizontal comparisons between the doctor and the medical establishment to make the correct evaluation, rewards and punishment. At the same time, it can be used for credit monitoring to patients and doctors, and so on; To take restrictive measures to the supply of checking exceedingly medical apparatus and instruments. The medical equipment inspection service is an important element to affect the average revenue of hospitals. Insurance institutions should carry out the “misuse” of compensation system to medical institutions and make respectively the “misuse” compensation standard with reference to the significant positive rate of medical equipment inspection in the world and the country.

5.2.3 Increase the Proportion of Compensation Finance for the Supplier

Hospital's average income is an important part of providers' influential elements, so a proper system can change the income structure of doctors or nurses and it will reduce that medical workers induce patients to pay for their own profits. Viewing from the model of government's offer and medical insurance's relationship, it shows that it will affect the increase of medical insurance. So it is important for government to increase the offer of medical, make rules about the range and ways, and provide necessary things for medical workers.

According to the analysis, the ability of consumers to pay has important influence on medical insurance. And proper controlling of the over-paying can reduce the cost of medical insurance. There are many unreasonable changes to patients and behavior of cheating patients in our daily life. If we can make rules to change the behavior of hospital, it is possible to

reduce the medical insurance. So there are some ways to control the rate of the increasing of our medical insurance: define the basic range of medical insurance, reduce the days in hospital, and build the information system of medical service and so on. Government can refer to these ways to create a model of controlling medical paying.

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