

# Income Growth, Price Variation and Health Care Demand: A Mixed Logit Model Applied to Two-period Comparison in Rural China

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## 1. Introduction

In rural China, during the period of the 60s and 70s, cooperative medicine was the dominant health care system at the grass-root level and a system under which the village collective runs and finances the clinics. Township health centers were supervised by county. In the 1980s, this system experienced transformations characterized by the disintegration of the rural cooperative medical service, by the decentralization of township hospitals from county to township governments. Many village clinics have closed or were privatized. According to the national survey in 1986, there was only 9.5% of the rural population covered by cooperative medical system. This number is 80.5% less than that in 1978. In 1989, the fee-for-service private clinics accounted for 59.4%, out of which 11.1% were group private practice and 48.3% were solo private. The collective clinics accounted for 40.6%, of which 32% were village clinics, 3.6% were satellite clinics established by township health centers, and 4.9% were others (Liu and Wang 1991). With the collapse of the rural health insurance and the underfunding of public facilities, private health expenditures have drastically increased at the same time as the cost of care (Herd, Hu and Koen, 2010). Therefore, the health of the Chinese became worse. In order to deal with, the Chinese government has implemented a new rural health insurance system in order to protect households from impoverishment due to catastrophic health expenditures (Central Committee of CPC, 2002) and therefore to increase health access. Moreover, the ambiguous government health policy (set prices below cost for basic health care, but above cost for high-tech diagnostic services; underfunding of public facilities) has contributed to change the supply of health services over the last two decades.

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Given this context, this paper assesses the evolution of health care demand and its determinants over two periods, included into an eighteen years interval: 1989-1993 and 2004-2006. These periods are in fact the start and the end of a period of deregulation of a state and collective-controlled health system and disintegration of cooperative insurance (since from 2003, Chinese government has decided to increase its share in the finance of health system and to restore rural cooperative insurance system).

The first focus of the paper is on the evolution of choices of healthcare providers and the study of rural patients' rational behavior in the face of the changes of financing barriers (income, prices) and distance to healthcare providers. As will be shown, during these periods, the balance of power between different types of healthcare providers has been in the disfavor of township centers and village clinics and in the favor of urban large-sized hospitals. Beyond them, the development of private health providers was observed, specifically during the second period.

Among the explanatory factors to the evolution of choice, income and price have always been given special attention in previous studies. There is an abundant literature on health care provider choice. Two main concerns have been to measure the effects of income and price on the choices. The results obtained on the basis of data from less developed countries achieved contradictory conclusions. For Lavy and Guigley (1991), the decision to seek medical treatment in Ghana is responsive to household income. Sahn et al. (2003) showed that own price elasticity of demand for all health care options are high in Tanzania. Other studies conclude that both price and income are a significant determinant of health care provider choice (Ntembe 2009 in the case of Cameroon, Lopez-Cevallos and Chi 2010 in the case of Ecuador). By contrary, Lindelow (2004) shows that income is not an important determinant of health care choices in Mozambique, and prices have significant but inelastic influences on the choice. Lawson (2004), in the case of Uganda, finds a strong income impact, while user fees are less significant than one might first expect. For Akin et al. (1986), the price is not a significant determinant of demand of primary health care and consequently it does not influence the provider choice decision in Philippines.

All these let us feel that maybe income and price effects vary across countries because they are different in development level as well as in social economic environments that shape the conditions under which rural households make choice on health care providers. Given that during the studied period, both income and prices of health care have significantly changed, it would be interesting to measure the effect of these changes on rural patients' choices of healthcare providers. With this context in mind, a comparative study on rural China over two distinct periods will be very promising since on the one hand, China is a large country in area and in population and hence presents large heterogeneity, and on the other hand, thank to its rapid growth rate, social economic conditions have undergone rapid change. In such context, one can answer such questions: Face to a general increase of prices, will people's choice be less sensible to price? Is the demand of the poor more elastic to prices?

And therefore, could less choice in price lead more choice on distance? This is what we call substitution hypothesis: when patients have less possibility to discriminate providers by price due to general increase of price level and uncertainty around price determination, they increase their preference in choice by distance. This substitution is more likely to happen as transportation fees is not included in price of healthcare in our samples, and distance reflects also to some extent the transport costs.

The second focus of this study will be to gather the evidence to the existence of the impacts of several factors that characterize the Chinese social, economic and demographic changes:

1. Insurance impact. Since the second period (2003-2006) begins with the application of the New Cooperative Medical System, we will also check the impact of this institutional change: if the restoration of cooperative insurance contributes to decrease those barriers, if any, and contributes to the choice of healthcare providers;
2. Impact of population aging. Given that population aging has been one of the most challenging problems in rural China and our samples reflect well this problem, we will check if population aging impacts the choice, in particular the choice on self-care;
3. Impact of regional inequality. As our samples are from 9 provinces with increasing inequality, we can check whether regional differences, notably differences in development level, affect patients' choices and if systematic different choice pattern among them may be observed.

Finally we will pay special attention to the evolution of one kind of choices: self-care and its linkage with such factors as population aging, education level and proximity to cities.

More generally we tend to gather the evidence to assess such judgment as "China today is experiencing a rural health crisis" (Dummer and Cook 2007). If, for example, in comparison with period 89-93, there has been a stronger wealth effect, in other words a stronger tendency of exclusion of poorer patients in period 2004-2006, we must agree with them. Otherwise, less radical conclusion may be necessary.

The originality of our paper is that:

- i) it studies healthcare demand in a comparative context of two samples surveyed within the same regions during two crucial periods, while important changes both into individual income, care prices, and age have occurred;
- ii) we use a relatively new model (mixed logit multinomial model) that is still very barely used in the context of healthcare demand (McFadden and Train 2000) and has few applications on health care choice (to our knowledge, four: Borah B. 2006, Canaviri, 2007, Hole, 2008, and Qian et al. 2009).

This paper is organized as follows: Section 2 reviews the background evolution, in particular supply and demand side changes in health care system of rural China in the period 89-06. Section 3 presents the methodology and data, and section 4, before concluding, analyzes the results of estimations.

## 2. Background

Since the end 1980s, supply of health care is overwhelmingly provided publicly and hospitals have been absorbing a growing share of the resources (Herd, Hu and Koen 2010). The number of doctors has increased fast but the level of qualification of incumbent doctors is often modest. Demand for care has risen rapidly, in line with incomes, and the relative price of care soared through the early 2000s. Hospital budgets and their doctors' pay are partly based on drugs they prescribe and sell, whose prices are regulated and involve considerable cross-subsidisation." Here we analyze this evolution from both supply and demand side of health sector between in the beginning of 1990s and in the mid-2000s in rural China since the two samples we will use correspond to these time points.

### 2.1. Supply side

In 1990 and 2004, the share of health expenditure in GDP was respectively 4.03 and 5.65 % (2005 Chinese Health Statistic Yearbook). From Table 1, however, we observe the tendency of a public disengagement in health sector.

Table 1: Shares of government budgetary expenditure, social expenditure and resident individual expenditure in total health expenditure

	1990	2004
government budgetary expenditure	25.1	17.0
social expenditure	39.2	29.3
resident individual expenditure	35.7	53.6

Source: 2005 Chinese Health Statistic Yearbook

Table 2 describe the evolution of the supply side statistics of health sector and in particular the evolution of the balance of power between county (and above) hospitals, the townships health centers and the village clinics. In this official statistics, the data on health institution measure the total force of Chinese health supply above the rural village level and do not include village clinics. First, we observe an increase of supply in number of health institutions and of health professional. Second, relating to county (and above) hospitals, township centers and village clinics had their force significantly decreased in line with Chinese urbanization during this period and also with the disengagement of the state. As exception, however, health professional for township health centers has increased.

Table 2: Some indicators of different health institutions

	Health institutions		Hospitals at county and above levels		Townships health centers		Village clinics	
	1990	2004	1990	2004	1990	2004	1990	2004
Number	208734	296492	14377	18396	47749	41626	803956	551600
Health professional beds	3897921	4389998	1763086	1904771	358770	402687	1231510	883075
Per unit professional beds			1868905	2364279	722877	668863		
Per unit professional beds			123	104	7.5	9.7	1.5	1.6
Per unit beds			130	129	15.1	16.1		
Professional Per 1000 rural population					0.99	0.77	1.55	1.02
beds Per 1000 rural population					0.81	1.18		

Source: 2005 Chinese Health Statistic Yearbook.

## 2.2. Demand side

As Yip and Hsiao (2009) described, the greatest discontents voiced by the public are unaffordable access to health care, impoverishment due to heavy medical expenses (commonly known in Chinese as “kan bing nan, kan bing gui”), and huge inequalities across regions and between urban and rural areas. Five aspects of the demand side evolution between 1989 and 2004 may be underlined.

First, rural population saw their income significantly increased, as well as the income inequality. The average GDP growth of China was 9%, and the GDP in 2004 was 8.07 times of 1989’s at current price, and 3.8 times at constant price. Incomes of per rural people and per urban people in 2004 were respectively 4.88 and 6.86 times of 1989’s at current price. Converted to incomes at constant prices, the income of per rural people in 2004 was 2.3 times of 1989’s. According to Chinese Agricultural Yearbook 2008, the Gini coefficients of rural population have increased from 0.3053 to 0.3692 between 1988 and 2004.

Second, the prices of health care have significantly increased. According to 2005 Chinese Health Statistic Yearbook, the average annual health expenditure in rural region has increased 7.39 times from 38.8 to 286.6 Yuan at current prices, higher than their income growth (4.88 times). The reason of this healthcare price increase is that “although the majority of Chinese health facilities are publicly owned, ...they are really “private, for-profit” in terms of behavior” (Yip and Hsiao, 2009). As of the early 1990s, government subsidies for public health facilities have represented a mere 10% of the facilities' total revenues. To keep health care affordable, the government sets prices for basic health care below cost. At the same time, the government wants facilities to survive financially, so it sets prices for new and high-tech diagnostic services above cost and allows a 15% profit margin on drugs. This price schedule has created perverse incentives for providers, who have to generate 90% of their budget from revenue-generating activities, and turned hospitals, township health centers and village doctors all alike into profit seeking entities.”

Third, with the disintegration of the Cooperative Medical Service in the 1980s, a great majority of rural people has lost their cooperative insurance. During this period, various forms of health insurance were experimented in the rural areas such as the Children Immunization Insurance (CII), Mother-Infant Medical Insurance (MIMI), and Medical Operation Insurance (MOI). These experimentations did not change the fact that till 2002, more than 80% of rural people had not been covered by a medical insurance. In 2003, the Chinese government initiated the New Cooperative Medical System (NCMS).

Fourth, aging problem appears in rural region: In 1990, the population of more than 65 years old represented 5.57% of population, this ratio reached 9.07% in 2005, with respectively 9.48 and 8.12% for rural and urban population (2005 Chinese population statistic yearbook and 2007 Chinese population and employment statistic yearbook). This means the percent of aging population has nearly doubled during this period. According to a study by ILO, by 2020, this ratio will reach 14.17% (Yang and Wang 2010). The health care demand of the older may be stronger than that of younger people and their preference patterns of healthcare must be different.

Fifth, regional inequality also increased. Table 3 illustrates the evolution of rural per capita net income at current price of the nine provinces included in our sample. We observe the persistence and accentuation of this inequality. The ratio between the richest (Jiangsu) to the poorest provinces (Guizhou) has increased from 2.2 to 2.8 times between 1990 and 2006. The coefficient of variation (Standard deviation divided by mean value) among them has increased from 0.23 to 0.28.

Table 3 Rural per capita net income of nine provinces in 1990 and 2006 (in current price)

	Jiangsu	Shandong	Liaoning	Heilongjiang	Hubei	Henan	Hunan	Guangxi	Guizhou
1990	959	680	836	760	671	527	664	639	435
2006	6561	4985	4773	4132	3997	3851	3904	3224	2374

Source: 2008 Chinese Countryside Statistic Yearbook

### 3. Methodology

#### 3.1 Econometric modeling

Econometric model is a mixed multinomial logit model (MMNL) (McFadden and Train 2000; Borah, 2006), that provides a flexible framework to incorporating both observed and unobserved factors that influence the provider choice decision. Individual with similar characteristics will also have similar preferences. In traditional multinomial logit models (MNL), the accent is on the mean impact of observed variables and all unobserved heterogeneity is classified in error terms. MMNL allows the parameter associated with each observed variable to vary randomly across individuals, and

their variance reflects the unobserved individual-specific heterogeneity. This method decomposes the mean and standard deviation of one or more random parameters to reveal sources of systematic taste heterogeneity. This way, in MMNL, the variance in parameters is treated explicitly as a separate component of the error such that the remaining error is "net" of this variance. Two sources of unobserved heterogeneity can be considered: features of alternative choices that are not recorded by the analyst, and unmeasured consumer characteristics that determine preferences (McFadden and Train 2000).

Let the utility of a patient  $I \in [1, I]$ , be a function of health status,  $h$ , and non health consumption,  $x$ .

$$U = U(h_i, x_i) \quad (1)$$

Health status,  $h$ , is determined by the quantity and quality of healthcare (C); other health inputs, e.g., sanitation, food consumption, etc., (F) and individual attributes, e.g., age, gender, education, income, etc., (R);

$$h = h(C_i, F_i, R_i) \quad (2)$$

Health care demand is a function of the price of health care ( $p_c$ ) and the distance to the health care provider (D). The importance of D is that distance not only implies costs to access, but also reflects the reputation and quality of providers.

$$C_i = (p_c, D_c) \quad (3)$$

Finally, F, the other health input is a function of expenditure on these inputs ( $E_{fi}$ ).

$$F_i = F(E_{fi}) \quad (4)$$

With equations (1) to (4), we get the indirect utility function in the case where individual I chooses the health care provider  $j$  in which  $y_i - p_{cj} - E_{fi}$  is the budget for non health consumption ( $y$  is income).

$$V_j^* = U(h(C_{ij}(p_{cj}, D_{cj}), F_i, R_i), y_i - p_{cj} - E_{fi}) \quad (5)$$

Among the alternative health care providers the patient will choose that which maximizes his indirect utility function. This is expressed by the equation (6).

$$\begin{aligned} V_j &= 1, \text{ if } V_j^* = \text{Max}(V_1^*, V_2^*, \dots, V_j^*) \\ V_j &= 0, \text{ otherwise} \end{aligned} \quad (6)$$

To make the model amenable to econometric estimation we must define a functional form of the above indirect utility function. This is expressed by the equation (7) in which the first term on the right is the deterministic component of utility in function of the above defined four types of attributes and the second term is a disturbance term. The term  $E_{fi}$  is unobserved and is treated as one part of error term.

$$V_{ij} = V_{ij}^*(p_{ij}, D_{ij}, y_i, R_i) + \varepsilon_{ij} \quad (7)$$

The equation (7) must be parameterized to allow estimation. The first term can be rewritten as:

$$V_{ij}^*(.) = Z_{ij}\beta_z + X_i\beta_x \quad (8)$$

The X variables are patient specific characteristics such as age, marital status, insurance status, income and so on. The Z variables are alternative health provider specific characteristics such as distance, price, healthcare quality, and so on. In our above defined variables, we have

$$V_{ij} = \alpha_j + \beta_1 p_{ij} + \beta_2 D_{ij} + \beta_3 y_i + \beta_4 R_i + \varepsilon_{ij} \quad (9)$$

The variable p, the healthcare price, and D, the distance of healthcare provider are two specific variables, and the y, income and R, individual attributes other than income are patient specific variables. In our econometric estimations, p and D are kept constant across options while y and all components of R vary across options.

If the equation (9) is estimated with MNL, the basic form of the multinomial logit model, with alternative specific constants  $\alpha_j$  and attributes  $x_{ij}$  (x represents both z and x variables in the equation (8)) will be:

$$Prob(j) = \frac{\exp(\alpha_j + \beta'_i x_{ij})}{\sum_{q=1}^J \exp(\alpha_q + \beta'_i x_{iq})} \quad (10)$$

The difference between MMNL and MNL is that in the former one part of the coefficients are random while in the latter all coefficients are non random. In equation (10)  $\beta'_{ij}$  is composed of  $\beta_{ki}$  with

$$\beta_{ki} = \begin{cases} \beta_k + \delta'_k w_i + \sigma_k \eta_{ki} & \text{if random} \\ \beta'_k & \text{if non - random} \end{cases} \quad (11)$$

where  $\beta_k$  is the population mean,  $\eta_{ki}$  is the individual specific heterogeneity, with mean zero and standard deviation one, and  $\sigma_k$  is the standard deviation of the distribution of  $\beta_{ki}$  around  $\beta_k$ . The elements of  $\beta_{ki}$  are distributed randomly across individuals with fixed means. A refinement of the model is to allow the means of the parameter distributions to be heterogeneous with observed data  $w_i$ . This would be a set of choice invariant characteristics that produce individual heterogeneity in the means of the randomly distributed coefficients so that selecting subsets of pre-specified variables to interact with the mean and standard deviation of random parameterized attributes.

In our case, we set both price and distance to healthcare providers as random variables. First, they may have a substitutive feature, in other words, when people have more choice in prices, they may less care about the distance. By contrary, when they have less choice in prices, they may prefer a less distant provider. Secondly, distance may reflect the reputation and quality of providers. It will be interesting to estimate the heterogeneity in their preference for both price and distance. In particular, we are interested in examination of their interaction with some variables of type  $w$  in Equation (11). Here  $w_i$  will be composed of four variables: income (asset), insurance, severity of the illness and rural labor ratio of the village (we will return to this point later).

Given that  $\eta_{ki}$  are individual specific,  $\sigma_k$  will reflect unobserved random disturbances - the source of the heterogeneity. Thus, as stated above, in the population, if the random terms are normally distributed,

$$\beta_{ki} \sim \text{Normal or Lognormal}[\beta_k + \delta'_k w_i, \sigma_k^2] \quad (12)$$

The equation (12) has useful empirical implication and we will return to this in application. Finally, to make our model more realistic, we will allow the two random parameters ( $p$  and  $D$ ) to be correlated.

### 3.2. Data

Data are from the CHNS database, edited by the Carolina Population Center (CPC, University of North Carolina). The survey covers about 16,000 individuals from more than 3,000 households (about two third from rural and one third from urban population) in nine representative provinces. It is a longitudinal survey with seven waves (1989, 1991, 1993, 1997, 2000, 2004, 2006), covering a period of 18 years.

As we have explained, over this long period, we are interested in the start and end periods of the liberalization of health care system. We have chosen to merge the data 1989, 1991 and 1993 in the first sample and the data of 2004 and 2006 in the second sample with two criterion: 1/ the size of the sample: given in the first period the number of the surveyed being ill is smaller than in the second period, we include three time periods for the first sample while two time periods in the second sample; 2/ within each sample, we keep attention to be sure that income, health care prices and supply conditions are not significantly changed. From this data source, we get 2117 rural people that declared to be ill in 1989, 1991 or 1993, and 2594 people that declared to be ill in 2004 or 2006.

Table 4 presents all variables we will use and their definitions. In this table, the first five items from Village-C to Self-Care are choice set of healthcare providers, and the following five items on price and distances are choice specific variables; all the rest are patient specific variables. The last three items are used to take into account the environmental features of the patients: rural population

rate is a proxy of the development level of the village, village size is a proxy of the village clinic's size, and finally suburb reflects the proximity of the village to urban medical infrastructure.

Table 4 Variable definitions

Village-C (V)	=1 if the choice of treatment is village clinic; =0 otherwise.
Town-C (T)	=1 if the choice of treatment is township center; =0 otherwise.
County-H (C)	=1 if the choice of treatment is county or higher level city hospital; =0 otherwise.
Oth_Type (O)	=1 if the source of treatment is pharmacy, private clinic, private hospital and other clinic; =0 otherwise.
Self-Care	=1 if self-treatment is chosen; =0 otherwise.
$P_j$	Medical expense at constant price of alternative $j$ ; $j=V, T, C, O$ : the four choices of treatment after eventual reimbursement by insurance.
Dist0 $_j$	=1 if distance <0.5 km; =0 otherwise; $j=V, T, C, O$ .
Dist1 $_j$	=1 if distance $\geq 0.5$ km & <3; =0 otherwise; $j=V, T, C, O$ .
Dist2 $_j$	=1 if distance $\geq 3$ km & <10km; =0 otherwise; $j=V, T, C, O$ .
Dist3 $_j$	=1 if distance $\geq 10$ km; =0 otherwise; $j=V, T, C, O$ .
Age	Age of the patient in years.
Female	=1 if the patient is female; =0 if male; =that of the decider: the Household chief if patient's age<16.
Marital	=1 if the patient is married; =0 otherwise; =that of the Household chief if patient's age<16.
Edu_years	=1 graduated from primary school;=2 lower middle school degree;=3 upper middle school degree;=4 technical or vocational degree;=5 university or college degree;=6 master's degree or higher. =that of the Household chief if patient's age<16.
Urb_job	=1 if the patient's job is not farmer; =0 otherwise; =that of the Household chief if patient's age<16.
Farmer	=1 if the patient's job is farmer; =0 otherwise; =that of the Household chief if patient's age<16.
No_job	=1 if the patient has not job;=0 otherwise;=that of the Household chief if patient's age<16.
No_insured	=1 if the patient is not insured; =0 otherwise.
Urb_Insu	=1 if the patient's insurance is one of the following types: commercial, free medical, workers compensation, for family member, urban employee: passway model, urban employee: block model, Urban Employee: Catastrophic disease; =0 otherwise.
Cooperative	=1 if the patient's insurance type is cooperative; =0 otherwise.
Oth_insu	=1 if the patient's insurance is other than Urban_insu and Cooperative (they include among others Health insurance for women and children, EPI (expanded program of immunization) insurance for children); =0 other wise.
Severity	=1 if the illness or injury not severe; =2 somewhat severe; =3 quite severe;
Fever	=1 if individual suffered from fever; =0 otherwise.
Chronic	=1 if individual suffered from chronic diseases; =0 otherwise.
Oth_deas	=1 if individual suffered from diseases other than fever and chronic diseases; =0 otherwise
Hhsize	The number of the household members.
Income	The annual per capita income at constant price of the household multiplied by $10^{-3}$ .
Asset	The annual per household value of the asset index $10^{-3}$ .
Rural popu. rate	The share of the rural employees in total labor of the village
Village_size	The household number of the village multiplied by $10^{-3}$
Suburb	=1 if the village is near a city; =0 otherwise.

From the CHNS database, we get household annual income at constant price. The variable "income" will be used to estimate the impact of income. However, we consider that income only partially reflects the economic and financial states of households and individuals. Furthermore, linked

with the specificities of farm activities, their incomes are often too volatile and some households have reclaimed their income negative (we have tried to remedy this by approaching the actual income to “permanent income”, with the criterion that when for the same household if their incomes in the two previous time periods are higher, we replace the actual income by the highest income). With this method, the problem is just partially solved since in our sample, one part of household lack continuous data and the data in the start year (1989) cannot be adjusted. Thus we judge necessary to constitute asset index of households and alternatively use income and asset to measure the income effect, or more exactly wealth effect. We use the following items for asset index: 1. drinking water (4 choices); 2. toilet facilities (8 choices); 3. kind of lighting (5 choices); 4. kind of fuel for cooking (8 choices); 5. type of ownership of apartment/house (6 choices); 6. ownership of electrical appliances and other goods (the number of appliances vary between 15 to 18 according to the periods of survey, and this information is absent only in 1989). 7. means of transportation (5 choices). 8. type of farm machinery (5 choices). 9. Household Commercial Equipment (6 choices). We use principal components analysis to derive weights for each time periods (Filmer and Scott 2008). The coefficients of correlation between obtained ASSET and INCOME are 0.29 for periods 89-93 and 04-06, both significant at 1%.

Another necessary work is to impute the missing prices of health cares. Since MMNL requires the prices of all the alternative providers, while in the survey only the prices of the providers that patients visited were recorded. So, the prices of alternative providers that the patient did not visit need to be imputed. Following Gertler et al. (1987) and Borah (2006), we use Stata ICE program created by Royston (2004) to impute the lacked price data. All reported prices are converted at constant price using the weights provided by CHNS data provider. ICE imputes missing values by using switching regression, an iterative multivariable regression technique. The chosen predictors of price include variables Age, Female, Marital, Edu\_years, Urb\_job, Farmer, Income, Severity, Year, Province, Urb\_Insu, Cooperative, Oth\_insu, Fever, Chronic, and finally hospitalized (=1 if hospitalized; =0 otherwise). The regressions are separately operated according to the choices V (village clinic), T (township center), C (county or city center) and O (other center, see Table 4). The descriptive statistics of imputed plus actual prices by type of providers are presented in Table 5.

In Table 5, the first part is that the sample distribution by province. The most significant difference between the two samples is that Heilongjiang is present only in sample 04-06. Since according to Table 3, Heilongjiang is a province with development level at the middle range among the 9 provinces, we consider that its inclusion in the sample 2004-2006 will not bias the comparability of the results.

When comparing the two samples, the choice for village clinic (more than 50% between 1989 and 1993) has considerably reduced (to 22%) and the choice on self-care has significantly increased (from 19% to 35%). These may be produced by two facts. As shown above, since this period, the force of small rural health care providers has significantly weakened while that of urban large hospital

reinforced, thereby leading to the decrease of choice to village clinic. The aging of population (second period) may cause the choice of self-care.

Between the two periods, the increase of medical expenses ( $P_V$ ,  $P_T$ ,  $P_C$  and  $P_O$ ) is less than 100%, and lower than the published statistics. According to 2005 Chinese Health statistic Yearbook, between 1995-2004 the per outpatient medical expense at county level hospital increased from 24.8 to 77.2 Yuan at current price, and the corresponding per inpatient medical expense from 880.6 to 2087.2 Yuan. Even converted to expense at constant price, they are higher than ours. But ours are medical expenses after the reimbursements by insurance. With more than 1/3 of patients that have been beneficiaries of insurance in period 04-06, this may sensitively reduced the real paid medical expenses. The variation of the medical prices in the second period is smaller than that in the first period. The coefficients of variation ( $SD/mean$ ) of  $P_V$ ,  $P_T$  and  $P_C$  have reduced from 1.11, 1.11 and 1.37 to 0.82, 0.82 and 0.92. As we know a larger heterogeneity of price allows the consumers a larger possibility of choice, this evolution may have an impact on the demand structure.

Fourth, there is an important difference in age between the two samples. While for the sample 89-93, to insure the sufficient size of the sample, we have kept the patients that were younger than 18 years old, while for the sample 04-06, all surveyed patients are above 18 years old. Consequently the average age of the sample 89-93 is much lower than that of 04-06. We argue that this fact has not significant impact on the objective of our study. As noted in the end of the Table 5, as the accent of this study is on the choice decider, for all patients under 16 years old, sex, marital and edu\_years, job types are all on household chiefs'. The only constraint for our study is that we cannot directly compare the coefficients of age of MMNL regressions of the two samples. This difference in age has not a bias on our study on aging problem. If we remove these young patients from the sample 89-93, there remain 1457 observations and their mean, SD, Min and Max are 44.47, 15.42, 18 and 92 respectively. Comparing these with the sample 2004-2006 in which all patients are 18 years old and above, we observe the aging problem: since the surveys were operated roughly in the same places, as the people get old and the aging people are more frequent to be ill, the mean age of the people get more than 10 years older during a period of 14 years (1991-2005, the mean time points of the two periods). Without accounting the patients of less than 16 years old in the sample 89-93, the % of aging patients (older than 60) was only 18.6% while this percent was 41.1% in the sample 04-06. In other words, in the sample 89-93, that fact of including or not the younger patients, the aging problem was not a concern, while in 04-06, it has become a concern. Therefore their comparison has implication into aging issue.

Fifth, in line with the evolution of age, there is also a significant difference on employment. While in the sample 89-93, only 13% patients have declared without job, this proportion has increased to 50%. We have checked that the mean age of the patients without job is 62.3 years old. As expected, the majority of them are retired aging people.

Sixth, as the period 1989 and 2003 is the beginning and the end of a period without insurance, the sample 2004-2006 (in which at least 1/3 rural households have had cooperative insurance) allow us to measure the impact of restoration of rural insurance.

Seventh, as explained, we are concerned to measure the impacts of permanent income, or wealth on healthcare choice. Thus we choose asset as principal, and income as secondary variable. Inequality measured in asset and in income is, however, different. With our samples, mean income at constant price has increased 2.57 times, roughly in line with national level (2.3), and inequality has increased from 0.78 to 1.14 in terms of coefficient of variation. Asset has increased 3.42 times, higher than income increase. But coefficient of variation of the asset in period 04-06 has significantly reduced. This is not unusual for two reasons: in our principal component estimations, all items have been equivalently weighted (for example, the access to water is given equal importance with the ownership of the house). This leads a sensitive reduction of inequality in the favor of the poor. While asset index is closer to permanent income, it is well-known that permanent income is much less unequal than real income due to accumulated and smoothing effects. As the households' income inequality in our sample is closer to national level income inequality, we use income as complementary variable to observe eventual difference between asset and income. If their impacts are significantly different, it is quite possible that larger inequality existing in income variable plays a role. Otherwise we can ignore the impact of inequality on healthcare choice.

Table 5 Descriptive statistics

	1989-1993 (n=2117)				2004-2006 (n=2594)			
	Mean	SD	Min	Max	Mean	SD	Min	Max
Sample distribution								
Liaoning	0.09	0.29	0	1	0.12	0.32	0	1
Heilongjiang	0	0	0	1	0.07	0.25	0	1
Jiangsu	0.14	0.35	0	1	0.12	0.32	0	1
Shandong	0.06	0.24	0	1	0.09	0.29	0	1
Henan	0.19	0.39	0	1	0.13	0.33	0	1
Hubei	0.12	0.33	0	1	0.10	0.30	0	1
Hunan	0.09	0.29	0	1	0.11	0.32	0	1
Guangxi	0.19	0.40	0	1	0.16	0.37	0	1
Guizhou	0.11	0.31	0	1	0.10	0.30	0	1
Village-C	0.51	0.50	0	1	0.22	0.41	0	1
Town-C	0.23	0.42	0	1	0.14	0.35	0	1
County-H	0.08	0.27	0	1	0.18	0.39	0	1
Oth_Type	0	0	0	1	0.11	0.32	0	1
Self-Care	0.19	0.39	0	1	0.35	0.48	0	1
P_V	0.066	0.073	0	0.477	0.096	0.079	0	0.598
P_T	0.140	0.156	0	0.859	0.207	0.169	0	1.166
P_C	0.425	0.579	0	3.506	0.651	0.597	0	3.808
P_O					0.204	0.318		3.972
Dist0_V	1	0	1	1	1	0	1	1
Dist0_T	0.39	0.49	0	1	0.48	0.50	0	1
Dist1_T	0.42	0.49	0	1	0.36	0.48	0	1
Bdist2_T	0.19	0.40	0	1	0.15	0.36	0	1
Cdist3_T	0	0	0	0	0	0	0	0
Odist0_C	0.16	0.37	0	1	0.23	0.41	0	1
Dist1_C	0.22	0.41	0	1	0.22	0.42	0	1
Dist2_C	0.21	0.41	0	1	0.25	0.43	0	1
Dist3_C	0.41	0.49	0	1	0.30	0.46	0	1
Dist0_O					0.63	0.48	0	1
Dist1_O					0.26	0.44	0	1
Dist2_O					0.09	0.29	0	1

Dist3_O					0.02	0.15	0	1
Age	32.29	22.31	1	92	55.88	15.12	18	97
Female	0.40	0.49	0	1	0.57	0.49	0	1
Marital	0.87	0.33	0	1	0.80	0.40	0	1
Edu_years	0.79	1.01	0	5	1.17	1.21	0	6
Urb_job	0.26	0.44	0	1	0.13	0.35	0	1
Farmer	0.61	0.49	0	1	0.35	0.48	0	1
No_job	0.13	0.34	0	1	0.51	0.50	0	1
No_insured	0.81	0.40	0	1	0.64	0.48	0	1
Urb_insu	0.11	0.32	0	1	0.10	0.30	0	1
Cooperative	0.03	0.16	0	1	0.25	0.43	0	1
Oth_insu	0.06	0.23	0	1	0.01	0.10	0	1
Severity	1.67	0.68	1	3	1.7	0.67	1	3
Fever	0.46	0.50	0	1	0.26	0.44	0	1
Chronic	0.10	0.30	0	1	0.34	0.47	0	1
Oth_diseases	0.44	0.50	0	1	0.40	0.49	0	1
Hhsize	4.50	1.50	1	13	3.66	1.69	0	13
Income	2.74	2.14	0.45	22.20	7.03	8.03	0.18	210.95
Asset	0.35	0.76	-1.05	3.08	1.20	0.96	-0.62	3.87
Rural_popu rate	0.54	0.33	0	1	0.41	0.30	0	1
Village_size	0.66	0.72	0.03	6.00	1.01	1.19	0.04	8.00
Suburb	0.24	0.43	0	1	0.24	0.43	0	1

Note: In 89-93, 29.9% (632 of 2117) of observations are under 16 years old. As the accent of this study is on the decider, in these cases, sex, marital and edu\_years, job types are all on household chiefs'. Therefore there are significant differences in means of these indicators between the two periods.

## 4. Results

In the followings, we present and analyze the results of MMNL estimations. Table 6 and 7 present the results of MMNL estimations with respectively asset and income variables. As we have explained, given the importance of the measurement of income effect, we use alternatively the two variables to obtain a more complete view given that one closer to permanent income and another reflects better increasing inequality. But to save space, in Table 7, for all patient specific variables (except income), we remove all variables of which the results are the same with that in Table 6 with criterion of the sign and significance of their coefficients. For example, if woman is a variable of which the coefficients have the same sign in both table, and both, significant or insignificant, we will not show it in Table 7. On the contrary, as age in 04-06 is not significant for the choice of Oth-type in Table 6, while it is significant in Table 7, this result will be kept in Table 7. This way, all results of patients specific variables we have kept are those that are different with the results in Table 6.

Table 6 Mixed Logit Regression results with asset as wealth indicator

	89-93			04-06			Oth_Type
	Village-C	Town-H	County-H	Village-C	Town-H	County-H	
PRICE		-3.10	(-3.24)***		-1.73	(-2.83)***	
Dist1		-1.15	(-2.46)**		-1.40	(-2.77)***	
Dist2		-1.61	(-2.77)***		-1.69	(-2.43)**	
Dist3		-1.55	(-1.51)		-2.69	(-3.05)***	
intercept	0.21 (0.44)	-0.52 (-0.86)	-0.90 (-1.01)	-1.05 (-2.04)**	-0.93 (-1.35)	0.27 (0.37)	-0.80 (-1.09)
Age	-0.02 (-6.99)***	-0.03 (-6.17)***	-0.02 (-2.79)***	-0.0005 (-0.09)	-0.01 (-0.83)	-0.01 (-2.36)*	-0.01 (-1.62)
Edu_years	0.01 (0.14)	-0.04 (-0.45)	0.04 (0.37)	-0.06 (-0.85)	-0.12 (-1.46)	-0.11 (-1.58)	-0.08 (-1.04)
Women	0.27 (2.00)**	0.20 (1.24)	0.21 (0.92)	0.08 (0.60)	-0.04 (-0.26)	-0.03 (-0.19)	-0.08 (-0.49)
Hhsize	-0.01 (-0.34)	0.06 (1.15)	-0.002 (-0.03)	-0.01 (-0.20)	0.01 (0.20)	-0.01 (-0.16)	-0.12 (-2.21)**
Asset	0.25 (2.00)**	0.09 (0.51)	-0.37 (-1.32)	-0.12 (-1.43)	0.01 (0.09)	0.19 (1.22)	0.02 (0.12)
Severity	0.45 (4.45)***	0.74 (4.86)***	0.77 (3.30)***	0.39 (3.89)***	0.77 (5.65)***	0.46 (2.60)***	0.45 (3.24)***
Marital	0.45 (2.48)**	0.45 (2.03)**	0.43 (1.40)	0.08 (0.49)	0.16 (0.81)	0.39 (2.12)**	0.19 (0.95)
Urb_Insu	0.25 (0.91)	0.13 (0.34)	-0.09 (-0.19)	-0.42 (-1.41)	-0.07 (-0.19)	0.29 (0.88)	0.06 (0.19)
Cooperative	0.64 (1.32)	0.69 (0.89)	0.94 (0.98)	0.24 (1.45)	-0.05 (-0.19)	-0.31 (-0.78)	0.11 (0.40)
Urb_job	0.30 (1.29)	0.16 (0.57)	0.09 (0.26)	-0.04 (-0.18)	0.07 (0.28)	-0.67 (-2.74)***	-0.30 (-1.13)
Farmer	0.19 (0.89)	-0.10 (-0.42)	-0.22 (-0.64)	0.09 (0.59)	-0.07 (-0.40)	-0.42 (-2.03)**	-0.08 (-0.40)
Fever	-0.23 (-1.71)*	-0.51 (-3.09)***	-0.75 (-3.17)***	0.90 (6.03)***	0.38 (2.02)**	-0.81 (-3.57)***	0.69 (3.75)***
Chronic	0.11 (0.49)	-0.23 (-0.87)	0.01 (0.02)	-0.09 (-0.60)	-0.14 (-0.82)	-0.17 (-1.09)	-0.43 (-2.27)**
Rural labor	0.60 (1.97)**	0.15 (0.34)	0.04 (0.05)	0.62 (2.01)**	-0.05 (-0.11)	-0.29 (-0.41)	-0.27 (-0.62)
Village_size	0.28 (2.26)**	0.04 (0.24)	0.33 (2.09)**	-0.10 (-1.17)	0.03 (0.39)	0.08 (1.29)	-0.10 (-0.95)
SUBURB	0.07 (0.27)	-0.32 (-1.08)	0.17 (0.39)	-0.42 (-1.78)*	-1.55 (-5.36)***	-0.35 (-1.21)	-0.08 (-0.29)
Jiangsu	-0.09 (-0.34)	0.74 (2.41)**	0.20 (0.46)	-0.33 (-1.24)	-0.86 (-2.46)**	-0.04 (-0.12)	-0.44 (-0.97)
Shandong	0.09 (0.25)	0.90 (2.27)**	1.09 (2.09)**	-0.02 (-0.09)	-0.47 (-1.36)	0.25 (0.66)	0.04 (0.09)
Liaoning	-1.09 (-4.14)***	-0.87 (-2.64)***	-0.96 (-1.87)*	-1.82 (-6.16)***	-1.08 (-3.56)***	-0.77 (-2.38)**	-0.28 (-0.71)
Heilongjiang				-0.48 (-1.68)*	-0.37 (-0.93)	0.51 (1.43)	-0.58 (-1.09)
Henan	-0.16 (-0.66)	0.10 (0.33)	-0.26 (-0.60)	0.66 (2.55)**	0.73 (2.24)**	1.10 (3.17)***	1.61 (4.00)***
Hunan	0.21 (0.70)	0.38 (1.06)	0.75 (1.59)	-0.92 (-3.39)***	-0.22 (-0.74)	-0.59 (-1.66)*	0.35 (0.87)
Guangxi	-0.09 (-0.39)	0.03 (0.12)	0.15 (0.38)	-0.27 (-1.11)	-0.20 (-0.67)	0.57 (1.95)*	0.89 (2.24)**
Guizhou	-0.45 (-1.82)*	-0.72 (-2.25)***	-0.94 (-2.05)**	-1.45 (-5.38)***	-0.87 (-2.65)**	-0.50 (-1.55)	0.48 (1.20)
1991	0.15 (0.95)	0.30 (1.61)	-0.17 (-0.63)				
1993	0.15 (0.84)	0.36 (1.68)*	-0.04 (-0.14)				
2006				0.38 (2.77)***	0.02 (0.12)	0.22 (1.42)	0.08 (0.45)
	Heterogeneity in mean parameters						
P:Asset	0.06		(0.19)	-0.21			(-1.31)
P:Urb_Insu	0.42		(0.72)	0.49			(1.15)
P:Cooperative	-1.84		(-1.36)	0.14			(0.50)

P:Severity	0.77	(2.55)**	0.76	(3.59)***
P:Rural labor	-0.41	(-0.53)	-0.17	(-0.34)
Dist1: Asset	0.40	(2.08)**	0.19	(1.45)
Dist1:Urb_Insu	0.08	(0.20)	0.09	(0.25)
Dist1:Cooperative	0.25	(0.31)	-0.01	(-0.03)
Dist1:Severity	0.19	(1.10)	0.19	(1.13)
Dist1:Rural labor	0.99	(2.20)**	0.24	(0.56)
Dist2: Asset	0.36	(1.41)	0.29	(1.65)*
Dist2:Urb_Insu	0.93	(1.79)*	0.32	(0.67)
Dist2:Cooperative	0.28	(0.30)	0.13	(0.40)
Dist2:Severity	0.36	(1.76)*	0.46	(2.13)*
Dist2: Rural labor	0.49	(0.85)	-0.54	(-0.88)
Dist3: Asset	0.49	(1.33)	0.07	(0.33)
Dist3:Urb_Insu	-0.08	(-0.09)	-0.26	(-0.45)
Dist3:Cooperative	0.32	(0.26)	-0.14	(-0.31)
Dist3:Severity	0.34	(1.10)	0.71	(2.80)***
Dist3: Rural labor	-0.02	(-0.02)	0.41	(0.53)
SD of parameter distributions				
PRICE	1.76	(4.71)***	1.55	(4.79)***
Dist1	0.26	(0.39)	1.17	(2.95)***
Dist2	0.60	(1.19)	1.23	(2.56)**
Dist3	0.95	(1.31)	0.95	(1.67)*
N		2117		2594
Log-likelihood		-2339.81		-3452.60
LR Chi Squared		1189.95		1444.56
McFadden Pseudo R2		0.2027		0.1730

Note: t-Statistics in parentheses. \*\*\* indicates significance at 1%; \*\* indicates significance at 5%; and \* indicates significance at 10%.

Table 7 Mixed Logit Regression results with income as wealth indicator

	89-93			04-06			Oth_Type
	Village-C	Town-H	County-H	Village-C	Town-H	County-H	
PRICE		-2.8 (-3.01)***			-1.98 (-3.68)***		
Dist1		-1.11 (-2.29)**			-1.04 (-2.64)***		
Dist2		-1.46 (-2.40)**			-1.43 (-2.56)**		
Dist3		-0.85 (-0.82)			-2.32 (-3.78)***		
intercept			-1.50 (-1.68)*				
Age							-0.01 (-1.74)*
Income	0.02 (0.74)	-0.05 (-1.02)	0.003 (0.04)	-0.004 (-0.38)	-0.01 (-0.63)	0.02 (1.03)	-0.01 (-0.69)
Hunan						-0.48 (-1.46)	
Guizhou						-0.60 (-1.87)*	
Heterogeneity in mean parameters							
P:Income	-0.03		(-0.31)	-0.01			(-0.81)
Dist1: Income	0.14		(2.28)**	-0.01			(-0.07)
Dist1:Rural labor	0.60		(1.50)				
Dist2: Income	0.11		(1.52)	0.05			(2.22)**
Dist2:Severity	0.33		(1.61)				
Dist3: Income	0.05		(0.54)	-0.04			(-1.50)
SD of parameter distributions							
PRICE	1.73		(4.59)***	1.45			(5.12)***
Dist1	0.32		(0.39)	1.14			(3.22)***
Dist2	0.64		(1.32)	1.12			(2.57)**
Dist3	0.67		(0.66)	0.76			(2.00)**
N		2117			2594		
Log-likelihood		-2342.20			-3454.48		
LR Chi Squared		1185.18			1440.80		
McFadden Pseudo R2		0.2019			0.1726		

Note: t-Statistics in parentheses. \*\*\* indicates significance at 1%; \*\* indicates significance at 5%; and \* indicates significance at 10%.

#### 4.1. Price effects

Assuming individual rationality, the impact of the healthcare prices on the choice among the healthcare providers must be negative. The higher the price associated with a provider, the less likely the later will be chosen. From Table 6, according to MMNL method, in both periods there are clear price effects, the estimated means for the two periods are respectively -3.1 and -1.73 and both significant at 1%, indicating negative price effect but a weaker effect in 04-06. The ‘Standard Deviation of Parameter Distributions’ section of Table 6 gives the standard deviations of the relevant coefficients. As we know, in standard MNL regression, individual heterogeneity is not treated and all unobserved heterogeneity factors are simply grouped in error term. In MMNL, one part of coefficient of price variable is allowed to randomly vary around the mean value. This part reflects the unobserved individual specific heterogeneity. With the SD of 1.76 and 1.55 of the two periods and both significant at 1%, we conclude that there exists heterogeneity in price preferences. In Table 7 with income as wealth indicator, these values are slightly different, but the tendency is the same with respect to sign and significance.

MMNL provides more information than MNL, in that the MMNL estimates the extent to which patients differ in their preferences for providers. Therefore, the interest of MMNL approach is to analyze the observed and unobserved heterogeneity on the impact of price on choices. While the ‘Standard Deviation of Parameter Distributions’ reflects the extent of unobserved heterogeneity, the “heterogeneity in mean parameters” reflects the observed heterogeneity on the impact of price choices (Table 6). As seen from the ‘Heterogeneity in mean parameters’, severity is found to be a significant source of preference heterogeneity in price preference. The positive sign for this variable implies that the sicker patients prefer to accept higher price in their choice of providers. Following the equation (12), we can easily calculate the level of this heterogeneity with the criterion of the percentage of patients for which the coefficients of price is above zero.

Table 8: Extent of heterogeneity (percentage of patients of which the coefficients of price > 0) by source of heterogeneity

		89-93	04-06
(1)	For patients with Asset=0, without insurance, Severity=1, and living in a village with rural labor=0	9.3%	26.6%
(2)	like (1), but asset=0.70 for 89-93, and asset =2.4 for 04-06	9.7%	17.1%
(3)	Like (1), but with urban insurance	13.9%	37.8%
(4)	Like (1), but with cooperative insurance	0.9%	29.6%
(5)	Like (1), but severity=3	32.7%	63.9%
(6)	Like (1), but rural labor=1	6.0%	23.1%
(7)	Total heterogeneity	19.2%	39.3%

Note: Calculated with equation (12) and using heterogeneity in mean parameters in Table 6.

Table 8 makes evidence of the price heterogeneity imputed to four observed sources. As seen in line (1), the probability for a patient with asset=0 (note that it is not equivalent to absence of asset since asset index can be negative), without insurance, severity=1, and living in a village with rural labor=0, to accept the coefficient of price>0 is 9.3% in 89-93, and this probability has increased to 26.60, indicating a significant rise of price heterogeneity. Line (2) shows the influence of asset to price preference. As the mean value of asset is 0.35 for 89-93 and 1.2 for 04-06, we use those with asset=0.70 in 89-93 and asset =2.4 to compare with those with asset=0. In 89-93, the probability to prefer coefficient of price>0 has just slightly increased from 9.3% to 9.7%, indicating a weak impact of asset on price preference. In 04-06, the direction of this impact is even inverted. The probability for richer patient to prefer coefficient of price>0 is even weaker. In our analysis of elasticity of price following Table 9, we will return to explain it. Line (3) indicates that patients with urban type insurance have higher price heterogeneity. Line (4) show that while in 89-93 the probability for price heterogeneity for patients with cooperative insurance (0.9%) is even lower than for patients without cooperative insurance (9.3%), while in 04-06, this probability becomes higher (29.6% versus 26.6%). Line (5) shows that the most important source of price heterogeneity is the severity of illness. For the patients declaring their illness quite severe, their probability to accept higher prices are sensibly increased. Line (6) shows that for the patients living in less developed villages (with higher proportion of rural labor), their price rationality is stronger. Finally the above analysis cannot give us an overall assessment of the price heterogeneity. To obtain this, line (7) is calculated on the basis of MMNL estimations with same variables but without heterogeneity in mean parameters. This way, the SD of parameter distribution of price reflects total observed and unobserved heterogeneity. Heterogeneity in preference of price has sensibly increased and the % of patients that has price coefficient>0 increased from about 20 to 40 %.

We have shown that price effect in choice exists in both periods and it is weaker in 04-06, and heterogeneity in price preference has meaningfully increased in the second period. This heterogeneity has been analyzed through the SD of parameter distribution of price and through heterogeneity in mean parameters. Another method is to calculate price elasticity by type of provider and asset range between the two periods. This method will provide more detailed information. In Table 9, price elasticity is calculated under MMNL using exactly the same variables than in Table 6 (and Table 7 if using income as wealth indicator). In the first half of Table 9, we observe that in all cases except for county hospital in 04-06, price elasticity by provider type is negative. This elasticity by provider type is lower in 04-06 than in 89-93, and becomes positive in the highest level provider type: county hospital. This more refined result is in line with the above analysis on MMNL results.

Table 9 Price Elasticity of choice by provider type and by asset range in two periods

	89-93			04-06			
	V	T	C	V	T	C	O
Price (using asset)	-0.0591	-0.1456	-0.0797	-0.0164	-0.0861	0.0364	-0.0438
Price (using income)	-0.0585	-0.1458	-0.0730	-0.0153	-0.0878	0.0308	-0.0467
By asset range							
Asset Q1	-0.1399	-0.1819	-0.7368	-0.0030	-0.0350	0.1863	-0.0083
Asset Q2	-0.0787	-0.1677	0.4014	-0.0525	-0.2424	0.1943	-0.1835
Asset Q3	-0.1193	-0.1774	0.1391	-0.0944	-0.0776	-0.0914	-0.0359
Asset Q4	-0.0291	-0.0998	0.0476	-0.0190	-0.0189	-0.0306	-0.0155

Note: Q1 is the first income quartile, Q2 is the second income quartile and so on.

## 4.2. Distance effects

The second random variable in our MMNL models is distance of health care providers. We distinguish four levels of distance: from Dist0 to Dist3 (see their definitions in Table 5). From Table 5, we know that all village clinics have Dist0, and in general the larger the hospitals the farther their distance. We expect that other things equal, patients prefer closer to farther healthcare providers. In Table 6, as in Table 7, except Dist3 in 89-93, all Distance dummies are significantly negative, indicating that relating to health care providers situated at Dist0, those with longer distance are less likely to be chosen. In comparison between the results of 89-93 and 04-06, we observe that impact of distance is stronger in 04-06 with larger coefficients in absolute values, and the coefficients are increasing, always in absolute values, as distance prolonged. In particular, the most significant difference between 89-93 and 04-06 is that in the former case, the Dist3 (the distance longer than 10km) is not significant while in the later case, the providers of Dist3 are least likely chosen in comparison to all other providers with the distances less than 10km. This leads us to conclude that in 04-06, patients have stronger preference to visit a health facility that is located at a shorter distance.

This result seems to confirm the hypothesis we tend to check: when patients have less possibility to discriminate providers by price, they increase their preference in choice by distance. With the general increase of price level, and in particular price determination has more and more ex-post feature, in other words in 04-06, the choices by price become more uncertain, patients rationally return to choose in distance that is known. For instance, when A is expensive and close and B is cheaper and far, to the extent that transport costs and opportunity cost of time are low, a lot of people prefer to go to B. But in 04-06, when the prices of A and B are not distinctly different, the choice of distance is privileged (note that the fees for transportation are not included in price of health care, hence the distance reflects also to some extent the transport costs), patients will prefer to go to A..

Another fact is that while in 89-93, heterogeneity of distance in term of SD of parameter distribution is weak and not significant, this heterogeneity becomes stronger and all significant in 04-06. In this case analyzing some observed sources of heterogeneity using “heterogeneity in mean parameters” is meaningful only to the period 04-06. We observe that distance seems to matter less the sicker the patients. This reflects the fact that sicker people tend to choose more reputed providers, and

therefore, willing to travel greater distance. Asset increases in general distance heterogeneity in all Dist1 to Dist3, while its contribution to distance heterogeneity in providers farther than 10km is very weak. This means that the richer patients are not exigent in the choices of near distance, while they are more dislike to long distance providers just as poorer patients. The coefficients of rural labor indicate that the patients living in less developed villages are less care to distance for the providers with Dist1 and Dist3, while they are more careful to distance for providers with Dist2 (between 3 to 10 km). The patients with urban insurance are stronger distance requirements for providers of farther than 10 km, while they are less care with distance for providers of less than 10 km. Roughly the same tendency is observed for the patients with cooperative insurance.

### 4.3. Wealth effects

Wealth effect on the choice of healthcare providers means that wealth positively impacts the choice of providers, in other word, the extent to which richer patients have access to health care is larger than poorer patients. The poorer patients are more likely to be excluded from health care. With the estimation results, we are allowed to use two complementary ways to test wealth effect: first, to check the coefficients of asset and income in MMNL in Tables 6 and 7; second, to check the price elasticity by asset range shown in Table 9.

From Table 6, in 89-93, the coefficient of asset for village clinic is significantly positive while in 04-06, asset is insignificant for all choices. In other words, the patients with more assets tend to choose village clinic than patients with low asset level with respect to self-care. Given that in 89-93, the choice of village clinic represents 51% of the total choices, we conclude that while there existed wealth effect in 89-93, this effect is absent in 04-06. Using income as explanatory variable in the place of asset, however, this effect is absent for both periods.<sup>2</sup> It means that while in 89-93, wealth level plays a role in some choices, in 04-06, it has no longer significant impact on the choice of healthcare providers. How to interpret this result? First, during this period in line with the increase of about 4 times of GDP at constant price, and with the increase of the share of health expenditure in GDP from about 4% to more than 5.5%, there is a significant improvement of supply side conditions on health care. Second, at the demand side, the income level of rural population, even increased at a slower rate than that of urban population, was more than doubled at constant price. Third, while wealth elasticity is strong for most normal goods, health care is a necessary goods and it is quite possible that it is price inelastic (Koc 2004). In the context of urban China, Mocan *et al.* (2004) found income elasticity was around 0.3, indicating medical care is a necessity. Medical care demand is price inelastic.

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<sup>2</sup> It is worthy to note that as income inequality has increased while asset inequality has decreased in our samples, the absence of wealth effect in the MMNL using alternatively income and asset in period 04-06 allows us to be sure that the evolution of inequality has not an impact on choice of health care providers.

The second half of Table 9 shows the price elasticity both by provider type and asset range over the two periods. As we know, if health care is a normal good, the price elasticity falls as asset rises. We observe that in 89-93, in the case of Village clinic and Township center provider (that represent 74% of choices), this rule is generally respected. The exception exists in the choice of country hospital. In 04-06, however, this rule has been generally violated. This is in line with the analysis on the coefficients of asset, and that in the second period the heterogeneity in price preference has largely increased. One unusual result, observed in 04-06, is that, when comparing Q3 and Q4 with Q1 and Q2, the richer patients often have higher price elasticity and in particular this is the case for County hospital type providers. This is in line with results shown in Table 8: the richer patients are less heterogeneous than other patients in price preference. One possible explanation may be that richer patient's severity level is significantly lower, hence poorer patients have to accept higher prices, but mean-comparison tests rejected this hypothesis. Another possibility may be that the richer patients have higher education level and better informed, thence are more able to choose providers in function of price and quality. In particular if health prices have more and more ex-post nature (in that patients know the real price only after the treatments have been done), in this case it is more likely the richer patients have more possibility to choose.

If there is no income effect in period 04-06: poorer patients have equal access to health care, it is probably because the health care is a necessary goods and poorer patients have to pay for health to the detriment of household every-day consumption expenditure. So the absence of income effect on provider choice only partially answered if poorer patients have been fairly treated. Another concern, maybe more important, is: Have poorer patients been to larger extent hurt and thus worse off due to increase of their expenditure of health care, in particular due to the increase of price of health care? To verify this, we construct two new variables:

Consumption ratio is defined as  $(y - p)/y$ , where  $y$  is trimester per head income,  $p$  is the price paid for health care (this equation assumes that the frequency of health care is 4 times per year), and it reflects patients' remained budget for consumption after health care. If the ratio is the same for patients of different income, we consider that the price of health care is proportional of the income and the poor is not unequally disfavored. On the contrary if this ratio rises with patient's wealth level, we can judge that the poorer patients' consumption level is reduced to larger extent than richer patients.  $\lnasset$  is household asset in logarithm form. We regress consumption ratio on  $\lnasset$  using year and province dummies as control variables. Table 10 gives the results. We find that in period 89-93,  $\lnasset$  is not significant to explain the expenditure ratio, meaning the absence of excess burden to poorer patients. Even considering the coefficient of  $\lnasset$  that is at the frontier of significance, patients with 1% less asset decrease 0.026 point of consumption ratio, in 04-06 this decrease has doubled and got to 0.052, suggesting that the extent to which the consumption expenditure has been negatively affected by health care expenditure is larger for poor patients than for richer patients, and

inequality in criterion of consumption expenditure is enlarged due to health care burdens that affect more poorer patients between the two periods.

Table 10 Regression of consumption ratio on lnasset

	89-93	04-06
	Expenditure ratio	Expenditure ratio
Lnasset	0.026 (1.60)	0.052 (2.12)**
Jiangsu	0.055 (1.19)	0.133 (2.90)***
Shandong	-0.041 (0.66)	0.093 (1.96)**
Liaoning	0.024 (0.47)	0.080 (1.12)
Heilongjiang		0.077 (1.55)
Henan	-0.006 (0.11)	0.041 (0.57)
Hunan	-0.008 (0.15)	0.106 (2.32)**
Guangxi	0.020 (0.34)	0.120 (2.75)***
Guizhou	-0.014 (0.21)	0.165 (4.10)***
1991	-0.075 (2.38)**	
1993	-0.065 (1.73)*	
2006		-0.023 (0.84)
Constant	0.845 (15.54)***	0.721 (18.87)***
Observations	2117	2594
F (prob>F)	1.95(0.035)	3.62(0.0001)
R-squared	0.005	0.0124

Note: Robust t-Statistics in parentheses. \*\*\* indicates significance at 1%; \*\* indicates significance at 5%; and \* indicates significance at 10%.

#### 4.4. Other effects

As the share of patients having cooperative insurance has increased from 0.03 to 25%, we expected an insurance effect on the choice of healthcare providers. Among some previous studies, Yip, Wang and Liu (1998) found that government and labor health insurance beneficiaries are more likely to use county hospital, while patients covered by cooperative medical system (CMS) are more likely to use village-level facilities. Wagstaff *et al.* (2009), and Huang *et al.* (2010) provided the evidence that application of the New Cooperative Medical System has increased outpatient and inpatient utilization, and has reduced the cost of deliveries. Brown and Theoharides (2009) found that because local governments have been given significant control over program design, the reimbursement scheme in place in each county and the average daily expenditure associated with hospitalization strongly influence hospital choice. This effect is, however absent in Table 6 and 7. One possible explanation is that the % of reimbursement is in general too low, as stated in Audibert, Dukhan and Mathonnat

(2008). According to Yip and Hsiao (2008), central and local government each subsidizes 20 Yuan per farmer in the western and central provinces, with the farmer paying an additional 10 Yuan in annual premiums to enroll in an NCMS plan. This total premium of 50 Yuan represents about one-third of farmers' health spending in the western and central provinces. Besides the deductible, patients still have to pay 40–60% of covered inpatient expenses.

Aging problem and self-care: with the share of aging patients (older than 60) rises from less than 20 to more than 40%, what is its impact on choice? In particular, given that the share of self-care in total choices has rose from 19% to 35%, has this evolution a link with aging problem? From Tables 6 and 7, as all coefficients of age are negative relating to the choice of self-care (and significant in most provider types), we conclude that aging patients prefer more self-care than patients of other ages. However, we cannot compare the coefficients of age between 89-93 and 04-06 to get an idea about evolution since in the sample 89-93, about one third of patients are less than 18 years old while in 04-06 sample, all patients are at least 18 years old. Another interesting fact is that in 04-06, the coefficients of *edu\_years* and *Suburb* are all negative, indicating that the patients with higher education, and patients of villages near cities tend to prefer more self-care. It seems that self-care is conditioned by individual knowhow on health care as well as by the conditions that favor the use of self-care. Most of these coefficients, however, are not significant.

In the less developed villages (with the share of rural labor as proxy), the patients choose more village clinic. This tendency persists in both periods. The size of the village positively impacted the choice to village clinic in 89-93. This impact disappeared, however, in 04-06.

Another interesting result is that when illness type is fever, in 89-93, the patients prefer self-care, in 04-06, however, the patients prefer go to see one of provider types (except county hospital), it seems that as the aging patients have significantly increased in 04-06, fever is more severe for aging people than for younger people.

Significant positive coefficients are associated with the severity of illness for all provider types over self-care. This indicates that sicker patients prefer to go to see doctors. It is interesting to observe that the coefficient of village clinic just slightly falls and that of township centers even increased during the two periods. *Other\_type* has to large extent taken the market share from Country hospital and to less extent from village clinic. This seems to indicate that even in case of severe illness, people seeks to find solution in near providers. In the trade-off between proximity and quality, township Center is the winner.

Finally, we have expected some systematic differences in choice of health care providers in function of development level of provinces. In Table 6, we have decreasingly classified the province dummies in terms of rural per capita income. We cannot observe via their coefficients systematic different choice pattern. This seems to indicate that the province specific features in choice of healthcare providers are to larger extent determined by such factors as historically and geographically formed infrastructures and organization forms rather than by economic development level.

## Conclusion

1989-2006 is a period of the start and the end of deregulation of Chinese health care sector and of disintegration of rural cooperative insurance system. During this period, while the supply and demand side conditions of health care have significantly progressed in line with Chinese economic growth and income increase, the ambiguous government health policy (set prices below cost for basic health care, but above cost for high-tech diagnostic services; underfunding of public facilities) has turned hospitals, township health centers and village doctors all alike into profit seeking entities. Face to the great discontents voiced by the public on unaffordable access to health care, Chinese government begun to restore rural cooperative insurance system (NRCMS).

From CHNS data source, we get 2117 rural people that declared to be ill in 1989, 1991 or 1993, and 2594 people that declared to be ill in 2004 or 2006 surveyed roughly in the same villages in 9 Chinese provinces. Since in 1989 to 1993 and in 2004 to 2006, the supply and demand conditions were roughly alike, we constitute two samples: 89-93 and 04-06 to compare their choice behaviors with the evolution of their individual features, in particular their wealth and their ages. In this context, our samples, also allow us to observe not only price, income, distance and insurance effects, but also the effects of aging and of regional inequality.

Using MMNL estimations and the calculations of price elasticity by healthcare provider type and by asset range, and some other complementary regressions, we have obtained the following results:

First, according to MMNL method, in both periods there are clear price effect, but this effect in 04-06 tends to be weaker. In particular, the heterogeneity in price preference considerably increased in the second periods. This fact corresponds well the fact that between the two periods price level has significantly increased and price variation reduced. In other words in a context where the extent to which the choice based on price has reduced, price elasticity becomes lower and price effect more heterogeneous. The analysis of price elasticity by provider and by asset range reinforced this conclusion.

Second, we observed a stronger negative distance effect in 2004-06, while in 89-93 this negative impact was lower and absent for providers farther than 10km. This result coincides with the difference in price variation between the two periods: during the second period, prices being higher and more homogenous among health facilities. There is a substitution effect: when patients have less possibility to discriminate providers by price, they increase their preference in choice by distance. During the second period, with weaker price effect, stronger distance effect is observed. But heterogeneity in distance preference is also enlarged in the second period.

Third, while in 89-93, wealth level plays a role in some choices, in 04-06, wealth level has no longer significant impact on the choice of health care providers. Explanations may be that during this period in line with the increase of about 4 times of GDP at constant price in China, and with the increase of health expenditure from about 4% to more than 5.5%, there is a significant improvement

of supply side conditions on health care. Also, at demand side, the income of rural population, even increased at a slower rate than that of urban population, was more than doubled at constant price. Last, health care is a necessary goods and it is quite possible that it is price inelastic.

But the absence of wealth effect just answered if poorer patients have or not equal access to health care. Another question is if the poorer patients are worse-off in terms of their consumption expenditure after having paid their health care? We regress consumption ratio (defined as the share of remained consumption expenditure after health care pays in trimester income) on lnasset using year and province dummies as control variables and found that during this period, the poorer patients have their consumption ratio more decreased due to their health care. The extent to which the consumption expenditure has been negatively affected by health care is larger for poor patients than richer patients, and between the two periods the inequality has enlarged.

Four, we have not observed significant positive cooperative insurance effect. The population aging, as well as better education level and closeness to cities, reinforce the choice of self-care.

Finally, we observed that while the patients living in less developed villages have stronger preference to village clinic, the difference in development level between provinces does not lead to systematically different patterns of choice of healthcare providers.

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