Two-Period Comparison of Healthcare Demand with Income Growth and Population Aging in Rural China: Implications for Adjustment of the Healthcare Supply and Development

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Abstract

We estimate the evolution of healthcare demand under the influence of income growth and population aging with two samples of patients surveyed in the same regions, but with an interval of 18 years in rural China and with mixed logit to deal with heterogeneity. In accordance with theoretical and inductive inferences, it is found that healthcare price effects decreased and became more heterogeneous. Aging impact overweighed income growth impact, resulting in increasing distance effect and patients' preference to proximity. In the face of this demand change, the adjustment of governmental supply should be to promote small and middle-sized healthcare providers. However during this period to cope with urbanization, the Chinese policy consisted of privileging large hospitals. This has led to a higher share of patients, especially the aging patients, to choose self-care and a higher share of poorer patients to suffer from catastrophic health expenditures. This finding carries broad implications for rural health policy-making on, along with income growth, population aging and urbanization, how to provide better coverage of rural areas by enough qualified and multifunctional small and middle-sized healthcare providers in the developing world.

KEY-WORDS: Two-period healthcare demand comparison, mixed logit model, price and distance effects, heterogeneity, insurance, rural China.

JEL Classification: D1, C5, I1.

1. Introduction

This study assesses the evolution of healthcare demand in terms of the choice of healthcare provider over an 18-year period in rural China. From the CHNS data source, we construct two data sets of patients: a 1989-1993 sample and a 2004-2006 sample, surveyed in the same villages in nine Chinese provinces. The originality of our samples resides in the evaluation of the healthcare demand change of the same population after a long interval in which the average patient becomes richer but ages. In the constitution of the samples for comparative study, it is very difficult to satisfy at once these three requisites: 1) the patients are surveyed within the same population but are in two different times; 2) the time interval is long enough to observe income growth and population aging; and 3) the income has substantially increased. The satisfaction of the two first requirements could be realized in most regions, for instance in Africa. Nevertheless, only in a few countries where a rapid income growth has occurred can the third requirement be fulfilled.

With our two-period comparison, we expect to achieve three goals: First, we are testing some theoretical and logical inferences. With income growth and population aging, we estimate the evolution of the effects of two important factors that determine healthcare demand: price and distance.[1] On the one hand, with the average per capita income at constant prices and the household assets increased two to three fold, and following microeconomic theory and inductive reasoning, people will be less sensitive to the price of healthcare and to distance but will be more careful on qualitative factors. On the other hand, aging patients with less favorable health conditions would be less sensitive to price and more to distance. We expect that the tests would confirm these inferences.

Second, we are measuring preference heterogeneity. With income growth, the choices would be more heterogeneous among the patients because budget constraints become softer and taste more diversified. People would tend to make their choices more as a function of factors like quality and reputation of the healthcare providers. With aging, patients' choices would be more affected by such unobservable factors as intra-household relationships, especially between young and aging members. Thus we expect the presence of a larger degree of heterogeneity of price effects in the 2004-2006 sample relating to the 1989-1993 sample. On the contrary, the evolution of preference heterogeneity of distance is uncertain since

[1] Distance is an important factor that conditions healthcare choices of Chinese rural villagers, first because of population aging, and second because of backward transportation conditions in most rural areas.

income growth would increase, while aging would reduce this heterogeneity. In traditional econometric treatments, the focus is on mean effects. The heterogeneity between the observations is treated as an unknown and is put in the error term. Since measuring "how different" between the observations is also of crucial importance in health economics, we use a mixed multinomial logit model that can quantitatively assess the extent of heterogeneity. On the other hand, in the presence of significant preference heterogeneity, it is better than an ordinary multinomial logit because the later could bias the estimation due to its unrealistic assumption of "independence from irrelevant alternatives" (IIA).

Third, we are exploring the implications of demand evolution for the adjustment of medical care supply and policymaking. With the two-period comparative estimations on the evolution of patients' demand in terms of the choice of healthcare provider, we will check whether the Chinese rural medical care supply adapted to this change through planning a rational geographical structure of healthcare providers around the villages during the period. In the case of maladjustment, what were the consequences?

The analysis of our samples arouses a general interest for most developing countries. In these countries, as population aging is a common process and income growth occurs at different paces, what is the evolution of rural healthcare demand as a function of these two key factors? Has the adjustment of supply adapting to it been a major concern for health policymakers?

This study is organized as follows. Section 2 reviews the evolution of the Chinese rural healthcare market, and in particular the supply and demand side changes between 1989 and 2006. Section 3 presents the methodology and data. Section 4 analyzes the results of estimations and explores the implications for policy-making. Section 5 presents conclusions.

2. Background

There is abundant literature on healthcare provider choice in developing countries. As explanatory factors, income and price have always received special attention. The results obtained led to 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 price elasticity of demand for all healthcare options is high in Tanzania. Other studies concluded that both price and income are significant determinants of healthcare provider choice (Ntembe, 2009 in Cameroon; Lopez-Cevallos and Chi, 2010 in Ecuador). In contrast,

Lindelow (2005) showed that income is not an important determinant of healthcare choices in Mozambique, and that prices have significant but inelastic influences on the choice. Lawson (2004) found a strong income impact in Uganda, while user fees are less significant than one might first expect. For Akin *et al*. (1986), price is not a significant determinant of demand for primary healthcare and consequently it does not influence provider choice decisions in the Philippines. Other studies showed that healthcare demand is either inelastic or low elastic when the quality of care is high or increases (Mariko, 2003; Cissé, 2004). Mocan *et al.* (2004) showed that the medical care demand in urban China in 1989 was price inelastic and slightly income elastic.

All these studies led us to believe that income and price effects might vary across countries and over time because of the differences in development levels. In the Chinese case, a comparative study on rural China over two distinct periods would be very promising due to its rapid transformation of demand and supply side conditions in the healthcare market from the beginning of the 1990s to the middle 2000s.

On the demand side evolution, four aspects in this period may be emphasized. First, the rural population saw its income significantly increase, along with income inequality. The average GDP growth of China was 9% at this time, and the GDP in 2004 was 8.07 times that of 1989 at current prices, and 3.8 times at constant prices. Incomes of rural and urban people in 2004 were respectively 4.88 (from 602 to 2936 Yuan) and 6.86 times that of 1989. At constant prices, the income of rural people in 2004 was 2.3 times that of 1989. According to the Chinese Agricultural Yearbook 2008, the Gini coefficients of the rural population increased from 0.305 to 0.369 between 1988 and 2004.

Second, household healthcare expenditures had risen considerably. According to the Chinese Health Statistic Yearbook 2005, the per capita annual health expenditure in rural regions rose 7.39 times from 38.8 to 286.6 Yuan at current prices, and the portions in the charge of households from 14 to 157 Yuan between 1990-2002, a more than 10 times increase. The reason for this increase was that, on the one hand, there was a trend toward the public disengagement from the healthcare sector and an increase in out-of-pocket payments (that will be shown in Table 1). On the other hand to keep healthcare affordable, the government set prices for basic healthcare services at below cost. At the same time, the government wanted facilities to survive financially, so it set prices for new and high-tech diagnostic services above cost and allowed a 15% profit margin on drugs. This price schedule created perverse

incentives so 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).

Third, with the disintegration of the Cooperative Medical Service in the 1980s, a great majority of rural people lost their cooperative insurance. Until 2002, more than 80% of rural people were not covered by medical insurance. In 2003, the Chinese government initiated the New Cooperative Medical System (NCMS).

Fourth, the aged population is increasing. In 1990, people more than 65 years old represented 5.57% of the population. This percentage reached 9.07% in 2005, with 9.48% and 8.12% respectively for rural and urban populations (Chinese Population Statistic Yearbook 2005; Chinese Population and Employment Statistic Yearbook 2007). This means that the percentage of the aged population has nearly doubled. According to a study by the ILO, this percentage will reach 14.17% by 2020 (Yang and Wang, 2010). The main cause of the increasing aged population in China is the application of family planning for limiting births for more than the last 50 years. Another rural region-specific reason is that during this period, according to our estimation based on the CHNS surveys, about one third of rural household members on average left their houses and worked in cities. They were mostly younger and thus exacerbated rural population aged statistics.

On the supply side changes, the share of health expenditures in the GDP in 1990 and 2004 increased from 4.03% to 5.65% (Chinese Health Statistic Yearbook 2005). Table 1 shows the trend toward the public disengagement from the health sector and the increase in out-of-pocket payments.

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: Chinese Health Statistic Yearbook 2005.

Another aspect of supply side changes is the evolution of the balance of power between county (and above) hospitals, township health centers and village clinics in terms of the numbers of institutions, health professionals, beds and visits. As one of the most important issues in this study is to check rural China's supply side deficiencies in the face of demand

changes in this period, we will introduce and analyze these indicators in Table 9 of Section 4.5.

In the evolution of the demand side factors, we focus on two of them that appear to be the most essential, income growth and population aging, and explore their possible influences on healthcare demand.

An obvious effect of general income growth would be that the patients' choices become less sensitive to healthcare prices and more heterogeneous because their budget constraints became softer. People would tend to make their choices more as a function of factors like quality and reputation of the healthcare providers. The heterogeneity of price effects would reflect increasing impact of these unobservable provider-specific attributes and patient-specific taste variations. General income growth could also reduce the distance effect and make its impact on preference more heterogeneous.

With aging and health conditions becoming less favorable, patients would be less sensitive to price and their choices would be more affected by other factors. Besides unobservable healthcare provider attributes and patients' tastes, there are many aging-specific factors. For example, one unobservable factor, the relationship within the households between the aging parents and the younger members (sons, daughter-in-law), may lead price sensibility to be very different. Another evident effect is that aging people like proximity; thus there may be a stronger distance effect and reduced heterogeneity of distance impacts.

To summarize on the basis of these arguments, with the increases of income and age, we expect a decreasing price effect and an increasing heterogeneity in price preferences. Their impact on distance effect is uncertain, depending on which influence is more important: the income growth that reduces distance effect but increases its heterogeneity, or population aging that increases distance effect and reduces its heterogeneity. The estimation results will indicate the trends and heterogeneity in distance effects.

3. Methodology

To take into consideration the economic and demographic changes that occurred in China since the 1990's and their potential effects on healthcare demand, we used two samples surveyed within the same region in two periods. During those periods, the most significant changes were income growth and population aging. We focus on the evolution of the effects

of healthcare price and distance and the extent of heterogeneity on them, after controlling for other relevant variables.

3.1 Econometric Modeling

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

$$\boldsymbol{U = U(h_i, x_i)} \quad \textbf{(1)}$$

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

$$\boldsymbol{h_i = h(C_i, F_i, R_i)} \quad \textbf{(2)}$$

Healthcare demand is a function of the price of healthcare (p) and the distance to the healthcare provider (D). The importance of D is that distance not only implies cost of access, but also reflects the reputation and quality of providers.[2]

$$\boldsymbol{C_i = C(p, D)} \quad \textbf{(3)}$$

Finally, the other health input, F, is a function of expenditures on these inputs (E_i).

$$\boldsymbol{F_i = F(E_i)} \quad \textbf{(4)}$$

With equations (1) to (4), we have the indirect utility function in the case where individual i chooses healthcare provider j in which $y_i - p_j - E_i$ is the budget for non-health consumption (y is income).

$$\boldsymbol{V_j^* = U\big(h\big(C_j(p_j, D_j), F(E_i), R_i\big), y_i - p_j - E_i\big)} \quad \textbf{(5)}$$

Among the healthcare provider alternatives, the patient will choose the one that maximizes his/her indirect utility function. This is expressed by equation (6).

$$\boldsymbol{V_j = 1, \text{ if } V_j^* = Max(V_1^*, V_2^*, \ldots V_J^*)}$$

$$\boldsymbol{V_j = 0, \text{ otherwise}} \quad \textbf{(6)}$$

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

[2] Large healthcare providers must be set in towns or in cities. Consequently, their distance is farther than small healthcare providers in the proximity of the rural villages.

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

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

$$V_j^*(.) = Z_{ij}\beta_z + X_i\beta_{xj} \quad \textbf{(8)}$$

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

$$V_j = \alpha_j + \beta_1 p_{ij} + \beta_2 D_{ij} + \beta_{3j} y_i + \beta_{4j} R_i + \varepsilon_{ij} \quad \textbf{(9)}$$

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

The generally used model to estimate healthcare-seeking behavior is the multinomial Logit (MNL). As the MNL model is based on the assumption of "independent and identically distributed" (IID), and hence on the assumption of IIA, its failure to deal with heterogeneity can result in inferior model specification, spurious test results and invalid conclusions (Louviere *et al.* 2000; Train 2003). Heterogeneity caused by alternative attributes and individual preferences can branch into three major topics: 1) unobserved heterogeneity in alternatives; 2) taste variation of the deciders; and 3) heterogeneous choice sets (Baltas and Doyle, 2001). As in middle 2000 relating to the end of 1980, general increases in income and age would lead healthcare choices in rural China to be much more heterogeneous. Mixed multinomial logit (MMNL) model analysis could give better performance.

In MNL models, the emphasis 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 this 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 (McFadden and Train, 2000). Several studies have applied MMNL in healthcare demand (Harris and Keane, 1999; Borah, 2006; Canaviri, 2007; Hole, 2008; and Qian *et al*., 2009).

If equation (9) is estimated with MNL, the basic form of the MMNL, and with alternative specific constants α_j and attributes x_{ij} (here, x represents both z and x variables in the equation (8)), the result will be:

$$\boldsymbol{Prob(j)} = \frac{\exp(\alpha_j + \beta_j^{'} x_{ij})}{\sum_{q=1}^{J} \exp(\alpha_q + \beta_q^{'} x_{iq})} \qquad \textbf{(10)}$$

The difference between MMNL and MNL is that in the former, one part of the coefficients is random; in the latter, all coefficients are non-random. In equation (10), β_j' is composed of β_{ji} with

$$\boldsymbol{\beta_{ji}} = \begin{cases} \boldsymbol{\beta_j + \delta_j^{'} w_i + \sigma_j \eta_{ji}\ if\ random} \\ \boldsymbol{\beta_j^{'}\ if\ non-random} \end{cases} \qquad \textbf{(11)}$$

where $\beta_j$is the population mean, $\eta_{ji}$is the individual specific heterogeneity, with mean 0 and standard deviation 1, and σ_j is the standard deviation of the distribution of β_{ji} around β_j. The elements of β_{ji} 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 produces individual heterogeneity in the means of the randomly distributed coefficients so that selecting subsets of pre-specified variables interact with the mean and standard deviation of random parameterized attributes.

We set both price and distance to healthcare providers as random variables. It would be interesting to estimate the heterogeneity in the preferences 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 six variables: asset, income, urban type insurance, cooperative insurance, severity of the illness and rural labor ratio of the village.

Given that η_{ji} are individual specific, $\sigma_j$will reflect unobserved random disturbances: the source of the heterogeneity. Thus in the population as stated above, if the random terms are normally distributed,

$$\boldsymbol{\beta_{ki} \sim Normal}\left[\boldsymbol{\beta_k + \delta_k^{'} w_i, \sigma_k^2}\right] \qquad \textbf{(12)}$$

Equation (12) has useful empirical implications and we will return to them in discussing their application. As the usual choice, we will use the normal distribution. Finally, to make our model more realistic, we will allow the two random parameters to be correlated.

3.2 Data

3.2.1 Survey data and sample

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

Several considerations guided the selection of the samples in the 1989 to 2006 period. We were interested in the starting and ending periods where a difference in the degree of preference heterogeneity is expected. So we decided not to keep data from the middle of the period and to build two samples: one for the first period and the other for the second. Within each sample, we ensured that income, healthcare prices and supply conditions were not significantly evolved over time. The number of the interviewed who were ill was smaller in the first waves than in the last (population aging is seemingly the main cause). So to keep some equilibrium between the two samples, we merged three time periods of two-year intervals (1989, 1991 and 1993) for the first sample and two time periods of two-year intervals (2004 and 2006) for the second sample, with 2,117 and 2,594 observations respectively. The last waves did not include individuals under 18 years old as the first waves did. We conducted a logistic regression analog of the Chow test to check whether the healthcare demand of the under-18 individuals differed from that of the over-18 ones (cf. Demaris, 2004). The results showed that the two models indeed differed. Consequently, observations of individuals under 18 were removed. Finally, our samples included 1,457 rural people who reported having been ill in 1989, 1991 or 1993, and 2,594 people who reported being ill in 2004 or 2006.

As our data panel included attrition and replacement, we checked the frequency of the patients and whether attrition was non-random. In the 1989-1993 sample, only 11.6% and 0.06% patients were surveyed two and three times; in the 2004-2006 sample, 16.3% patients were surveyed two times. CHNS data collectors have not given more details on attrition.

[3] We thank the National Institute of Nutrition and Food Safety, China Center for Disease Control and Prevention; the Carolina Population Center, University of North Carolina at Chapel Hill; the National Institutes of Health (NIH; R01-HD30880, DK056350, and R01-HD38700); and the Fogarty International Center, NIH, for financial support for the CHNS data collection and analysis files since 1989. We thank those parties, the China-Japan Friendship Hospital, and the Ministry of Health for support for CHNS 2009 and future surveys.

Nevertheless, as Deaton (1997) stated, the rate of refusal of participation is lower in developing countries. It must be still lower in rural China since political institutions exert strong control. Villagers in and out of participation must be mainly attributable to their absence, their moves or their deaths. Therefore, attrition can be regarded as random.

3.2.2 Definitions of variables

Table 2 presents all variables that were used and their definitions. The first five items (V, T, C, O, S) concern the dependent variable spread in a selected set of healthcare providers. All the following variables concern the independent variables. With the exception of the first five and the last three, all the remaining variables, are individual-specific attributes. The last three variables were used to take into account the environmental features. 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 suburb reflects the proximity of the village to the urban medical infrastructure.

Table 2. 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 health center; =0 otherwise.
County-H (C)	=1 if the choice of treatment is county or higher level city hospital; =0 otherwise.
Other-type (O)	=1 if the source of treatment is pharmacy, private clinic and other clinic; =0 otherwise.
Self-care (S)	=1 if self-treatment is chosen; =0 otherwise.
P_j	Medical expense at constant prices of alternative j after eventual reimbursement by insurance multiplied by 10^{-3}; j=V, T, C, O, S. The expense of self-care is assumed =0.
$Dist0_j$	=1 if distance <0.5 km; =0 otherwise; j=V, T, C, O.
$Dist1_j$	=1 if distance >=0.5 km & <3; =0 otherwise; j=V, T, C, O.
$Dist2_j$	=1 if distance >=3 km &<10km; =0 otherwise; j=V, T, C, O.
$Dist3_j$	=1 if distance >=10 km; =0 otherwise; j=V, T, C, O.
Age	Age of the patient in the wave.
Female	=1 if the patient is female; =0 if male.
Marital	=1 if the patient is married; =0 otherwise.
Edu_level	=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.
Urban_job	=1 if the patient's job is not farmer; =0 otherwise.
Farmer	=1 if the patient's job is farmer; =0 otherwise.
No_job	=1 if the patient has not job;=0 otherwise.
No_insured	=1 if the patient is not insured; =0 otherwise.
Urban_insurance	=1 if for family members, the patient's insurance is one of the following types: commercial, free medical, workers compensation, and for the members that are urban employee, pass-way model, block model, catastrophic disease; =0 otherwise.
Cooperative_insurance	=1 if the patient's insurance type is rural cooperative; =0 otherwise.
Other_insurance	=1 if the patient's insurance is other than Urban_insurance and Cooperative_insurance (they include among others Health insurance for women and children, EPI (expanded program of immunization) and 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.
Other_deseases	=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 prices of the household multiplied by 10^{-3}.
Asset	The annual household value of the asset index.
Rural_popu_rate	The share of the rural employees in total labor of the village.
Village_size	The household number of the village multiplied by10^{-3}.
Suburb	=1 if the village is near a city; =0 otherwise.

The CHNS database provides household per head annual income at a constant price. The variable "Income" was used to estimate the effect of income on the choice of healthcare provider. Nevertheless, we consider that income only partially reflects the economic and financial states of households and individuals. Furthermore, linked with the specifics of farm activities, incomes are often too volatile and some households have declared negative income. Another problem is the extent to which incomes are measured with non-random errors. Thus, following several authors (Sahn and Stifel, 2000; Filmer and Kinnon, 2008), we judged it

necessary to build an asset index and simultaneously used income and asset to measure the income and wealth effect. It could be assumed that their impact on healthcare choice can be sensibly different. For instance, income could have a stronger effect on the provider choices (including self-care) in the case of relatively moderate illness. Asset could be more influential on choices in the case of serious illness, since an important expenditure is concerned. Therefore, the simultaneous use of income and asset as explanatory variables could address the distinct effects. We used 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 house (6 choices);
6) Ownership of electrical appliances and other goods (the number of appliances varied between 15 to 18 according to the periods of survey, and this information was absent only in 1989);
7) Means of transportation (5 types);
8) Type of farm machinery (5 types); and
9) Household commercial equipment (6 types).

For each wave, we used principal components analysis to derive weights (Filmer and Kinnon, 2008) on the basis of all rural households surveyed in the CHNS project. Then we only kept the obtained asset index for the households that declared having patients. Coefficients of correlation between income and asset were 0.29 for both periods (1989-1993 and 2004-2006) and were significant at 1%.

One interesting feature of Asset index is that as all items contained in Asset index have qualitative features, and thus reflect to a larger extent (like Income) per capita rather than overall household wealth. This enhances their comparability. Since the correlation is not so high, both variables could be simultaneously introduced in the model.

A second point is how to compensate for missing prices of healthcare. MMNL requires the prices of all the alternative providers, while in the survey only the prices of the providers that the patients visited were recorded. So the prices of alternative providers that patients did not visit needed to be imputed. Following Gertler *et al.* (1987), Gertler and van der Gaag (1990), and Borah (2006), we used the Stata ICE program created by Royston (2004) to impute the lacking price data. All reported prices were converted at constant prices

using the weights given by the CHNS data provider. The chosen predictors of prices included 16 variables: Age, Female, Marital, Edu_level, Urban_job, Farmer, Income, Severity, Year, Province, Urban_insurance, Cooperative_insurance, Other_insurance, Fever, Chronic, and hospitalized (=1 if hospitalized; =0 otherwise). The regressions were separately operated according to the healthcare provider choices (V, T, C and O). The descriptive statistics of imputed plus actual prices by type of providers are presented in Table 3.

A third point is that since severity is a perception variable, it may be determined by a series of non-observables that jointly determine the choice of providers. One way to measure the "objectiveness" of the reported severity is to observe the prices paid after treatments. In 1989-1993, the average prices paid for severity 1, 2 and 3 were respectively 46, 122 and 234 Yuan, and in 2004-2006, they were 90, 191, and 541 Yuan. Even their proportional increases by degree of severity remained stable between the two samples. Thus, we concluded that their perceptive severities were also highly objective and endogeneity was not a concern.

A last point of interest was insurance. If the extent to which the possibility of choice of insurance is large, like with severity, the problem of endogeneity may also appear. We argue that at least in the studied period, there was not really a possibility of insurance choices for rural people. Besides the people with urban jobs and hence automatically insured by their enterprises, most peasants got insurance because the government decided that the villages where they lived began to be covered by cooperative insurance. In both cases, the freedom of choice was low.

Table 3. Descriptive statistics.

	1989-1993 (n=1457)				2004-2006 (n=2594)			
Sample distribution by provider choice	Mean	SD	Min	Max	Mean	SD	Min	Max
Village-C	0.48	0.50	0	1	0.22	0.41	0	1
Town-C	0.21	0.41	0	1	0.14	0.35	0	1
County-H	0.09	0.29	0	1	0.18	0.39	0	1
Other-type					0.11	0.32	0	1
Self-care	0.21	0.41	0	1	0.35	0.48	0	1
P_V	0.074	0.078	0	0.477	0.096	0.079	0	0.598
P_T	0.159	0.162	0	0.859	0.207	0.169	0	1.166
P_C	0.466	0.617	0	3.506	0.651	0.597	0	3.808
P_O					0.204	0.318	0	3.972
Dist0_V	1	0	1	1	1	0	1	1
Dist0_T	0.40	0.49	0	1	0.48	0.50	0	1
Dist1_T	0.39	0.49	0	1	0.36	0.48	0	1
Dist2_T	0.21	0.40	0	1	0.15	0.36	0	1
Dist3_T	0	0	0	0	0	0	0	0
Dist0_C	0.13	0.34	0	1	0.23	0.41	0	1
Dist1_C	0.16	0.37	0	1	0.22	0.42	0	1
Dist2_C	0.22	0.41	0	1	0.25	0.43	0	1
Dist3_C	0.49	0.50	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	44.47	15.41	18	92	55.88	15.12	18	97
Female	0.53	0.50	0	1	0.57	0.49	0	1
Marital	0.84	0.37	0	1	0.80	0.40	0	1
Edu_level	0.98	1.06	0	5	1.17	1.21	0	6
Urban_job	0.26	0.44	0	1	0.13	0.35	0	1
Farmer	0.60	0.49	0	1	0.35	0.48	0	1
No_job	0.14	0.35	0	1	0.51	0.50	0	1
No_insured	0.80	0.40	0	1	0.64	0.48	0	1
Urban_insurance	0.15	0.36	0	1	0.10	0.30	0	1
Cooperative_insurance	0.03	0.17	0	1	0.25	0.43	0	1
Other_insurance	0.02	0.13	0	1	0.01	0.10	0	1
Severity	1.71	0.70	1	3	1.70	0.67	1	3
Fever	0.35	0.48	0	1	0.26	0.44	0	1
Chronic	0.13	0.33	0	1	0.34	0.47	0	1
Other_diseases	0.52	0.50	0	1	0.40	0.49	0	1
Hhsize	4.40	1.50	1	13	3.66	1.69	0	13
Income	2.91	2.26	0.45	22.20	7.03	8.03	0.18	210.95
Asset	0.39	0.77	-1.05	3.08	1.20	0.96	-0.62	3.87
Rural_popu_rate	0.52	0.34	0	1	0.41	0.30	0	1
Village_size	0.66	0.74	0.03	6.00	1.01	1.19	0.04	8.00
Suburb	0.28	0.45	0	1	0.24	0.43	0	1

Table 3 calls for some comments. First in comparing the two samples, we observe the aging trend. The average age of the 2004-2006 sample was around 10 years higher than that of 1989-1993, and according to more detailed calculation, with the share of patients older than 60 rising from less than 20% to more than 40%. Second when comparing the two samples, the choice for village clinic (48% in 1989-1993) was considerably reduced (to 22% in 2004-2006).

It was only partially compensated by Other-type.[4] Third, the choice of self-care was significantly increased (from 21% to 35%). While population aging is a natural trend, the explanations on the reduction of the choice of village clinic and the drastic increase of the choice for self-care depended a lot on the results of our forthcoming estimations. We will return to these questions in the next section.

4. Results and Analysis

For reference in the subsequent discussions in this section, Table 4 presents the results of MMNL estimations.

Table 4. Results of multinomial mixed logit regressions

	1989-1993			2004-2006			
	Village-C	Town-C	County-H	Village-C	Town-C	County-H	Other-Type
Price		-2.72 (-2.50)**			-1.61 (-2.66)***		
Dist1		-0.68 (-0.82)			-1.43 (-3.09)***		
Dist2		-0.85 (-0.94)			-1.95 (-2.96)***		
Dist3		-1.02 (-0.59)			-2.68 (-3.78)***		
Intercept	0.05	-1.28	-2.34	-0.96	-0.78	0.66	-0.82
	(0.08)	(-1.53)	(-1.84)*	(-1.85)*	(-1.23)	(0.91)	(-1.17)
Age	-0.02	-0.02	-0.01	-0.001	-0.01	-0.02	-0.01
	(-3.01)***	(-2.09)**	(-0.71)	(-0.19)	(-0.88)	(-2.82)***	(-1.56)
Edu_level	1.12	0.07	-0.002	-0.06	-0.11	-0.13	-0.08
	(1.31)	(0.64)	(-0.01)	(-0.92)	(-1.46)	(-1.87)*	(-1.07)
Women	0.45	0.27	0.34	0.08	-0.03	-0.08	-0.09
	(2.93)***	(1.38)	(1.22)	(0.60)	(-0.19)	(-0.53)	(-0.59)
Hhsize	-0.02	0.05	0.07	-0.01	0.002	-0.01	-0.12
	(-0.36)	(0.76)	(0.75)	(-0.25)	(0.04)	(-0.29)	(-2.27)**
Asset	0.40	0.42	-0.15	-0.11	0.03	0.13	0.04
	(2.58)**	(1.77)*	(-0.39)	(-1.15)	(0.20)	(0.88)	(0.34)
Income	-0.02	-0.05	0.06	-0.002	-0.01	0.01	-0.01
	(-0.56)	(-0.81)	(0.60)	(-0.21)	(-0.77)	(0.46)	(-0.81)
Severity	0.44	0.69	0.55	0.37	0.74	0.40	0.41
	(3.86)***	(3.74)***	(1.93)*	(3.72)***	(5.74)***	(2.31)**	(3.19)***
Marital	0.38	0.41	0.64	0.05	0.15	0.33	0.17
	(2.01)**	(1.62)	(1.80)*	(0.32)	(0.80)	(1.82)*	(0.92)
Urban_insurance	-0.11	0.24	0.28	-0.42	-0.06	0.31	0.06
	(-0.37)	(0.57)	(0.48)	(-1.39)	(-0.19)	(0.92)	(0.19)
Cooperative_insurance	0.51	1.01	2.41	0.27	0.002	-0.33	0.14
	(0.95)	(1.14)	(2.23)**	(1.62)	(0.01)	(-0.86)	(0.55)
Urban_job	0.50	0.23	0.11	-0.04	0.08	-0.68	-0.26
	(1.79)*	(0.64)	(0.25)	(-0.20)	(0.34)	(-2.87)***	(-1.04)
Farmer	0.16	0.003	-0.27	0.09	-0.08	-0.42	-0.06
	(0.64)	(0.01)	(-0.64)	(0.59)	(-0.46)	(-2.16)**	(-0.34)
Fever	-0.21	-0.64	-0.68	0.89	0.38	-0.80	0.67
	(-1.35)	(-3.03)***	(-2.36)**	(6.12)***	(2.12)**	(-3.93)***	(3.78)***
Chronic	0.07	-0.28	0.07	-0.06	-0.15	-0.15	-0.43
	(0.31)	(-0.94)	(0.16)	(-0.42)	(-0.89)	(-0.98)	(-2.34)**
Rural_popu_rate	0.49	0.61	1.003	0.63	-0.12	-0.09	-0.24
	(1.40)	(1.16)	(1.05)	(2.15)**	(-0.31)	(-0.13)	(-0.56)
Village_size	0.23	-0.10	0.42	-0.09	0.03	0.08	-0.09
	(1.69)*	(-0.48)	(2.29)**	(-1.09)	(0.38)	(1.29)	(-1.15)

[4] Other-type includes in general very small healthcare providers that practice Chinese medicine near a pharmacy, or the retired doctors that open a clinic with elementary equipment. They are far from being a growing alternative force to the three principal healthcare providers.

Suburb	-0.06 (-0.20)	-0.55 (-1.49)	0.16 (0.29)	-0.43 (-1.89)*	-1.63 (-5.82)***	-0.28 (-1.02)	-0.10 (-0.38)
Province and wave dummies	included	included	included	included	included	included	included
	Heterogeneity in mean parameters						
P:Asset	0.21 (0.50)			-0.19 (-1.28)			
P:Income	-0.08 (-0.68)			-0.002 (-0.16)			
P:Urban_insurance	0.35 (0.51)			0.43 (1.08)			
P:Cooperative_insurance	-2.08 (-1.26)			0.10 (0.37)			
P:Severity	0.70 (2.01)**			0.76 (3.83)***			
P:Rural labor	-0.29 (-0.32)			-0.29 (-0.63)			
Dist1: Asset	0.06 (0.23)			0.20 (1.59)			
Dist1:Income	0.08 (1.06)			-0.004 (-0.23)			
Dist1:Urban_insurance	-0.27 (-0.55)			0.12 (0.36)			
Dist1:Cooperative_insurance	-0.27 (-0.28)			0.04 (0.15)			
Dist1:Severity	0.14 (0.60)			0.22 (1.48)			
Dist1:Rural_popu_rate	0.21 (0.33)			0.26 (0.62)			
Dist2: Asset	-0.25 (-0.67)			0.27 (1.57)			
Dist2:Income	0.10 (1.06)			0.04 (1.94)*			
Dist2:Urban_insurance	0.62 (0.97)			0.22 (0.46)			
Dist2:Cooperative_insurance	-1.26 (-0.84)			0.14 (0.44)			
Dist2:Severity	0.34 (1.22)			0.44 (2.27)**			
Dist2: Rural_popu_rate	-1.01 (-1.32)			-0.39 (-0.71)			
Dist3: Asset	0.60 (1.12)			0.18 (0.94)			
Dist3:Income	-0.01 (-0.06)			-0.04 (-1.42)			
Dist3:Urban_insurance	-0.65 (-0.65)			-0.17 (-0.30)			
Dist3:Cooperative_insurance	-1.01 (-0.68)			-0.03 (-0.07)			
Dist3:Severity	0.39 (0.92)			0.76 (3.36)***			
Dist3: Rural_popu_rate	-1.35 (-1.07)			0.32 (0.45)			
SD of parameter distributions							
PRICE	1.75 (3.73)***			1.39 (4.85)***			
Dist1	1.08 (1.28)			1.08 (3.03)***			
Dist2	0.99 (1.49)			1.11 (2.72)***			
Dist3	1.31 (1.17)			0.75 (1.94)*			
N		1457			2594		
Log-like		-1640.85			-3448.36		
LR Chi Squared		757.96			1453.04		
McFadden Pseudo R2		0.1876			0.1740		

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 effect of healthcare price on the choice among the healthcare providers must be negative. The higher the price associated with a provider, the less likely that provider is to be chosen. From Table 4, according to the MMNL model, in both periods there are clear price effects. The estimated means of Price are respectively -2.72 and -1.61 and are significant at least at 5%, indicating negative price effect but a weaker effect in 2004-2006. This result confirms the inference that with a general income increase and population aging, price effect on choice tends to be weakened.

Calculating marginal effects in terms of price elasticity (the percentage of probability of choosing the healthcare provider by one percent of price increase) will provide more

detailed information at the healthcare provider level than the mean effect estimated in Table 4, where the coefficients of Price are estimated across all healthcare providers. In Table 5, we observe that whatever the provider choice, price elasticity was weak, especially in the second period for county hospitals. This result is in accordance with the theoretical inference that healthcare is a necessary good (Koc, 2004). A comparison between 1989-1993 and 2004-2006 reveals that price elasticity in the first period is indeed higher than in the second period at the healthcare provider level. This result is in line with the above analysis on mean price effect of MMNL results.

Table 5. Price elasticity of choice by provider type.

	1989-1993			2004-2006			
	Village-C	Town-C	County-H	Village-C	Town-C	County-H	Other-Type
Price elasticity	-0.0612	-0.1763	-0.1159	-0.0297	-0.1021	-0.0151	-0.0495

Note: calculated under MMNL using the same variables as in Table 4.

4.2 Distance Effects

We expect that all else being equal, patients prefer closer to farther healthcare providers and hence the coefficients of distance variables would be negative. In Table 4, while all coefficients of Distance are negative, only those of 2004-2006 are significant. Further, from DIST1 to DIST3, the coefficients in absolute terms are generally rising, meaning that as distance is prolonged, the probability to be chosen declines. In comparing the results of 1989-1993 and 2004-2006, we observe that the distance effect was stronger in 2004-2006 with larger coefficients in absolute terms. This is a logical consequence of general population aging, since other things being equal, aged people have a stronger proximity preference than younger people. This leads us to conclude that, while in 1989-1993 the distance did not matter, patients in 2004-2006 had a stronger preference for a health facility that was closer to where they lived.

4.3 Preference Heterogeneity

Several sources for unobservable taste variations of rural patients could be present. First is the difference in judgment of the efficiency of Chinese medicine across patients. Those believing more in Chinese medicine tend more to choose lower levels of healthcare providers, while those trusting more in Western medicine tend to choose higher levels of

healthcare providers. Second is the difference of the patients' perceptions about the efficiency of the same type of health providers due to their experience with certain healthcare providers. Third is the difference in the connection with a personal relation network. This connection with a healthcare provider is different across patients. One patient may prefer a provider just because he has a relative working with it. Four is the subjectivity on self-evaluation of health. The social, cultural and psychological factors that shape their self-evaluations are different across patients.

These unobservable factors might exert a larger influence on preferences in the 2004-2006 sample since with income growth and population aging, price effect was lessened and people began to make their choice decisions as a function of these factors.

The significant (at 1%) standard deviations of the coefficients of Price for both periods (1.75 and 1.39) indicate that parameters do indeed vary in the population, and allow one to conclude that there is unobserved individual specific heterogeneity in price preferences. A generally used method to measure the level of this heterogeneity is to compute the percentage of the patients for which the coefficients of Price are above zero. Following equation (12), we can easily compute it and table 6 gives the results. In 1989-1993, while about 80 % of patients followed the rule that demand falls as price rises, 22.22% of patients did not follow this rule. In 2004-2006, the latter was doubled and rose to 38.30%. These results are in accordance with our reasoning that preference heterogeneity in price would go with income growth and population aging.

Table 6. Extent of heterogeneity measured by percentage of patients of which the coefficients of Price or Distance were >0.

	1989-1993	2004-2006
Price	22.22%	38.30%
Distance 1	45.03%	26.00%
Distance 2	26.73%	26.86%
Distance 3	13.59%	8.92%

Note: Calculated with equation (12) using Table 4 mean coefficients and SD of parameter distributions.

Heterogeneity decreased from 45.03% to 26.00% in Distance1 and from 13.59% to 8.92% in Distance3, meaning that patients had less divergence in their preferences for proximity in close and far distances. With Distance 2, this heterogeneity was unchanged. In line with our reasoning that general income growth would positively affect and population

aging would negatively affect the extent of heterogeneity of distance effects, the outcome depends on which force was stronger. The comparison of the coefficients of three distance dummies leads to concluding that the impact of aging exceeded that of income growth since heterogeneity in distance preferences had decreased during the period.

The "heterogeneity in mean parameters" reflects the influences of observed variables over the effects of Price and Distance on choices. For instance, as seen from the "heterogeneity in mean parameters", severity was found to be a significant source of preference heterogeneity in price and in distance. The positive sign of this variable implies that the sicker preferred to accept higher prices and farther distance in their choice of healthcare provider if they thought it would improve their satisfaction.

4.4 Assessing Extent and Origins of Healthcare Exclusion

The choice among healthcare providers not only reflects the demand. Through the choice, the extent of the exclusion from healthcare can also be estimated and the origins identified.

The effects of Severity are the first indication of exclusion. Exclusion is present if sicker patients have no better access to healthcare providers. Significant positive coefficients are associated with the severity of illness for all provider types over self-care, implying the absence of this kind of exclusion.

Another type of exclusion comes from the difference in income and asset. The existence of a positive income and wealth effects on the choice of healthcare provider means that richer patients have more access to healthcare than poorer patients, and the later are more likely to be excluded from healthcare. According to Table 4 in both periods, income had no impact on the choices. In 1989-1993, the coefficient of Asset was significantly positive at 5% for village clinic and significantly positive at 10% for township health center. It was insignificant for all choices in 2004-2006. Given that in 1989-1993, the choices of village clinic and township health center represented 74% of the total choices, we conclude that while there was a wealth effect in 1989-1993, it was absent in 2004-2006. This evolution seems to be the consequence of the general income growth, which allowed fewer less fortuned patients to be excluded from healthcare. As healthcare is a necessary good, general income growth serves in priority to satisfy the demand for necessary goods.

Exclusion effects can also be observed through insurances (Urban_insurance, Cooperative_insurance). As the share of patients having cooperative insurance increased from

3% to 25%, we expected an insurance effect on the choice of healthcare provider. Table 4 shows that in 1989-1993, if the cooperative insurance had an effect on the choice of County hospital, this effect was absent in 2004-2006 for any choice of healthcare. One possible explanation is that the percentage of reimbursement during this period was too low, as stated in Audibert *et al*. (2008) and in Yip and Hsiao (2008).

Exclusion can also be identified by checking the effects of social status of the patients. From sex (Women), marital status (Marital) and education level (Edu_level) to the types of job (Urban_job, Farmer), nearly all of them produced insignificant effects. Focusing on Age, while in 1989-1993, elderly people significantly preferred self-care to going to the village clinic and township health center. In 2004-2006, this significance disappeared and the coefficient of Age for the choice of County hospital became negatively significant in 2004-2006. This appears to be an improvement, since while in 1989-1993, aged people were discriminated from access to village clinics and township health centers that constituted around 70% of choices; in 2004-2006, this discrimination disappeared, although their worse access to county hospitals in 2004-2006 became a new concern.[5]

So far, we have checked for the existence of different kinds of exclusion from access to healthcare providers and their possible causes. We could conclude that during the period, there was an improvement in terms of income and wealth effects due to general income growth, and there were no noteworthy exclusions due to socioeconomic status. Yet there remained an important type of exclusion: the share of self-care in the total choices increased from 21 to 35% during the period. What were the causes?

In our MMNL estimations, given that self-care was used as the baseline choice and there were no systematic exclusion effects due to the differences in socioeconomic status, it can be concluded that the growing choice of self-care were not caused by socioeconomic status of the patients. Since during the period, the share of patients older than 60 rose from less than 20% to more than 40%, we must check its possible link with the growing choice of self-care.

We first analyzed the evolution of choice structure between the two samples. From Table 7 within the 1989-1993 sample, the patients over 60 years old had 27.17% choosing self-care, higher than the two younger groups. In 2004-2006, the three age groups all distinctly increased their shares of self-care, and had roughly reached the same level.

[5] This may be a logical result of healthcare demand change. With population aging, patients preferred geographical proximity and dislike going to county hospitals that are distant.

Nevertheless, it does not mean that the situation in 2004-2006 was desirable, since it hides an exclusion of aged patients: As aged patients have poorer health conditions, if they are equally treated, they should have a lower share of choice of self-care.

Table 7. Evolution of choice structure by age (in %).

	1989-1993 sample			2004-2006 sample		
	<40	>=40&<60	>=60	<40	>=40&<60	>=60
Village clinic	51.54	48.22	40.94	23.44	22.25	20.17
Township center	21.76	21.58	20.65	13.64	15.68	12.38
County hospital	6.64	10.51	11.23	15.79	16.22	21.86
Self-care	20.06	19.70	27.17	33.25	35.77	34.24
Other type				13.88	10.09	11.35
Total	100	100	100	100	100	100

One can learn from Table 7 is that the increase of self-care came from two sources. First, population aging especially contributed to the total increase in self-care. As the shares of the three age groups in total patient numbers evolved from 44%, 37% and 19% in 1989-1993 to 16%, 43%, and 41%, patients became significantly aged. Then with a higher share of aged patients choosing self-care, the shares of the three age groups in the total choices of self-care evolved from 42%, 34% and 24% in 1989-1993 to 15%, 44%, and 41%. Second, the younger patients also drastically increased their choices of self-care, indicating rising difficulty of access to healthcare providers.

Together with the growing choice of self-care, rising catastrophic health expenditures is possibly another type of exclusion. Even though having shown that the poor patients were not discriminated in access to healthcare, they may have a higher risk of lacking enough money for food after their payments for healthcare. To verify this, we constructed three new variables. The first, used as the dependent variable, is the consumption ratio defined as $(y-p)/y$, where y is trimester per head income, p is the price paid for healthcare, and (y-p) reflects a patient's remaining budget for consumption after healthcare.[6] The second and the third, used respectively as explanatory variables, are Lnasset and Lnincome, household asset and trimester per head income in logarithm form. The income and healthcare price are all at constant prices. We also used year and province dummies as control variables. If the coefficients of the two explanatory variables are close to zero, and thus the price of healthcare is proportional to income, the poor are not unequally disfavored and catastrophic health

[6] This equation assumes that the frequency of healthcare is 4 times per year. According to the Chinese Health Statistic Yearbook 2005, in rural regions, two-week visit rates were respectively 164.6% and 139.2 % in 1998 and 2003. Converting them into an annual rate, per rural people visits were 3.34 and 3.95 times per year.

expenditures are absent. On the contrary, if they are significantly larger than zero, we can judge that the poorer patients' consumption expenditures after healthcare are reduced to a larger extent than that of the richer patients. Table 8 presents the results.

Table 8. Regression of consumption ratio on asset and income

	1989-1993		2004-2006	
	Consumption ratio		Consumption ratio	
Lnasset	0.011		0.052	
	(0.70)		(2.12)**	
Lnincome		0.150		0.190
		(6.60)***		(3.93)***
Province fix effect	Yes	Yes	yes	yes
Year effect	Yes	Yes	yes	yes
Constant	0.860	-0.044	0.721	-0.574
	(21.87)***	(-0.30)	(18.87)***	(1.74)*
Observations	1457	1457	2594	2594
F (prob>F)	1.95(0.035)	5.66 (0.000)	3.62(0.000)	5.30 (0.000)
R-squared	0.01	0.04	0.01	0.06

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

We find that for 1989-1993, Lnasset is not significant in explaining the consumption ratio, meaning the absence of an excess burden for poorer patients. For 2004-2006, however, the coefficient of Lnasset is 0.052 and becomes significant. The coefficient of Lnincome also increased distinctly from 0.15 to 0.19, suggesting that the extent to which consumption expenditures were negatively affected by the healthcare expenditures was larger for poor patients than for richer patients. Inequality in the criterion of consumption expenditures was enlarged as healthcare burdens affected more low-income patients during the period.

Thus we arrive at the key question: why the choice of self-care had increased for all age groups in general and for aged groups in particular, and why the catastrophic health expenditure became a concern?

In previous studies to explain China's "rural health crisis" (Dummer and Cook, 2007), most of them focused on demand-side causes, that is, with the collapse of the rural health insurance, underfunding of public facilities, rising medical care prices, and private health expenditures that drastically increased (Yip and Hsiao, 2008, 2009; Herd *et al*., 2010). According to our estimations, growing self-care was not mainly due to price rises since during the period, the price effect had reduced. We can also argue that price rises were at least partially compensated by significant income growth. According to the Chinese Health Statistic Yearbook 2005, Chinese rural populations had their per capita annual medical expenditures in the charge of households increase more than 10 times from 14 in 1990 to 157 Yuan in 2004. We also know that their income increased 4.88 times from 602 to 2,936 Yuan

in the same period. Thus owing to income growth, the share of medical expenditure in income increased from 2.3 to 5.3%. This was not a drastic increase relating to other expenditures, especially to housing price.

If only to a lesser extent that the problem was on the demand side, another possibility is a supply-side deficiency. Due to income growth and population aging, the patients had a higher demand for less distant providers and their preferences became more heterogeneous. Only the development of small, and to some extent, middle-sized providers could adapt to this demand change. Meanwhile, the promotion of small and middle-sized providers is a solution to the concern about catastrophic health expenditures. As the services of small providers are cheaper, a poor population benefits more from them. Consequently, if the small and middle-sized healthcare providers are in shortage, the drastic increase of self-care and catastrophic health expenditures might become unavoidable. Is this the case in rural China during the period?

4.5 Supply Side Deficiency and Implications for Policy

We checked the supply side aspects after the demand changes with income growth and population aging during the period. The healthcare demand must provide guidance to assess the relevance and the efficiency of the healthcare supply since a rational supply must satisfy demand. With this in mind, we explored the implications of the previous findings for policy-making.

The direct observation is that the Chinese structure of rural healthcare supply did not adapt to the demand during the period in question. Historically, village clinics and township health centers have been deficient in professional staff and in equipment, and in general specialized in a few less serious diseases. During this period, they were still further weakened.

Table 9 depicts the evolution of the supply side indicators of the health sector and, in particular, the evolution of the balance of power between county (and above) hospitals, township health centers and village clinics in 1990, 2004 and 2011. Note that they are representative of large, middle-sized and small healthcare providers.

Table 9. Some indicators of different health institutions

	Hospitals at the county and above levels			**Townships health centers**			**Village clinics**		
Year	**1990**	**2004**	**2011**	**1990**	**2004**	**2011**	**1990**	**2004**	**2011**
Number of units	14,377	18,396	21,979	47,749	41,626	37,295	803,956	551,600	662,894
Health professional	1,763.1	1,904.8	3,705.5	776.9	881.1	981.2	1,231.5	883.1	1,126.4
Beds	1,868.9	2,363.5	3,705.1	722.9	668.9	1,026.3			
Number of visits	1,494	1,305	2,259	1,065	681	867			1,792
Per unit professional	123	104	168	16.27	21.17	26.31	1.64	1.37	1.91
Per unit beds	130	129	168	15.14	16.07	27.52			
Professionals/1,000 rural population				0.99	1.18	1.32	1.38	1.00	1.27
Beds/1,000 rural population				0.81	0.77	1.16			
Per unit number of visits	104	71	103	22	16	23		2.23*	2.70
Per professional number of visits	847	685	610	1,371	773	884		1,459*	1,591

* 2008 data.

Source: Chinese Health Statistic Yearbook 2005 and Chinese Health Statistic Yearbook 2012. The number of institutions is in ones, health professional and beds are in thousands, the number of visits is in millions per year, per unit health professional, per unit beds, and professional/1,000 rural population and beds/1,000 rural population are in ones, per unit number of visits is in thousands, and per professional number of visits is in ones.

Between 1990 and 2004, relating to county (and above) hospitals, township health centers and village clinics had their resources significantly decreased. As township health centers and village clinics principally cover the healthcare of rural populations, these data confirm that Chinese allocation of healthcare resources privileged urban areas during this period. The policy of the Chinese government consisted of reinforcing the position of large hospitals to the detriment of smaller healthcare providers, especially the village clinics during the period 1990-2004. Unlike county hospitals that had their unit numbers and professional staff increased by 28% and 8%, the numbers of village clinics dramatically decreased by 31% and 28%. For the township health centers, their unit numbers had a decrease of 13%.

It must be argued that the process of urbanization cannot give a reason for this trend. According to official statistics, rural populations had reduced by 10% in this period, much lower than this dramatic medical care supply contraction in rural areas. A good indicator of the coverage of rural populations by healthcare providers is the number of professional staff per 1000 rural population. It decreased from 1.38 to 1.00 for village clinics. It increased from 0.99 to 1.18 for township health centers, and their professional staff increased by 13%. But, these increases were mainly for serving the growing urban population living in towns.[7] As

[7] Township health centers are set in towns (zhen) and townships (xiang). They are at the same administration level, but towns include a growing share of the urban population living in them, while

indicators of equipment levels, the number of beds and the number of beds per 1000 rural population for township health centers even significantly decreased. Unlike county hospitals that had their number of beds increase more than 26%, this number for township health centers decreased by 7.5%. The number of beds per 1000 rural population for township health centers decreased by 26%.

This evolution did not respond to the demand for geographical proximity revealed by the result of this study, since only keeping enough numbers of qualified small, and, to some extent, middle-sized healthcare providers could satisfy this demand. This medical care policy focusing on urban and large hospitals to the detriment of smaller healthcare providers may be the main cause of the Chinese rural health crisis in this period. The consequence of this supply deficiency in rural areas was a degradation of the performance of small and middle-sized healthcare providers in terms of the number of visits. For township centers, this number decreased 36%. Their per unit number of visits and per professional number of visits decreased 26% and 42% respectively. The data for village clinics are missing. From the surveyed data used in this study, the number of visits might have decreased by 50%.

From Table 9, we also notice that in 2011, the Chinese government began to correct this serious bias. The coverage of rural populations by healthcare providers in terms of the number of professional staff per 1000 rural population had increased from 1.00 to 1.27 for village clinics, though was still lower than the 1990 level. This number for township health centers had significantly increased from 1.18 to 1.32. Township heath centers also significantly improved their equipment levels. Their number of beds had increased by 52% between 2004 and 2011. Thus, the beds per 1000 rural population, after a decrease of 5% between 1990 and 2004, had increased by 51% between 2004 and 2011.

Owing to these changes focusing on "repairing" the damages caused in the previous period, the productivity of rural healthcare providers was appreciably boosted. Before 2008, there were no statistics on village clinics' number of visits. The comparison between 2008 and 2011 revealed that the number of visits has increased by 31%. Per unit number of visits and per professional number of visits were both in progression by 21% and 9%. These numbers for township health centers were also in growth. The number of visits increased by 27% after a decrease of 36% between 1990 and 2004. Their per unit number of visits and per

townships, in principle, only contain rural populations. The share of towns in the total number of towns plus townships increased from 20% in 1990 to 53% in 2004, meaning that a growing share of patients of township health centers were in the urban population.

professional number of visits, after drastic decreases of 26% and 44% between 1990 and 2004, increased by 42% and 14%. This may be a big lesson for China to adjust its structure of the rural medical care supply in the future. Its large hospitals in big cities are actually crowded with patients coming from the countryside, and their supply capabilities will always be deficient if the government does not make a bigger effort to enhance the supply capability of small and middle-sized healthcare providers in rural areas.

5. Conclusions

We constructed two samples of rural patients surveyed within the same regions, but with an interval of 18 years. We focused on the two most important factors that could lead patients' healthcare demand to change: general income growth and population aging.

Four main results can be highlighted. First, while in both periods there was a clear price effect, this effect was weaker in 2004-2006. This corresponds well to the fact that during the period, the general income growth and population aging led the patients to be less sensitive to healthcare price.

Second, we observed a strong distance effect in 2004-2006, while for 1989-1993 we did not. This result also coincides with general income growth and population aging. While income growth led patients to be less sensible to distance, aged patients attached more importance to proximity. The result suggests that the aging effect overweighed income effects, leading the distance effect to be stronger.

Third, analysis on preference heterogeneity shows that the heterogeneity in price preferences considerably increased in the second period. This is logical since both income growth and population aging led the patients to be more sensitive to other observable and unobservable provider-specific attributes and patient-specific tastes. On the other hand, while aging increased patients' preference to proximity and reduced the heterogeneity in distance preferences, income growth allowed more heterogeneous distance preferences. The overall heterogeneity in distance preferences was decreasing, indicating that the aging effect had dominated the income effect.

Fourth, the Chinese structure of rural healthcare supply in adapting to this demand evolution should have reinforced the small, and to some extent, middle-sized providers in number and in quality because they are closer to villages and are more able to satisfy heterogeneous demand if they are enough diversified and multi-functional. The reinforcement

of small and middle providers could also be more helpful for poor populations, which became a concern in rural China due to increasing inequality, because the services of small providers are in general cheaper.

However, this was not the way followed by the Chinese rural medical care system during this period. To cope with the urbanization process, the policy consisted of reinforcing the position of large hospitals to the detriment of small healthcare providers, especially the village clinics. As the consequence of this deficiency of qualified small and middle-sized healthcare providers, we identified two types of exclusions. On the one hand, there was a straight increase in the share of the patients, especially aged patients, to choose self-care. On the other hand, there was a rising trend of catastrophic health expenditures, which principally punished the poorer patients.

Our findings has broad implications for most developing countries to adjust their medical care supply and rural medical care systems in developing countries, since they all face rural population aging, industrialization (hopefully with rising incomes) and urbanization. According to United Nations (2009), in the less developed regions, older persons account today for just 8 per cent of the population but by 2050 they are expected to account for a fifth of the population. The pace of population aging is faster in developing countries than in developed countries. Consequently, developing countries will have less time to adjust to its consequences.

In the arbitrage between rural development and urbanization, the adjustment of medical care supply is too easily biased in favor of large hospitals in urban areas in the name of the efficiencies derived from scale economics and concentration. Our findings suggest that better coverage by more qualified and multifunctional small and middle-sized healthcare providers is desirable in the face of more heterogeneous and pro-proximity demand, boosted by income growth and population aging. This is perhaps the most important message delivered by this study.

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