

Determinants of health care demand in poor, rural China: the case of Gansu Province

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This paper examines the determinants that influence health care demand decisions in rural areas of Gansu province, China. This represents the first effort to identify and quantify the effect of price of care on choice of provider in China, and is the first quantitative examination of this topic focusing on poor rural areas in China. In the three-tier health care system in rural China, we further distinguish the public village clinics and private village clinics using a mixed multinomial logit model. The results show that price and distance play significant roles in choice of health care provider. The price elasticity of demand for outpatients is higher for low-income groups than for high-income groups. When outpatients have particular concerns about provider quality or reputation, or when their health status is poor, distance tends to matter less, i.e. they are willing to travel further in order to obtain better treatment for their illness. Insurance status has a significant impact on the choice of public village clinics relative to self-treatment. Furthermore, age and the attributes of illness are also statistically significant factors. We discuss the policy implications of the results for meeting the health care needs of the poor in rural China.

Keywords Health care seeking behaviour, rural health, insurance, health policy, health economics, China

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KEY MESSAGES

- Price is a significant determinant of health care demand in poor rural areas in China, with price elasticity higher for low-income than for high-income groups, and for county hospital than for village clinics.
- Distance is another important determinant of health demand. When provider quality or reputation is a particular concern, or when health status is poor, some rural outpatients are willing to travel further to obtain better treatment.
- Enrolment in the New Rural Cooperative Medical Scheme significantly increased an individual's probability of seeking treatment at a public village clinic relative to self-treatment.
- The rural elderly have a higher probability of visiting lower level providers or choosing self-treatment than accessing higher levels of care.

Introduction

Despite its rapid economic growth and rural-urban migration, China is still a predominantly rural society, with 58.24% of the population living in rural areas at the end of 2004 (National Bureau of Statistics 2005). China is experiencing a widening gap in health status between residents of urban and rural areas. The problems of access to and delivery of health care for rural residents are major areas of concern in China (Liu *et al.* 1999; Gao *et al.* 2002). With the introduction and implementation of market-oriented health system reforms, high user fees for health care, shirking by health professionals at village- and township-level health institutions, and inadequate health care have all become increasingly serious problems in rural areas (Gao *et al.* 2004; Liu *et al.* 2004). As a result, the utilization of health care services in rural areas is falling. According to China National Health Household Interview Surveys in 1998 and 2003, the two-week non-visit rate among rural patients was 33.2% in 1998, but rose to 45.8% in 2003 based on illness reporting. Among rural non-visit patients, the proportion of non-visits due to financial difficulties was 36% in 1998 and 38% in 2003, respectively (Ministry of Health 1998; Ministry of Health 2003). The situation is worse in rural areas of western China (Wang and Liu 2005; Tang *et al.* 2006).

Another dimension of the problem is that the pattern of utilization of outpatient care in rural China has changed considerably. In 1998, 60.17% of rural outpatient visits were to public or private village clinics (VCs), and 14.06% to county and higher-level hospitals. In 2003, visits to public or private VCs declined to 53.5%, while visits to county and higher-level hospitals rose to 18.1% (Ministry of Health 1998; Ministry of Health 2003). Furthermore, over a longer period of time, visits to township health centres have also declined. The Chinese health statistical digest 2007 indicates that between 1995 and 2006, annual visits to township health centres decreased by 25.3%, from 0.938 billion to 0.701 billion visits. At the same time, annual visits to county and higher-level hospitals increased by 17.5%, from 1.252 billion to 1.471 billion visits (Ministry of Health 2007).

Understanding the underlying process of the demand for health care is necessary for a better assessment of the role of public intervention in the health sector. While there are a few studies using a simple multinomial logit model (MNL) to analyse determinants affecting individual choice of health care

provider in China (Ministry of Health 1998; Yip *et al.* 1998; Ministry of Health 2003; Yang *et al.* 2005), there is no study examining the impact of price of health care on the choice of health care provider in China. In addition, there is no study of the role of private providers among the range of provider choices in China. Finally, in this field, there is a lack of quantitative study focusing on poor rural areas of China. This paper attempts to fill all these gaps in the available literature.

The health delivery system in rural China has been characterized mainly by three levels of health care institutions (county, township and village levels). However, with the health system reforms, the supervision of lower levels of the network by higher levels has ceased (Meng *et al.* 2004). Of these rural health institutions, village-level clinics are usually perceived to be the providers of the lowest standard of care at the lowest price, whereas county hospitals are perceived to be the providers of the highest standard of care at the highest price. Township health centres, at the secondary level, have full-time doctors providing primary health care and supervising the public health and medical care services provided by the clinics. Village clinics or health stations served by one or more part-time staff member provide basic health care. Township health centres and county hospitals are owned by the government, and there are seldom private health institutions at these two levels. However, there are many privately owned VCs (Dang *et al.* 2007).

Thus, in this study, we distinguish between the private VCs and public VCs. Public VCs include clinics set up by the village collectively as well as branches of township health centres. Private VCs are privately owned and include group practice and solo practice. There are no significant differences in the behaviour and institutional constraints between the public and the private VCs, except for responsibilities for immunization and other public health services, which are provided mainly by the public clinics with some compensation from the government. Both sets of practices have to rely on revenues charged to the largely uninsured patients for their income (Liu *et al.* 2002). Private VCs are an important complement to the provision of primary health care services in rural China. The poorer the region, the higher is the proportion of private VCs among the rural clinics (Ministry of Health 2003). According to official data from the Ministry of Health (MOH), 60.51% of VCs were public and 39.49% were private in 2006 (Ministry of Health 2007). Qu *et al.* (2006) reported that, based on the

mode of management and operation, many public VCs are only nominally public and in fact should belong to the private group.

Rural residents mainly have the above-mentioned four types of health care providers. In 2003, 79.1% of farmers were not covered by any health insurance system (Ministry of Health 2003). In order to strengthen rural health services, the government launched a new insurance scheme in 2003: the New Rural Cooperative Medical Scheme (NCMS). By 2004, 333 counties (16% of all counties) in 31 provinces had implemented a pilot NCMS, with an average household participation rate of about 75% (Dang *et al.* 2007). For outpatients, the NCMS usually covers only medical expenditures incurred at public VCs and township health centre, but with a higher discounted price at the former. The discounted price is about 20% at public VCs, compared with about 15% at township health centres (Mao *et al.* 2006). Inpatients with NCMS coverage can get reimbursement for visits to township health centres or county hospitals. Private VCs are generally not included in the benefit package of NCMS because policymakers have serious concerns about their quality of care (Wang *et al.* 2006).

The demand for private health care providers among the range of provider choices has received extensive attention in other developing countries (Dow 1995; Sahn *et al.* 2003; Habtom 2006), but there are hardly any such studies of China. As for the determinants of health care utilization, many international studies indicate that price, income and distance exert strong influence on outpatients' choice of health care provider in rural areas (Dow 1995; Sahn *et al.* 2003; Borah 2006). In order to examine the situation in China, this study pays particular attention to these factors. In recent years, medical expenditures have also been rising progressively in China (Dang *et al.* 2007). The high financial burden of illness has restrained health care utilization by rural people, especially the poor (Liu *et al.* 2004). In this context, it is obviously imperative to have a clear understanding of how changes in the pricing of services will affect utilization by rural patients, and what differences there will be across income groups in response to price. Further, the geographic distance between health facilities is great in rural areas, especially in the western part of China. Most outpatients may choose to visit the closest health care provider. However, some people may have a preference for a given health care provider further away, if that provider has a better reputation or skills. We are therefore interested in gaining some insight into the effect of distance on the choice of provider and related preferences in poor rural China.

According to many international studies, insurance status plays a significant role in patients' choice of health care provider (Deb and Holmes 1998; Hanson *et al.* 2004). Yip *et al.* (1998) studied the effect of the Cooperative Medical System (CMS) on provider choice in China. With the implementation of the NCMS, this issue needs re-examining. As the NCMS is at an early stage of development, by examining its effect on patients' utilization of health care services, some policy insights can be gained. In addition, information on the health-seeking behaviour of patients with a low health insurance coverage rate will be useful for the organization of rural health care financing and delivery.

We also examine the effects of a series of other characteristics of the household and individuals, types of illness, etc. on health care choice, which provides useful insights into patterns of demand. The data for this study come from a household survey in rural areas of Gansu province, China. The results on patients are conditional on reporting illness.

The paper is organized as follows. In the next section, we briefly introduce the methods used, followed by a description of the data. The empirical results are then presented. The final section provides a discussion of relevant issues and policy implications.

Methods

The demand variable that we model is the patient choice of health care provider. This is a discrete choice and it is estimated as the probability that one selects a given option on the basis of utility-maximizing behaviour. Following Borah (2006), the utility function is defined as $U(C, H)$, where C is consumption of composite goods other than medical care after paying for the cost of a provider and H is the expected level of improvement after receiving treatment from a provider. The usual assumptions are made about the utility function: $U_c > 0$, $U_{cc} < 0$, $U_h > 0$ and $U_{hh} < 0$.

We assume an individual faces J alternative health care providers and that the production function for health of receiving treatment from provider i is $H_i(X, Z_i)$, where X is a set of individual or household variables, and Z_i is a set of provider i variables.

The budget constraint of an individual is

$$C + P_i = Y, i \in M = \{1, 2, \dots, J\} \quad (1)$$

$$\text{Thus, } C = Y - P_i \quad (2)$$

where Y is the income of an individual, P_i is the price of health care provider i , and $C (Y - P_i)$ is net income after paying for health care provider i . In our model, the functional form for prices and income is quadratic in the logs of net income, which is in line with Gertler *et al.* (1987, 1990). Therefore, the utility that an individual derives from provider i is given by

$$U_i = \beta_{0i} + \beta_1 \ln(Y - P_i) + \beta_2 [\ln(Y - P_i)]^2 + \beta_{3i} X + \beta_{4i} Z_i + \varepsilon_i \quad (3)$$

where ε_i is an error term that captures the residual uncertainty. The X variables include age, marital status, insurance status, bed-days, and so on. In all cases we allow coefficients on these variables to vary across options. The Z_i variables include distance, price and so on. The coefficients on these provider-specific variables are kept constant across options when the model is estimated.

The above utility that a person n derives from provider i can be simplified to

$$U_{ni} = \theta_i + \beta'_n \tilde{X}_{ni} + \varepsilon_{ni} \quad (4)$$

where $\tilde{X}_{ni} = (X, Z_i, \ln(Y - P_i), [\ln(Y - P_i)]^2)$, $\beta'_n = (\beta_{0i}, \beta_1, \beta_2, \beta_{3i}, \beta_{4i})$, θ_i is the consumer's valuation of some provider's unobserved attributes.

The individual n knows her \tilde{X}_{ni} , β'_n , θ_i and ε_{ni} for all j and chooses alternative i if and only if $U_{ni} > U_{nj} \forall i \neq j$. The researcher does not observe the β'_n nor θ_i . For purposes of

estimation, U_{ni} remains latent and a function such that y_{ij} acquires the values of 1 if the individual makes a health care provider choice and 0 otherwise. Thus, the probability that an individual n chooses alternative i is given by:

$$p(y_{ni} | \beta'_n \tilde{X}_n) = \prod_{i \in M} P_{ni}^{y_{ni}} \quad (5)$$

Different assumptions on the error structure and the random coefficients lead to different models. If the errors are assumed to be iid extreme value distributed, while random coefficients can assume any distributions, the mixed multinomial logit (MMNL) model can be obtained. The MMNL model is also known by the terminology of random parameter logit (RPL) (Revelt and Train 1998). Flexibility in the MMNL model is achieved by allowing some or all of the coefficients β'_n in the individual's utility specification to be random.

Coefficient β'_n in (4) can be rewritten as

$$\beta'_n = \begin{cases} b_1 + D\omega_n + \Gamma\eta_n & \text{if random} \\ b_2 & \text{if non-random} \end{cases} \quad (6)$$

The k th component of β'_n can be decomposed as $\beta'_{nk} = b_1 + \delta'\omega_n + \sigma\eta_{nk}$ if the coefficient is random, and it is simply $\beta'_{nk} = b_2$ if the coefficient is non-random (David and William 2003; Borah 2006). Here b_1 and b_2 represent the average taste in the population for the associated attribute; ω_n is a vector of choice-invariant characteristics that generates individual heterogeneity in the means of random coefficients β'_n ; D is the relevant parameter matrix; η_n is the vector of white noise, the source of random taste variation; and $\Gamma = \text{diag}(\sigma_1, \sigma_2, \dots, \sigma_k)$ is a diagonal matrix. To allow for correlated parameters, we need to specify Γ as a lower triangular matrix so that the variance-covariance matrix of the random coefficients becomes $\Gamma \Gamma' = \Sigma$. Non-random parameters in the model can be easily incorporated in this formulation by specifying the corresponding rows in D and Γ to be zero (Borah 2006). Thus, the conditional choice probability that individual n chooses alternative i , conditional on the realization of η_n , is given by

$$p(i | \eta_n, \theta) = \frac{\exp(\theta_i + \beta'_n \tilde{X}_{ni})}{\sum_{j \in M} \exp(\theta_j + \beta'_n \tilde{X}_{nj})} \quad (7)$$

where β'_n is as defined in (6), $\theta = (b, D, \Gamma)$ and η_n follows some distribution $G(\cdot)$ with mean vector $\mathbf{0}$ and variance-covariance matrix \mathbf{I} .

The unconditional choice probability (P_{ni}) of individual n choosing alternative i is given by

$$p_{ni} = \int_{\eta_n} P(j | \eta_n, \theta) dF_{\eta}(\eta_n) \quad (8)$$

where $F_{\eta}(\cdot)$ is the joint cdf of η_n . Thus, the choice probability under the MMNL model can be thought of as a weighted average of standard MNL probabilities with weights given by the mixing cdf $F_{\eta}(\cdot)$. Since the unconditional choice probability P_{ni} in (8) involves a multi-dimensional integral over the mixing distribution, the corresponding log-likelihood function does not generally have a closed form. Therefore, the choice probability P_{ni} is usually estimated through simulation and then maximizes the resulting simulated likelihood with respect to the

parameter vector. This model has been given detailed explanation by Borah (2006) and Train (2003).

With the development and application of computer simulation techniques, the MMNL model has been used increasingly in other fields over the past decade (Jan and Erik 2001; David and William 2003; Frode 2004). In the health care field, however, the use of this approach is very limited. Harris and Keane (1999) used such a model to study health insurance plan choice. Borah (2006) and Canaviri (2007) used the model to study health care provider choice in rural India and in Bolivia, respectively. Previous studies on modelling provider choice tend to use a simple multinomial logit (MNL) or nested logit and multinomial probit (MNP) models. The MNL requires that the well-known assumption of the 'independence of irrelevant alternatives' (IIA) be satisfied (McFadden 1974). Bolduc *et al.* (1996) find the assumption too strong in practice. While the nested logit can overcome the problem of the IIA, it has another drawback. The nests are specified *a priori*, which might induce some amount of subjectivity of the researcher, resulting in unreliable estimates (Jones 2000; Nevo 2000). Further, alternatives not located in the same nest are uncorrelated (McFadden and Train 2000). The MNP requires the normal distribution assumption for the random components of the utility, which may not be satisfied in some situations (Train 2003).

The MMNL model is more flexible than other discrete choice models in that the random components of the utility specification may be assumed to have any distribution, not just the normal distribution. This allows for flexible modelling of unobserved heterogeneity that results from unobserved or unrecorded factors such as quality of care, tastes and attitudes, waiting time, etc. (Borah 2006). The MMNL model can obtain the individual's preference for selecting a given option, and it also allows for flexible substitution patterns among alternative health care providers. Further, it can approximate any random utility model (McFadden and Train 2000). Therefore, in order to capture the taste or preference for distance factor and examine the impact of price of health care on the choice of health care provider in China, we have chosen the MMNL model to analyse the determinants of outpatient health care provider choice. The dependent variables are the outpatients' choice from the five options: self-treatment, public VC, private VC, township health centre and county hospital.

Data and variables

The data for this study come from a household survey in rural areas in Gansu province of China, conducted by Shandong University during the autumn of 2004. Gansu Province, located in northwest China, is one of the poorest provinces in China. Based on government statistics, the annual per capita net income of rural households in Gansu province was about 1673.05 yuan (US\$230) in 2003, which ranked 30 among 31 provinces, municipalities and autonomous regions in China (National Bureau of Statistics 2004). Following a multi-stage stratified random sampling framework, the survey collected information from 1007 households and 4376 individuals from 44 villages of 11 townships in 4 counties. Questions concerning children were answered by parents or guardians. The survey

focused on different aspects of health care, including maternity and child care, morbidity and utilization of health services. The survey also contained a rich set of socio-economic and demographic information on the respondents. Regarding non-hospitalized ailments, the survey collected information about the details of health care received, provider choice, and the corresponding amount of out-of-pocket expenditure relating to health care service use during the 30 days preceding the day of the survey.

In the case of infants, for example, it is difficult to measure their bed-days due to illness as representing severity of illness. Additionally, in our original data, only 12 patients were under-5s (accounting for 1.16% of total patients), a very small sample. Hence, we excluded under-5s in this study in order to examine accurately what factors prompt the choice of using a given provider. This approach can also be found in other similar studies (Sahn 2003). In the end, the sample used for MMNL analysis consists of 1015 users. Among these, 34.38% ($N=349$) opted for self-treatment, 26.11% ($N=265$) attended a public VC, 18.13% ($N=184$) a private VC, 11.63% ($N=118$) went to a township health centre, and 9.75% ($N=99$) sought care at a county hospital. Table 1 describes the variables used in the study.

Insurance status is divided into two main types: NCMS and no insurance (self-pay: fee-for-service). In our sample, only three outpatients had government health insurance (which covers government employees, retirees, disabled veterans) and nine outpatients had labour insurance (which covers employees, retirees, and their dependents, of state enterprises), forming 0.93% and 2.81% of those having any insurance, respectively. Therefore, we merged these outpatients into the NCMS category. General education level is recorded as a categorical variable, with about 6 and 9 years of education in primary and secondary education categories, respectively. Education level of the mother is used as a proxy for a child's education level because a child's decision to visit is mainly made by his/her mother (Sahn *et al.* 2003; Borah 2006). Occupations of respondents are divided into three groups (farmer, salaried, other). The salaried group includes village teachers, village cadres and rural migratory workers. The 'other' group includes children, students and other people with no ability to work. Distance is also measured through a set of dummy variables (see Table 1). Distance and price are the provider-specific variables in our estimated model. Since the survey did not collect data on the quality of care, the effect of perceived quality of care on the choice of providers is incorporated into unobserved factors in this study. Some variables are non-significant in the model estimated, and hence Table 2 only provides the respective summary statistics of the alternative specific constants and independent variables included in the final model.

As for the price of each option, the indirect costs (transportation, gifts and opportunity costs) were missing (not available) in many cases. Therefore, we do not include the indirect costs in our price variable. Only the direct costs (out-of-pocket medical expenditure, net of any insurance reimbursements) are included. While such prices are observable for actual users of a particular provider, there are no prices of alternative providers that an individual did not visit and hence they need to

be imputed or estimated. We use the log-linear regression specification to impute the relevant prices for non-users for some given providers. This method has been tested by other similar studies dealing with this issue (Deb and Holmes 1998; Hanson *et al.* 2004). The prices are specified as functions of patient demographic variables, income, insurance status, bed-days, illness-time and types of illness. Patient socio-demographic variables include age, sex, education, marital status and occupation. Regional dummy variables are included in order to capture geographic effects.

We first regress the observed log prices on a vector of the observed variables. Then the estimated equations are used respectively to predict the corresponding missing log prices. Following other similar studies (Gertler and van der Gaag 1990; Sahn *et al.* 2003), the price of self-treatment is normalized to zero, and thus there are four price equations related to other alternative providers that were estimated (these estimates are not shown here, but are available upon request).

Results

The MMNL model was estimated using SAS 9.1.3 Service Pack 4 (SAS Institute Inc., USA). In order to estimate the model using the simulated maximum likelihood method, 500 Halton draws are made for each sampled individual to generate the simulated choice probability. The self-treatment alternative is kept as the base alternative in the estimation and hence the coefficient estimates for the other four alternatives should be interpreted relative to self-treatment. The parameter estimates of the MMNL model are presented in Table 3. Through initial model estimation, we tested which variables should be included based on experiential studies and theoretical analysis. Extraneous variables (non-significant) will cause an increase in the variance of the prediction, though this will usually be very small. Therefore, non-significant variables were dropped and the model was re-estimated in order to find the most parsimonious model (Wooldridge 2007).

We allow the coefficients of the distance dummies to be random with normal distribution. These distance dummies are included in the regression to capture the possibility that an individual prefers a shorter distance to a health care provider than a longer one. We also examine the preference heterogeneity in the choice of health care providers, but no significant source of heterogeneity is found in our data. The distance dummies are provider-specific variables and hence we keep these coefficients constant across providers. The mean and standard deviation (SD) of parameter distributions for the coefficients of the distance dummies are estimated (shown in Table 3). $DIST_{j_M}$ ($j=2,3,4$) denotes the mean value for $DIST_j$, and $DIST_{j_S}$ ($j=2,3,4$) denotes the corresponding SD. Each of the mean value coefficients associated with the distance dummies is significant for each provider model. This implies that distance to the provider plays a significant role in the choice of health care provider. Moreover, the absolute value of these coefficients increases as we move from $DIST_2$ to $DIST_4$, indicating that the longer the distance, the higher is the reduction in demand. All the mean value coefficients are significantly negative. This reflects the situation that even after considering the good reputation that more distant providers

Table 1 Variable definitions

Variable	Variable definitions
Type of provider	
Self-treatment	= 1 if self-treatment is chosen; = 0 otherwise
PUBVC	= 1 if the public village clinic is chosen; = 0 otherwise
PRIVC	= 1 if the private village clinic is chosen; = 0 otherwise
Township health centre	= 1 if the township health centre is chosen; = 0 otherwise
County hospital	= 1 if the county hospital is chosen; = 0 otherwise
Price _j	price of alternative j, where price is out-of-pocket medical expenditure, net of any insurance reimbursements. j = self-treatment, PUBVC, PRIVC, township health centre, county hospital. The price of self-treatment is normalized to zero.
Income	household's annual per capita income
C _j	=(Income - Price _j) $\forall j$ = self-treatment, PUBVC, PRIVC, township health centre, county hospital
lnC _j	=ln(Income - Price _j) $\forall j$ = self-treatment, PUBVC, PRIVC, township health centre, county hospital
(lnC _j) ²	=[ln(Income - Price _j)] ²
Age	age in years
Male	= 1 if male; = 0 otherwise
Married	= 1 if married; = 0 otherwise
Occupation	
Farmer*	= 1 if farmer; = 0 otherwise
Salaried	= 1 if salaried worker; = 0 otherwise
Other	= 1 if children, students, and other people of no ability to work; = 0 otherwise
Education of injured/ill person or mother	
Illiterate*	= 1 if illiterate; = 0 otherwise; omitted group
Elementary	= 1 if elementary school, 1–6 years; = 0 otherwise
Secondary	= 1 if secondary school, 7–9 years and above, = 0 otherwise
Household size	the number of family members
Insurance status	
Self-pay*	= 1 if fee-for-service patients; omitted group
NCMS	= 1 if covered by NCMS; = 0 otherwise
Types of illness	
Fever*	= 1 if individual suffered from fever; = 0 otherwise; omitted group
Chronic	= 1 if individual suffered from chronic illness; = 0 otherwise
Other illness	= 1 if individual suffered from other illness; = 0 otherwise
Illness-time	= 1 if illness started before the reference period; = 0 otherwise
Bed-days	number of days the individual is confined to bed due to illness
Distance	(The distance for self-treatment is normalized to zero)
DIST 1 _j *	= 1 if 0 km < distance < 1 km; = 0 otherwise $\forall j$ = PUBVC, PRIVC, township health centre, county hospital
DIST 2 _j	= 1 if 1 km \leq distance < 3 km; = 0 otherwise $\forall j$ = PUBVC, PRIVC, township health centre, county hospital
DIST 3 _j	= 1 if 3 km \leq distance < 10 km; = 0 otherwise $\forall j$ = PUBVC, PRIVC, township health centre, county hospital
DIST 4 _j	= 1 if 10 km \leq distance; = 0 otherwise $\forall j$ = PUBVC, PRIVC, township health centre, county hospital

*These variables are reference groups in the MMNL model.

$\forall j$ means it is true for all j.

might have, people are, on average, averse to distance and their aversion increases as distance increases. This result is in line with the situation in rural areas in Gansu province, where there are many mountainous areas and rural residents are usually far from township health centres, especially county hospitals. To a large extent, these county hospitals deter rural patients from visiting them due to the long distances involved and poor roads.

According to the standard deviation of parameter distributions, *DIST3_S* is significant in the model. Thus, the coefficient of *DIST3* is distributed as $N(-0.8447, 1.1769^2)$. Using the attributes and formulae of normal distribution, the probability that this coefficient is positive is about 28%. This implies that distance of 5~10 km to a medical institution is disliked by some 72% of the rural population. Those who choose to visit a health care provider within this range of distance might

Table 2 Descriptive statistics

Variable	Mean	SD	Min	Max
Self-treatment	0.34	0.46	0	1
Public village clinic (PUBVC)	0.26	0.44	0	1
Private village clinic (PRIVC)	0.18	0.39	0	1
Township health centre (THC)	0.12	0.32	0	1
County hospital	0.10	0.30	0	1
Price of self-treatment	0	0	0	0
Price of PUBVC	50.43	63.89	1.01	544.41
Price of PRIVC	58.17	68.49	2.00	600.00
Price of THC	99.27	89.05	3.00	835.29
Price of county hospital	229.45	147.15	12.00	1900.00
Income	1552.74	1179.57	74.00	9650.00
Age	41.71	19.06	5	86
Married	0.70	0.46	0	1
NCMS	0.32	0.47	0	1
Fever	0.34	0.48	0	1
Chronic	0.32	0.48	0	1
Other illness	0.34	0.48	0	1
Illness time	0.56	0.50	0	1
Bed-days	2.89	6.22	0	30
DIST1_PUBVC	0.63	0.49	0	1
DIST1_PRIVC	0.28	0.45	0	1
DIST1_THC	0.23	0.42	0	1
DIST1_County hospital	0.00	0.07	0	1
DIST2_PUBVC	0.34	0.47	0	1
DIST2_PRIVC	0.61	0.49	0	1
DIST2_THC	0.11	0.31	0	1
DIST2_County hospital	0.01	0.09	0	1
DIST3_PUBVC	0.03	0.18	0	1
DIST3_PRIVC	0.10	0.31	0	1
DIST3_THC	0.59	0.49	0	1
DIST3_County hospital	0.13	0.33	0	1
DIST4_PUBVC	0.00	0.03	0	1
DIST4_PRIVC	0.01	0.11	0	1
DIST4_THC	0.07	0.25	0	1
DIST4_County hospital	0.86	0.35	0	1

consider that the provider has a good reputation in treating their disease. However, the other distance coefficients as the estimates of standard deviations are not significant.

The coefficient of NCMS is statistically significant and has a positive sign in the public VC model. This indicates that an individual who has NCMS coverage has a higher probability of visiting a public VC relative to self-treatment than an individual who has no medical insurance. This reflects the fact that outpatients covered by NCMS face a more highly discounted (i.e. lower) price at public VCs (Mao *et al.* 2006) and hence they are more likely to seek care from them. Therefore, the coefficients of NCMS are not significant in other provider models.

Relative to self-treatment, the marital status of rural patients is also a significant factor, affecting the choice of county hospitals at the 0.10 level of significance of test. The positive coefficient of the married variable implies that married outpatients, on average, have a higher probability of visiting county hospitals relative to self-treatment than unmarried outpatients (including divorced, widowed, etc.) in rural areas.

An increase in age reduces the probability that an individual chooses any of the four providers relative to self-treatment for rural outpatients. From the view of comparison between the four providers, the absolute value of the coefficient of age for the county hospital is maximal, indicating that an individual, on average, has a lower probability of visiting the county

Table 3 Health care demand models

Variable	Health care providers			
	Public village clinic	Private village clinic	Township health centre	County hospital
Constant	0.5131 (1.88)*	0.2609 (0.87)	-0.2833 (-0.75)	-1.2127 (-1.64)
Married	0.2924 (1.41)	0.2270 (1.02)	0.2485 (0.79)	0.8025 (1.90)*
NCMS	0.4263 (2.19)**	-0.1494 (-0.66)	-0.2897 (-0.95)	-0.0460 (-0.14)
Age	-0.0124 (-2.30)**	-0.0119 (-2.06)**	-0.0150 (-2.01)**	-0.0358 (-3.40)***
Chronic illness	0.5739 (1.80)*	0.9238 (2.59)***	1.3085 (2.90)***	2.7439 (4.11)***
Other illness	1.0833 (3.50)***	1.6850 (5.09)***	1.7748 (4.15)***	3.6390 (5.58)***
Illness time	-0.9605 (-3.22)***	-0.8707 (-2.70)***	-0.9816 (-2.43)**	-0.3511 (-0.86)
Bed-days	0.0622 (3.88)***	0.0657 (3.77)***	0.0757 (3.61)***	0.1175 (6.88)***
DIST2_M	-0.3531 (-1.95)**	-0.3531 (-1.95)**	-0.3531 (-1.95)**	-0.3531 (-1.95)**
DIST3_M	-0.8447 (-2.02)**	-0.8447 (-2.02)**	-0.8447 (-2.02)**	-0.8447 (-2.02)**
DIST4_M	-1.1694 (-2.83)***	-1.1694 (-2.83)***	-1.1694 (-2.83)***	-1.1694 (-2.83)***
lnC	1.0211 (8.35)***	1.0211 (8.35)***	1.0211 (8.35)***	1.0211 (8.35)***
(lnC) ²	-0.0566 (-4.52)***	-0.0566 (-4.52)***	-0.0566 (-4.52)***	-0.0566 (-4.52)***
SD of parameter distributions				
DIST2_S	0.2871 (0.25)			
DIST3_S	1.1769 (1.75)*			
DIST4_S	0.0084 (0.00)			
N	1015			
Log likelihood	-1384			
Adjusted Estrella R ²	0.3613			

Notes: t-statistics in parentheses.

***significant at 1%; **significant at 5%; *significant at 10%.

hospital than of visiting the other providers as his/her age increases (holding all other factors constant).

Chronic patients have a higher probability of visiting any of the four providers relative to self-treatment than patients with fever (an acute illness). Moreover, the coefficients of chronic illnesses for private VC, township health centre and county hospital are significant at the 0.01 level. Relative to self-treatment, patients in the 'other illness' group also have a higher probability of visiting any of the four providers than fever patients (at the 0.01 level of significance). According to the absolute value of the coefficients of the chronic and other illness variables, on average, the order of probability of an individual choosing a provider, from high to low, is county hospital, township health centre, private VC, public VC, respectively.

An individual with an ailment which started before the reference period has a lower probability of visiting a public VC, private VC, or township health centre relative to self-treatment than an individual whose ailment started within the reference period (of which the coefficients of public VC and private VC are significant at the 0.01 level of significance). This indicates that if the ailment started before the reference period, the patient is more likely to choose self-treatment relative to the above three types of providers. However, the illness-time variable has no significant effect on patients' choice of county hospital relative to self-treatment.

Bed-days reflect the severity of the illness. Bed-days are quite a significant factor, affecting the choice of the four types of providers relative to self-treatment at the 0.01 level of

significance. The coefficients of bed-days for the four types of providers are positive, indicating an individual may be more likely to seek health care services from these providers relative to self-treatment. Between the four types of providers, an individual has a higher probability of visiting the county hospital as his/her bed-days increase according to the absolute value of the coefficients of bed-days. And then, from high to low, the order is township health centre, private VC, public VC, respectively.

The coefficients of log C and its square $(\ln C_j)^2$ are considered as non-random in our model and are statistically significant at the 0.01 level. Since $C=Y$ (income) $-P$ (price), this implies that price and income do play an important role in the demand for outpatient care. Since price and income enter the model in a non-linear fashion, it is difficult to make any assessment by just looking at these coefficients, so we compute price elasticity of the choice probabilities for different income groups, and we compute arc price elasticity, evaluated with all variables set at their mean value. Because the substitution between self-treatment, public VC and private VC is the same in our model, we only compute own price elasticity. Table 4 gives estimates of demand elasticity for the four providers, but not self-treatment, when price increases by 10, 20, 50 and 100 yuan, respectively. These elasticities measure the effect of price on the demand for each health care option.

It is apparent from Table 4 that the price elasticity of lower-income groups is higher than that of higher-income groups, suggesting that people in lower-income groups are more price-sensitive in their demand for the given health care options than

Table 4 Price elasticities of health care demand by income group

Place/range of price increase (yuan)	Low income	Middle income	High income
Public village clinic			
10	-0.1719	-0.1012	-0.0131
20	-0.1888	-0.1112	-0.0688
50	-0.2403	-0.1419	-0.0837
100	-0.3284	-0.1954	-0.1063
Private village clinic			
10	-0.1813	-0.1071	-0.0663
20	-0.1973	-0.1165	-0.0709
50	-0.3678	-0.2173	-0.1255
100	-0.3928	-0.2462	-0.1439
Township health centre			
10	-0.3741	-0.2215	-0.1183
20	-0.3939	-0.2335	-0.1228
50	-0.4535	-0.2702	-0.1357
100	-0.5527	-0.3331	-0.1551
County hospital			
10	-0.8664	-0.5131	-0.1613
20	-0.8895	-0.5275	-0.1626
50	-0.9586	-0.5711	-0.1663
100	-1.0705	-0.6455	-0.1708

those in higher-income groups. For example, when the price of public VC rises to 20 yuan (holding all other factors constant), the price elasticity of the public VC in the low-income group is -0.1888, and that in the high-income group is -0.0688. This indicates that a higher price has a larger effect on the poor than on the rich.

From Table 4, we can see that the price elasticities become higher as the prices of each provider type increase, especially in the low-income group. Between the different provider types, the price elasticity of the county hospital is highest. The order from high to low is then township health centre, private VC and public VC. This suggests that changes in price at the county hospital have the strongest effect on the demand for its health care by rural outpatients, and changes of price at township health centre, private VC and public VC, respectively, have smaller effects on the corresponding demand.

Discussion

In this study, we used an MMNL model to examine the determinants that influence health care demand decisions in rural areas of Gansu Province, China. This represents the first attempt to identify and quantify the effect of price of care on the choice of provider in China, and is also the first quantitative examination of this topic focusing on poor rural areas in China, thus providing important new information for policy-makers. The study's main limitations are that data on indirect costs of medical care and perceived quality of care are not included. Future studies will need to take these dimensions into account.

We apply the MMNL model as previously done by Borah (2006) and Canaviri (2007). Using the random coefficients in the MMNL model, we have captured outpatients' preference regarding distance as a factor in provider choice in rural Gansu Province, including all the main providers in the rural health care system – county hospital, township health care and both public and private VCs. We also estimated the average proportion of individuals who prefer a particular attribute. Further, we computed the price elasticity of demand.

Distance should be an attribute that everyone dislikes. However, some people may prefer to visit a more distant provider if that provider has a better reputation (or skills) and their individual health status is such that only that provider can treat their illness. Thus, the (random) distance coefficient may be assumed to have normal distribution. This justification, however, hinges on the assumption that medical resources have a heterogeneous distribution across rural areas, with 'quality' providers concentrated in large towns or cities. The latter assumption seems to be reasonable in the context of rural China's health system (Ban 1999; An *et al.* 2004). Under the normality assumption for the random distance coefficients in our MMNL model, which further assumes a heterogeneous distribution of medical resources including those of 'quality' (or 'reputed') providers across rural areas, the (random) distance coefficients not only reflect preference for a given distance, but also preference for providers with good reputation. Additionally, the distance coefficient in our MMNL framework is actually a measure of composite preference of distance and reputation, thus it is necessarily biased upward as a measure of preference for distance (Borah 2006).

According to the present NCMS system design, farmers have the freedom to choose whether to participate in the NCMS, but such freedom is limited by the regulation that enrolment is by family, so as to prevent adverse selection (He 2005). In this study, the numbers of enrollees and non-enrollees to NCMS with reported chronic illness were 101 (31.4%) and 221 (68.6%), respectively. Therefore, there is no evidence to indicate the problem of adverse selection in our data.

The study's main results can be summarized as follows:

- Price is a significant determinant of health care demand in poor rural areas in China.
- Price elasticity of health care is higher for low-income groups than for high-income groups. The price and the price elasticity changes of private VCs are close to those of public VCs. Among the different provider types, the price elasticity for the county hospital is highest.
- Individuals with lower incomes have a higher probability of seeking self-treatment relative to formal treatment, and a higher probability of visiting village-level clinics relative to high-level health institutions. Private VCs play an important role in providing services for the low- and middle-income groups.
- Distance is an important determinant of health care demand. The preference that some people have concerning distance implies that for those who have special concerns about the quality or reputation of providers, or when their health status is poor, distance tends to matter less.
- Enrolment in NCMS significantly increases an individual's probability of seeking treatment at a public VC relative

to self-treatment. This result is of particular interest for poor rural areas. It is known that financial difficulties of individuals in poor rural areas lead to under-utilization of health services (Ministry of Health 2003; Liu *et al.* 2004). Therefore, increasing the visits of these individuals to formal health care providers is likely to improve their health status.

- Older people have a higher probability of visiting lower level providers or choosing self-treatment.
- The attributes or types of illness have a significant effect on patients' choice of health care providers. For example, fever patients have a lower probability of visiting any of the four providers relative to self-treatment than chronic patients and other illness patients.

Policy implications

These findings have a number of major policy implications. Firstly, measures need to be taken by government to decrease out-of-pocket payments for health care in order to benefit the poor. The government should increase investment in health care in poor rural areas, and launch relevant medical aid projects to help those in poverty. Among the three levels of health care institutions, village-level clinics usually have the lowest quality of care (Yip *et al.* 1998). Our study shows that individuals with lower incomes have a higher probability of visiting village-level clinics. Therefore, enhancing the quality and service of village-level clinics will benefit those of lower income in particular, thus improving the equity of the health care system.

Since private VCs play an important role in providing services for the low- and middle-income groups, further measures should be taken to promote their development; for example, enhancing their service capability and quality. In addition, qualifying private VCs should be included in the NCMS benefit package.

Since enrolment in the NCMS has a significant effect on utilization of public VCs, the NCMS should consider providing more generous coverage for villagers at these clinics to encourage them to visit these facilities rather than higher-level providers. According to Meng *et al.* (2004), village-level visits focus mainly on preventive and primary care, and these services are usually cost-effective. Therefore, it is advisable to encourage villagers to visit village-level clinics through the NCMS.

In order to improve rural residents' access to health care services, it is important to locate health facilities and personnel rationally, and to reduce the obstacle of distance in access to health care. The preferences that some people have regarding distance indicate that it is important to improve the quality or reputation of local providers in order to make local residents utilize them.

China still lacks a system of support for the rural elderly. It is generally acknowledged that the rural elderly are one of the most disadvantaged groups in China. According to the China National Health Household Interview Survey in 2003, the fact that doctors are 'expensive and hard to visit' is a major reason why rural patients choose self-treatment (Ministry of Health 2003). It is easy to believe that rural elderly people choose self-treatment or visit lower level providers mainly for reasons

related to finance or ease of access. Therefore, in order to improve equity and access to health care for this group, the government needs to target them specifically, for example by establishing a medical aid project to address the financial and geographical barriers to care that they face.

Finally, the results on the attributes or types of illness also have important implications for the health care system. Providers at village and township levels need to change their service model and enhance their service capability in order to adapt to the different types of patients in need of health care. Similarly, the planning of health resources allocation needs to be responsive to patients' health care demand in order to improve access to health services.

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