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The Demand for Medical Care in Urban China

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Summary. — The link between health and productivity on the one hand, and the growing demand for health services and the shortage of funds to finance the health care system on the other hand pose a major challenge for developing countries. This paper uses a data set that consists of detailed characteristics of 6,407 urban households from People's Republic of China to investigate the determinants of the demand for medical care. A two-part model and a discrete factor model are used in the estimation. Income elasticity is around 0.3, indicating medical care is a necessity. Medical care demand is price inelastic, and price elasticity is larger in absolute value for poorer households. This suggests that while total revenue from provision of health care can be increased by raising the price of care in the inelastic segment of the demand curve, this would increase the inequality in access to medical care.
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Key words — Asia, China, health, medical care, income elasticity

1. INTRODUCTION

There has been a growing concern among policy makers both in developed and developing countries regarding the rapidly increasing national spending on medical care and rising medical care costs. To suggest policies that may help the financing of the health care delivery system without creating burdens on low income groups, researchers have been investigating the determinants of health care demand and spending (e.g., Colle & Grossman, 1978; Di Matteo & Di Matteo, 1998; Kenkel, 1990; Manning, Newhouse, Duan, Keeler, & Leibowitz, 1987; Wagstaff, 1986; Wedig, 1988). The issue is especially important for developing countries which face an increasing demand for health services, coupled with a lack of funds to finance the health care system due to adverse macro-economic conditions (Abel-Smith, 1986). Consequently, a significant amount of research has been devoted to the investigation of the determinants of the demand for medical care in developing countries (Akin, Griffin, Guilkey, & Popkin, 1986; Akin, Guilkey, & Denton, 1995; Dor, Gertler, & Van der Gaag, 1987; Gertler, Locay, & Sanderson, 1987; Musgrove, 1983; Sauerborn, Nougtara, & Latimer, 1994).

Given the link between health and labor supply and productivity (Deolalikar, 1988; Pitt & Rosenzweig, 1986; Pitt, Rosenzweig, & Hassan, 1990; Strauss, 1986), it is important to understand the economic determinants of

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health and the derived demand for medical care, especially in developing countries. Critical questions for developing economies include whether health care is a luxury good, what the magnitude of the price elasticity of demand for medical care is, and whether this elasticity differs by income level within the country. There is no consensus on the magnitude of the income elasticity of health care obtained from cross-country data (Blomqvist & Carter, 1997; Di Matteo & Di Matteo, 1998; Hitiris & Posnett, 1992; Newhouse, 1977; Parkin, McGuire, & Yule, 1987). This paper is one of the few that exploits a household-level data set with alternative measures of income. This enables the estimation of the income elasticity, while addressing the issue of potential endogeneity of income. Price elasticity is an important piece of information for developing countries where health care is subsidized by the government. For example, in developing countries fees charged at public health facilities are typically below the marginal cost. This is believed to create a superficial demand for services, that can be reduced by raising the price of care (Musgrove, 1986). If a price increase does not generate significant reductions in the use of health services, then it constitutes a legitimate option to collect revenue to (partially) finance the health care delivery system.

Analysis of China in this context is important because it creates an opportunity to investigate the issues outlined above in a transition economy. Furthermore, the richness of the data set employed in this paper provides information which is not available from other developing countries. After China started its economic reforms in the late 1970s, and especially after the State Council approved the "Report on the Permission of Private Medical Practices" submitted by the Ministry of Public Health in 1980, a private medical market began to emerge. For example, in Shanghai four private hospitals appeared in 1984; by 1989 the number rose to 15. There were 110 private hospitals in China in 1990 (Liu, Liu, & Meng, 1994). The transition to a more market-oriented health care system in China coincided with increased demand for medical care services, partly due to increased disposable incomes. It also coincided with increased medical care costs. China spent 3.5% of its GNP on health care in 1990 (World Bank, 1993). Since the inception of government and labor health insurance schemes in 1951–52, spending on these insurance programs increased from 270 million yuan in 1952 to 22.4 billion yuan in 1989: an average 12.7% annual rate of increase (Liu & Hsiao, 1995).

Although there exists research on the determinants of health care coverage and health services utilization in China (Davis, 1988; Henderson *et al.*, 1998; Lin & Bian, 1991), very little information on the demand for medical care is available. [1] In this paper we employ very detailed household-level data, which include a continuous measure of health care spending as well as price. Employing two estimation methods we report the impact of a host of household characteristics on the demand for medical care along with price and income elasticities. Section 2 describes the theoretical model and empirical framework. Section 3 describes the data set, Section 4 presents the results, and Section 5 is the conclusion.

2. EMPIRICAL IMPLEMENTATION

Based on Grossman's seminal work (Grossman, 1972a, 1972b) an individual's utility function is assumed to depend on a consumption commodity and sick time. Sick time, in turn, depends on the level of health capital. Net investment in the stock of health capital depends on gross investment, depreciation, and environmental factors. Individuals are assumed to produce gross investment in health by combining their own time with purchased medical care and food. This formulation gives rise to the structural demand for health and the derived demand for medical care. The reduced form equation for medical care can be derived from structural demand. It can be depicted as: [2]

$$M = m_r(P^{\mathrm{m}}, P^{\mathrm{f}}, P^{\mathrm{time}}, t, X, E), \tag{1}$$

where M stands for the demand for medical care, P^{m} is the price of medical care, P^{f} stands for the price of food, P^{time} is opportunity cost of time, t stands for age, X is a vector of environmental factors, and E represents the variables that influence the productivity of health investment, such as the stock of human capital. Our empirical analysis involves estimation of Eqn. (1), using a data set that contains information on 6,407 households in urban locations of the People's Republic of China.

The demand for medical care can be measured in different ways. Estimation of a demand for medical care equation requires the treatment of zero expenditures if demand is measured as medical care expenditures. Researchers

have dealt with this issue by either estimating two-part models, or selection models. The use of the two-part model assumes that the decision to spend (the participation equation) is independent of the decision on the level of spending. Although the two-part model can be criticized on the grounds of this potentially restrictive assumption (e.g., Hay & Olsen, 1984; Maddala, 1985), it has been shown that estimation of a two-part model does not have a significant impact on the results (Duan, Manning, Morris, & Newhouse, 1984), and that if the true model is of the selection type, then the two-part model provides a good estimate of the response surface (Manning, Duan, & Rogers, 1987). In addition to its robustness, another appealing feature of the two-part model is that it allows an investigation as to whether variables of interest have larger impacts on the participation or consumption decisions (Manning, Blumberg, & Moulton, 1995). Thus, two-part models are frequently employed benchmarks in health economics research that involves observations with a cluster at zero.

The main objection to the selection models centers around the fact that they assume a bivariate normal distribution between the error terms (Duan, Manning, Morris, & Newhouse, 1983), and they are known to be sensitive to departures from normality (Goldberger, 1983). In this paper we also estimate a discrete factor method (DFM) (Heckman & Singer, 1984; Mroz, 1999). The discrete factor model allows for selection, but unlike standard selection corrections, DFM estimates a semi-parametric distribution to approximate the distribution between the error term of the selection and spending equation. Mroz (1999) demonstrates that when the true distribution of the error terms is normal, DFM performs well in comparison to estimators which assume normality; and DFM performs better than normality-based estimators when the underlying distribution is nonnormal. (See Blau and Hagy (1998), Hu (1999) and Mocan and Tekin (2003) for applications of the DFM.)

The empirical framework can be summarized as follows. The latent variable I_i is a function of a set of explanatory variables X, and error term ϵ_1, where i represents the households.

$$I_i = X_i\alpha + \epsilon_{1i}. \tag{2}$$

A dichotomous variable D_i is defined as $D_i = 1$ if $I_i > 0$ (households with positive health care spending), and $D_i = 0$ otherwise. For those households with positive health care spending, the log-level of spending is determined by

$$\ln(S_i|D_i = 1) = X_i\beta + \epsilon_{2i}, \tag{3}$$

where S stands for spending on medical care ($S = MP^{\mathrm{m}}$ where M is the quantity and P^{m} is the price of medical care), and ln stands for natural logarithm. Identification of the model is discussed in the results section.

Estimation of a two-part model treats the first equation as a logit, where the probability of the discrete event of positive medical care spending is explained as

$$\mathrm{Prob}(D_i = 1) = \exp\{X_i\alpha\}/[1 + \exp\{X_i\alpha\}], \tag{4}$$

where X is a row vector of explanatory variables. In this framework, the expected value of the unconditional spending is $E(S_i) = \mathrm{Prob}(D_i = 1)E(S_i|D_i = 1)$. Taking the natural logarithm of (4) yields

$$\ln[\mathrm{Prob}(D_i = 1)] = X_i\alpha - \ln[1 + \exp\{X_i\alpha\}]. \tag{5}$$

If a particular explanatory variable x is in logs, the elasticity of $\mathrm{Prob}(D_i = 1)$ with respect to x is equal to $\alpha[1/(1 + \exp\{X_i\alpha\})] = \alpha[1 - \mathrm{Prob}(D = 1)]$. In Eqn. (3), if x is in logs, the elasticity of S with respect to x is β. Thus, the unconditional elasticity is

$$\eta = \alpha[1 - \mathrm{Prob}(D = 1)] + \beta. \tag{6}$$

If the explanatory variable x is not in logs, then using (5) it can be shown that the elasticity of $\mathrm{Prob}(D_i = 1)$ with respect to x is $\alpha[1 - \mathrm{Prob}(D = 1)]x$. Using (3) it can be seen that the elasticity of S with respect to x is (βx). Thus, the unconditional elasticity in this case is

$$\eta = [\alpha\{1 - \mathrm{Prob}(D = 1)\} + \beta]x. \tag{7}$$

The unconditional elasticity of medical care with respect to price, on the other hand, is calculated as

$$\eta = \alpha[1 - \mathrm{Prob}(D = 1)] + (\beta - 1). \tag{8}$$

This can be seen by noting that the demand for medical care is estimated as $\ln M = \gamma + \beta \ln P^{\mathrm{m}}$, where M is the quantity of medical care, and P^{m} stands for its price. Adding $\ln P^{\mathrm{m}}$ to both sides of this equation yields $\ln M + \ln P^{\mathrm{m}} = \gamma + (\beta + 1)\ln P^{\mathrm{m}}$. The left-hand side of this equation is $\ln(MP^{\mathrm{m}})$, which represents the logarithm of the spending on medical care, which is the dependent variable to be employed in this paper. Thus, to recover the price elasticity of medical care from the

spending equation, −1 should be added to the coefficient of the price in spending equation (3).

Alternatively, the DFM is based on the assumption that the decisions described by Eqns. (2) and (3) are done jointly, rather than sequentially. In this case, a common unobservable is assumed to influence the decision to spend as well as the amount of spending. To account for this potential correlation in the errors of the two equations, we model the error structure as

$$\epsilon_{1i} = u_{1i} + \rho_1 v, \qquad \epsilon_{2i} = u_{2i} + \rho_2 v, \tag{9}$$

where u_1, u_2 and v are mutually independent disturbances with mean zero, and v symbolizes the common factor that impacts error terms ϵ_1 and ϵ_2. ρ_1 and ρ_2 are factor loadings which allow for the impact of the common factor v to vary among equations. u_1, u_2 and v are also independent of the explanatory variables. Following Heckman and Singer (1984), we assume that v is governed by a discrete distribution

$$\text{Prob}(v = \mu_k) = \pi_k; \quad k = 1, \ldots, K; \;\; \pi_k \geqslant 0, \;\; \sum_k \pi_k = 1. \tag{10}$$

μ_k are the points of support of the distribution, and π_k are the probability weights. The μ_k's, π_k's, ρ_1 and ρ_2 are parameters to be estimated. K, which is the number of support points, is specified a priori, and we estimate the models for alternative values of K. The two equations are estimated jointly with full-information maximum likelihood. The unconditional elasticities are provided by the estimated coefficients of the spending equation.

3. THE DATA

A cross-sectional micro-data survey of urban families in the People's Republic of China was conducted in the spring of 1989 for the principal purpose of providing more complete measures of welfare than had previously been available. To this end, the survey collected detailed information regarding demographic characteristics of the members of the household, their income, earnings, food consumption and prices, as well as medical expenditures and types of health insurance held by the members. The survey covered 6,407 urban households. The households were themselves part of the national panel of urban households used by the State Statistical Bureau of China for its regular survey program. But, this particular survey was administered to these households by local statistical bureaus. Administrative complexity and financial restrictions limited the survey to 71 cities in 10 of China's 30 provincial-level administrative regions. [3] The provinces were selected to provide a representative sample from the wide variations in geographical conditions and economic development in China. [4]

Total household medical spending depends on the type of insurance used by the members of the household. Health care coverage in urban China is provided through the place of employment, and as explained by Whyte and Parish (1984) and Hsiao (1995), there is significant variation in coverage of workers and their dependents as a function of the sector of employment. There are two main types of health insurance schemes in urban China: the Government Employee Health Insurance System and the Labor Insurance System. In general, those employed at state economic enterprises have almost all their medical expenses covered by the Labor Insurance System, and pay only a nominal registration fee to initiate treatment. They also get half of most medical expenses for their dependents covered. Government employees, such as teachers, government clerks and other workers in noneconomic units are covered by the Government Employee Health Insurance System. In most cases they have to pay for their own dependents. Individuals working in collective enterprises may have similar coverage, partial coverage or no coverage at all depending upon the history and resources of the local unit and neighborhood (Whyte & Parish, 1984, p. 65).

There exist substantial differences regarding the extent of coverage within insurance type and within regions. For example, state-run enterprises with high profits often provide comprehensive benefits, but unprofitable enterprises may only be able to offer partial coverage with high cost-sharing levels. Similarly, poor enterprises often do not cover dependents at all (Grogan, 1995, p. 1079). Differences also exist between co-payment policies across regions. For example, individuals with government or labor insurance have on the average 90% of their outpatient fees covered in the province of Jiangsu, whereas the rate is 76% in the province of Hubei (Henderson *et al.*, 1995).

Individuals who are not covered by health insurance are required to pay for their own

health expenses. They include self-employed, the unemployed, migrant workers and employees of private, foreign and in some cases jointly owned enterprises (Yuen, 1996). Henderson *et al.* (1995) reports that 30% of the individuals living in capital cities or small cities have no insurance.

The descriptive statistics of the variables used in the econometric analysis are reported in Table 1. Insurance type is controlled by four variables: the number of members in the household covered by publicly financed medical care, the number of household members who pay part of medical costs, the number of members who pay all medical costs, and the number of household members who use other forms of provision of care. As explained by Newhouse, Phelps, and Marquis (1980), the expected medical care consumption and the choice of the type of insurance may be jointly determined, which would bias the estimated coefficients. In our case, however, the type of health insurance is attached to the job. Therefore, to the extent that workers do not choose sectors of work based on the health insurance concerns, insurance type is an exogenous variable in our analysis.

Twenty-eight percent of the 6,407 households report zero medical spending. The sample average of medical spending is 51 yuans per year per household, with a standard deviation of 256, including zero expenditures. The average expenditure on medical care for the households that report positive spending is 71.5 yuans. For this group, the spending at the bottom 25th percentile is 7.3 yuans, the median spending is 26 yuans, and the 75th percentile is 70 yuans.

Most of the members of the zero-spending households are covered by publicly financed health insurance. For example, in 91% of these households there is at least one individual who is covered by publicly financed medical care. Seventy-five percent of these households involve at least two individuals who are covered by such insurance. Seventy-eight percent of them report that they have no member who pays all medical costs, and 51% declare the absence of members who pay part of the medical costs. The individuals who pay all their own medical expenses are asked about the basic fee they paid for a visit to a local clinic during the last month. Only 9% of the households with zero spending on medical care answered that question, whereas 53% of the relevant households with positive spending provided an answer. [5]

It is well known that the existence of deductibles and coinsurance may generate endogeneity of the price of medical care, which may in turn bias the estimated price elasticity. Studies on the demand for health services have struggled to find an exogenous price measure that is not correlated with usage. It has been observed that it is difficult to find a truly exogenous price measure, unless the consumers are randomly assigned to various insurance categories, as was the case in the Rand Health Insurance Study in the United States. As argued above, the institutional structure of the Chinese health care delivery system suggests the exogeneity of insurance. In this case, the price of medical care net of insurance can be approximated by the average coinsurance rate. Because we implicitly control for the variation in coinsurance by including into the model the four insurance classifications described above, the price of medical care is measured by the unit price in the private market. In the survey that created our data set, household members who pay all their medical costs are asked about the basic fee they paid for their last visit to the local clinic. The average value of the responses to this question is used as the unit price of medical care. For the households where no response was recorded, the average price of the province is assigned. [6]

For each household, the data set contains information on the monthly average consumption of various food items and their prices. Furthermore, types of food are classified into two categories depending upon whether they are purchased with coupons in state-owned stores, or purchased at the free market. For purchases in state-owned stores, the average price paid in 1988 (in yuan) and the average monthly consumption (in jin) of wheat, rice, and other staple food, edible oil, pork, beef and mutton, poultry, fish and seafood, sugar and vegetables are recorded. The quantities and prices of the same items were recorded for purchases at the free market, with the exception that wheat is replaced by flour. Using these prices and quantities purchased, a food price index is created as follows. $P_i = k_1 P_{1i} + k_2 P_{2i} + \cdots + k_m P_{mi}$, where P_i stands for the food price for the ith household, P_{mi} is the price of the mth food item for the ith household, k_j is the sample share of the jth food ($j = 1, \ldots, m$). Thus, k_j is total spending on the jth food by all households, divided by total food spending of all households.

To measure the opportunity cost of time for the household we included the following

Table 1. *Descriptive statistics*

Variable	Definition	Mean	Standard deviation
SPENDING (yuan/year)	Total cost of medical care borne by all members of the household	51.46	256.23
MEDPRICE (yuan/visit)	Price of medical care. It is the average basic fee paid for a visit during the last month prior to the interview by household members who paid all medical expenses. If no such member is present, province average fees are substituted	17.92	22.52
PUBFIN	Number of household members covered by publicly financed medical care	2.00	1.13
PARTPAY	Number of household members who pay part of medical costs	0.72	0.89
ALLPAY	Number of household members who pay all medical costs	0.55	0.91
OTHERCARE	Number of household members using other forms of provision of medical care	0.30	0.74
FOODPRICE (yuan/jin)	Weighted average of the unit prices (per jin) of wheat, rice, flour and other staple food, and edible oil, pork, beef and mutton, poultry, fish and seafood, sugar and vegetables; weighted by the share in food total expenditures	0.62	0.30
SPOUSE	Number of spouses in the household	0.93	0.25
IRONRICE	Number of household members who work at state-owned or publicy owned enterprises	1.70	0.86
OWNER	Number of household members who own private or individual enterprise, or own and manage such enterprise	0.02	0.17
TECHNICAL	Number of household members who are professional or technical workers	0.37	0.67
GOVERNMENT	Number of household members who are responsible officials of government office or institutions	0.10	0.33
FTRYDIRECTOR	Number of household members who are factory directors or factory managers	0.04	0.20
OFFICEWORKER	Number of household members who are office workers	0.52	0.71
WORKBATH	The number household members who take baths in work unit's bathhouse	0.86	1.05
WORKEAT	The number of household members who eat in work unit's dining hall	0.57	0.88
CITY	Dichotomous variable ($=1$) if the household is located within a city, ($=0$) otherwise	0.50	0.50
ROOMS	Total number of rooms by household *per capita*	0.73	0.39
MINORITY	Number of household members who are national minority	0.09	0.44
EDUCATION	Average years of schooling of the household members who are 25 years of age and older	10.26	2.63
MINORITY	Number of household members who are national minority	0.09	0.44
FEMALE0–1	Number of females in the household who are between ages 0 and 1	0.01	0.11
FEMALE2–5	Number of females in the household who are between ages 2 and 5	0.08	0.28
FEMALE6–10	Number of females in the household who are between ages 6 and 10	0.16	0.38
FEMALE11–18	Number of females in the household who are between ages 11 and 18	0.29	0.55
FEMALE19–24	Number of females in the household who are between ages 19 and 24	0.14	0.39
FEMALE25–60	Number of females in the household who are between ages 25 and 60	1.02	0.28
FEMALE60+	Number of females in the household who are older than 60	0.10	0.30

Table 1—*continued*

Variable	Definition	Mean	Standard deviation
MALE0–1	Number of males in the household who are between ages 0 and 1	0.02	0.12
MALE2–5	Number of males in the household who are between ages 2 and 5	0.08	0.28
MALE6–10	Number of males in the household who are between ages 6 and 10	0.16	0.38
MALE11–18	Number of males in the household who are between ages 11 and 18	0.31	0.55
MALE19–24	Number of males in the household who are between ages 19 and 24	0.14	0.40
MALE60+	Number of males in the household who are older than 60	0.06	0.24
DISABLED	Number of household members who are disabled	0.001	0.04
TOTINCOME (yuan/year)	Total household labor income (see the text for the definition)	4197.52	1960.68
VARINCOME (yuan/year)	The sum of all kinds of bonuses, above-quota wages, and other wages and income that are not part of regular wage and income	889.25	1009.32
NLABORD-INCOME (yuan/year)	Unearned (nonlabor) income (see the text for definition)	894.01	688.44

variables: The number of spouses, the number of members who work at state-owned or publicly owned enterprises, the number of household members who own private or individual enterprise, or own and manage such enterprise, the number of people in the household who are professional or technical workers, the count of members who are responsible officials of government offices or institutions, the number of household members who are factory directors or factory managers, and the number of household members who are office workers. These variables represent the occupation of the members of the household, thus they may proxy market efficiency and therefore the cost of time. They may also represent environmental factors that are represented by the vector E in Eqn. (1). Controlling for the occupational affiliation we hope to capture the differing rate of health depreciation across the households. Similarly, two additional variables try to gauge the characteristics of the work environment. They are the number of household members who bathe in the work unit's bathhouse, and the number of household members who eat at their work unit's dining hall. We include a dichotomous variable to represent whether the residence is in a city. This variable may capture the ease of access to medical services. Table 1 demonstrates that 50% of the households are in a city. The number of household members who are national minorities may capture the variation in the access to medical care because of minority status. *Per capita* number of rooms used by the household is related to the wealth of the household, and thus aims to capture the impact of wealth on the demand for medical care.

Nonmarket efficiency is measured by the level of the human capital, which can be approximated by the level of schooling. Each working member of the household is assigned to one of the following eight categories. Less than three years of primary school, three years or more of primary school, primary school graduate, lower middle school graduate, upper middle school graduate, professional school graduate, community college (dazhuan) graduate, college (daxue) graduate or above. Using the reported level of education for each household member who is 25 years of age and older, the average years of schooling for the household is calculated. The mean value of education is 10 years.

Biological differences, differences in attitudes toward risky and unhealthy behavior, as well as the differences in lifestyles and the efficiency in health production may differ between genders. This suggests inclusion of gender as an explanatory variable into the demand function (Grossman, 1972b; Hunt-McCool, Kiker, & Ng, 1995; Sindelar, 1982; Wilensky & Cafferata, 1983). Age captures the depreciation in health capital. Consequently, as presented in Table 1, the number of males and females in the household are categorized into various age

intervals. Another variable that may capture the variation in the rate of depreciation of health capital is the number of disabled individuals in the household.

Total household labor income is calculated by the sum of regular wage and floating wage income, contract income, all kinds of bonuses, above-quota wages, the sum of housing subsidy, subsidy for nonstaple food, heating, water and electricity subsidy, book and paper allowance, bath and haircut subsidy, transportation subsidy, single-child subsidy, one-time only subsidies (bonuses for birth control, creation and invention, etc.), hardship allowances, income from second job, total market value of all coupons (for movies, haircuts, color TV, refrigerator, etc.), retirement pension, supplementary income, other income received by retired members, total income of nonworking members, total income in kind received by all household members, total gross income received by the member of the household who is an owner of private or individual enterprise minus total operating cost of the enterprise (including expenditures on wages, raw materials, interest, etc.), minus total taxes paid, minus various fees paid to government departments. Variable income is a component of total income. It is the sum of all kinds of bonuses, above-quota wages, and other wages and income that are not part of regular wage and income. Nonlabor income is the sum of interests on savings accounts, dividends, bond interest, income from house rent, income from leasing out other goods, machinery or tools, other nonlabor income, alimony income, transfer income, the value of gifts, boarding fees from relatives and friends, and the value of food coupons received by all household members.

4. RESULTS

Since both participation and spending equations are reduced forms, there is no completely satisfactory way to identify the system. The issue is less troublesome in case of the discrete factor model, because identification can be achieved due to nonlinearity (Akin & Rous, 1997). For both estimation methods, however, in the benchmark cases we excluded *ROOMS* from the participation equation, and *CITY* from the spending equation. This assumes that the location of the household, which may proxy access to health care, may determine whether to buy medical care, and the number rooms *per capita* impacts the amount of spending if it proxies a wealth effect. The results, however, were extremely robust to any alternative identification restriction. We also estimated the model with discrete factor model relying on identification through nonlinearity as described below.

If $K = 1$ in Eqn. (10), the discrete factor model becomes identical to the two-part model. Likelihood ratio tests rejected the hypothesis of one point of support in favor of two points. Following Mroz (1999) we increased the number of support points and performed likelihood ratio tests to determine the number of supports that maximizes the likelihood function. The results are based on five points of support ($K = 5$ in Eqn. (10)). The bottom of Table 3 displays the estimated coefficients and the t-statistics of the common factor in both equations. Although the estimated ρ_1 is not different from zero, ρ_2 is highly significant. Furthermore, we tested and rejected the hypothesis that $\rho_1 = \rho_2 = 0$. The bottom of Table 3 also reports the estimated mass points and the associated probabilities. As can be seen, most of the mass of the distribution is given to two points, indicating a bimodal distribution. This suggests that estimation frameworks based on selection models using normality may not be appropriate. To test the normality assumption, we approximated a normal distribution for the common factor by imposing the location of the steps and the associated probabilities as follows: 0.00 with probability 0.06, 0.37 with probability 0.24, 0.50 with probability 0.40, 0.63 with probability 0.24, and 1.0 with probability 0.06. The estimated model yielded a likelihood value of −11,275, which generates a likelihood ratio test with a value of 158 with seven degrees of freedom, strongly rejecting the hypothesis of normality. The coefficients obtained from the spending equation of the discrete factor model are unconditional elasticities, while the calculation of the elasticities based on the two-part model is explained in Section 2.

(a) *Household characteristics*

Table 2 presents the estimated two-part model. Column I displays the estimated coefficients of the logit model, and column II presents their z-values. The estimates of the spending equation coefficients and their t-ratios are presented in columns III and IV, respec-

Table 2. *Estimated two-part model*

	Participation equation		Log-spending equation	
	Coefficient	*z*-Stat.	Coefficient	*z*-Stat.
PUBFIN	−0.211*	−1.86	0.038	0.48
PARTPAY	0.204*	1.71	0.333***	4.11
ALLPAY	0.364***	2.98	0.474***	5.91
OTHERCARE	0.229*	1.86	0.276***	3.36
MALE0–1	0.801***	2.57	0.217	1.1
MALE2–5	0.831***	4.48	0.207*	1.74
MALE6–10	0.43***	2.85	−0.048	−0.47
MALE11–18	0.199	1.53	−0.135	−1.54
MALE19–24	−0.04	−0.29	−0.137	−1.47
MALE60+	0.135	0.82	−0.043	−0.39
FEMALE0–1	0.758**	2.15	0.693***	3.43
FEMALE2–5	0.254	1.42	0.139	1.16
FEMALE6–10	0.349**	2.31	−0.116	−1.16
FEMALE11–18	0.097	0.75	−0.177**	−2.04
FEMALE19–24	0.029	0.2	−0.227**	−2.35
FEMALE25–60	−0.136	−0.81	−0.019	−0.16
FEMALE60+	0.113	0.68	0.103	0.95
SPOUSE	0.098	0.66	0.023	0.23
EDUCATION	0.013	0.83	0.009	0.89
MINORITY	0.052	0.68	−0.035	−0.67
DISABLED	0.187	0.3	0.224	0.43
IRONRICE	0.088*	1.73	−0.013	−0.39
OWNER	0.009	0.04	−0.101	−0.8
TECHNICAL	−0.087	−1.42	0.095**	2.2
GOVERNMENT	0.02	0.2	0.126*	1.67
FTRYDIRECTOR	−0.152	−0.9	−0.185	−1.6
OFFICEWORKER	−0.082	−1.59	0.041	1.16
WORKEAT	0.164***	3.91	0.067**	2.41
WORKBATH	-0.025	−0.7	−0.043*	−1.66
Ln(MEDPRICE)	−0.756***	−9.6	0.175***	5.06
Ln(FOODPRICE)	−0.143	−1.42	−0.238***	−3.22
Ln(TOTINCOME)	0.3**	2.24	0.211**	2.55
CITY	0.132**	1.97	–	–
ROOMS	–	–	0.17***	2.83
CONSTANT	0.051	0.07	1.246***	2.71
	$n = 6,407$		$n = 4,611$	
	$\log L = -2959.07$		R-squared $= 0.28$	

* Indicates significance at the 10% level.
** Indicates significance at the 5% level.
*** Indicates significance at the 1% level.

tively. For both equations robust standard errors are calculated. Table 3 presents the estimated coefficients of the spending equation from the discrete factor model. To control for unobserved region effects, the models include nine dummy variables for the 10 provinces where the data are obtained. The unconditional price and income elasticities obtained from both models are displayed in Table 4. The elasticities are evaluated at the mean values of the variables and using the mean predicted probability of participation, which is 0.72.

The regressions control for the household size as the sum of *PUBFIN*, *PARTPAY*, *ALLPAY* and *OTHERCARE* is equal to the size of the household. Thus, some variables need to be dropped to avoid perfect multicollinearity. For example, because the sum of all age categories also adds up to the size of the household, we dropped the category

Table 3. *Estimated log-spending equation discrete factor model*

Variable	Coefficient	*t*-Stat.
CONSTANT	0.826**	1.77
PUBFIN	0.055	0.70
PARTPAY	0.336***	4.13
ALLPAY	0.444***	5.50
OTHERCARE	0.277***	3.35
MALE0–1	0.287*	1.44
MALE2–5	0.179*	1.49
MALE6–10	−0.028	−0.27
MALE11–18	−0.126*	−1.43
MALE19–24	−0.132*	−1.41
MALE60+	−0.021	−0.19
FEMALE0–1	0.701***	3.47
FEMALE2–5	0.121	1.01
FEMALE6–10	−0.135*	−1.33
FEMALE11–18	−0.187**	−2.15
FEMALE19–24	−0.216**	−2.22
FEMALE25–60	0.021	0.18
FEMALE60+	0.123	1.12
SPOUSE	0.004	−0.0038
EDUCATION	0.012	1.09
MINORITY	−0.041	−0.78
DISABLED	0.128	0.27
IRONRICE	−0.002	−0.07
OWNER	−0.079	−0.62
TECHNICAL	0.075**	1.71
GOVERNMENT	0.079	1.05
FTRYDIRECTOR	−0.157*	−1.36
OFFICEWORKER	0.022	0.62
WORKEAT	0.047**	1.66
WORKBATH	−0.054**	−2.03
ROOMS	0.195***	3.20
Ln(TOTINCOME)	0.239***	2.94
Ln(MEDPRICE)	0.191***	5.33
Ln(FOODPRICE)	−0.192***	−2.60
ρ_1	0.161	0.32
ρ_2	6.05	27.38
	Mass points	Probabilities
	0	0.05
	0.33	0.25
	0.605	0.65
	0.612	0.02
	1	0.02
	$n = 6{,}407$	$\log L = -11{,}196$

* Indicates significance at the 10% level.
** Indicates significance at the 5% level.
*** Indicates significance at the 1% level.

MALE25–60, which is the number of males ages 25–60 in the household. Therefore, the coefficients of gender-age categories represent the relative spending associated with an increase in each interval in comparison to the number of males aged 25–60 (the left-out category). The estimated coefficients are consistent between the two-part model and the DFM,

Table 4. *Estimated elasticities*

	I Elasticity (two-part model)	II Elasticity (DFM model)
Food price	−0.28	−0.19
Medical care	−1.04	−0.81
Total income	0.30	0.24

although statistical significance is not always achieved in both models for the same variables. The number of disabled household members, the number of minorities, and average years of schooling have no impact on medical care demand. [7] The average education of the adult household members is not a significant determinant of medical care spending.

An additional household member who uses the work unit's bathhouse reduces annual household medical demand by 4-to-5%. An additional household member who eats at the work unit's dining hall increases the demand by 5-to-6%, which may be due to the additional income that is being created by the provision of meals at the workplace. *Per capita* rooms of the household has an elasticity of 0.12–0.19. To the extent that the number of rooms reflects some aspects of wealth, this implies that wealthy households spend more on medical care.

Using the estimated coefficients, the elasticity of medical care with respect to food price is calculated as between −0.19 and −0.28, which suggests that food and medical care are gross complements (columns I and II of Table 4).

(b) *Price and income effects*

Most previous work reported insensitivity of medical spending to changes in price for the United States (Feldstein, 1977; Manning, Newhouse, *et al*., 1987; Newhouse & Phelps, 1976; Phelps & Newhouse, 1974; Wedig, 1988). The evidence is less clear-cut in developing countries. While the majority of research reported inelastic demand (e.g., Akin *et al.*, 1986; Gertler *et al.*, 1987; Heller, 1982; Sauerborn *et al.*, 1994), there are some studies that found elastic demand for medical services (Chernichovsky & Meesook, 1986; De Bethune, Alfani, & Lahaye, 1989; Yoder, 1989). Columns I and II of Table 4 present the price and income elasticities calculated from Tables 2 and 3. The estimated medical care price elasticity is −1.04 in the two-part model. But its 95% confidence interval is −0.95 to −1.11; thus we cannot reject the hypothesis of inelastic demand for medical care. On the other hand, the price elasticity estimated from the DFM, which is arguably more reliable, is −0.81, with a 95% confidence interval of −0.74 to −0.88. Given these results, we conclude that the demand for medical care is price inelastic. This suggests that an increase in price would generate an increase in revenues obtained from medical care services as long as the increase in price is not too large so that the resultant equilibrium is on the elastic segment of the demand curve.

Most studies which used cross-country data estimated income elasticities that are greater than one (Gerdtham, Søgaard, Andersson, & Jönsson, 1992; Newhouse, 1977; Parkin *et al.*, 1987), which suggests that health care is a luxury good. On the other hand, pooled country cross-sections provide income elasticity estimates that are less than or near one (Di Matteo & Di Matteo, 1998; Hitiris & Posnett, 1992). Thus, no consensus emerged from aggregate data, and the debate on whether health care is a luxury good continues (Blomqvist & Carter, 1997). Table 4 demonstrates that the estimated income elasticity is 0.30 in the two-part model, and 0.24 in the discrete factor model, and they are significantly different from 1. This suggests that medical care is a necessity in urban China.

Newhouse (1992) points out the possibility that within-country income elasticities may be distorted by the endogeneity of income at the household level. This is because sickness simultaneously depresses income and increases medical spending. To entertain the possibility that household income is endogenous, we instrumented household income with nonlabor income (*NLABORINCOME*) and variable income (*VARINCOME*). Nonlabor income is the sum of interests on savings accounts, bonds and dividends, income from house rent and from leasing out other goods, machinery or tools, as well as other nonlabor income, alimony income, transfer income, the value of gifts, boarding fees from relatives and friends, and the value of food coupons received by all household members. *VARINCOME* is the sum of all kinds of bonuses, above-quota wages,

and other wages and income that are not part of regular wage and income. Sickness of the household members is not likely to significantly impact these items. In the first stage, these variables were significant determinants of total income. The income elasticities obtained from this procedure were 0.52 and 0.44, respectively, from the two-part and discrete factor models. This suggests that medical care is a necessity in urban China, which is consistent with estimates obtained from other within-country data sets.

Even though the insensitivity of medical care usage to changes in its price seems like the norm with few exceptions, price elasticity may be different for different groups in the population. In particular, the poor may be more sensitive to changes in price than the rich. In this case, a nondiscriminating increase in user fees may have a detrimental impact on health care utilization of the poor. There are only a few studies that investigated the difference in price responsiveness of different income groups. Akin *et al.* (1995) found no difference in price elasticity between poor and nonpoor in Nigeria, while Gertler *et al.* (1987) report that price elasticity is larger for the very poor in Peru, and Sauerborn *et al.* (1994) find that the services used by infants and children, and lowest income quartile are price elastic in Burkina Faso.

To calculate the price elasticity for different income groups, we re-estimated the models with an interaction term of the price of medical care and income. We evaluated the resultant price elasticity at the 10th, 50th and 90th percentiles of the income distribution. The price elasticity of medical care was −1.06 for the 10th percentile, −1.03 for the median income household, and it was −0.98 for the 90th percentile of the income distribution using the two-part model. Discrete factor model provided the same pattern with lower price elasticities. Price elasticity was −0.83 for the 10th percentile, −0.80 for median income, and −0.76 for the 90th percentile. This indicates that poor households are more sensitive to changes in price. Thus, although an increase in the price of medical care would be associated with increased revenues, it would reduce the demand for medical care more for poor households than it would for rich households.

Although identification may be arguable as discussed earlier, DFM provides an opportunity to estimate the model where identification is achieved through nonlinearity. Table 5 presents the DFM results where *ROOMS* and *CITY* are dropped from the model. The estimated coefficients from this specification are very similar to the ones obtained from Table 3, indicating that identification and potential endogeneity of *ROOMS* and *CITY* is not a major concern. To further investigate the sensitivity of the results to potential endogeneity of some variables, we dropped from the models all right-hand side variables with the exception of the ones that measure the number of males and females in the household, insurance dummies, number of spouses, average household education, province dummies, income, food price and the price of medical care. In the two-part model, the elasticity of food price was −0.29. The elasticity of medical care price was −1.04 and income elasticity was 0.31. In the DFM, food price elasticity was −0.20, medical care price elasticity was −0.82, and income elasticity was 0.22, indicating that the results are not sensitive to potential endogeneity of the explanatory variables.

5. CONCLUSION

The impact of health on labor supply and productivity makes it important to investigate the economic determinants of health and the derived demand for medical care. The issue is particularly significant in developing countries which often face rising medical care costs coupled with government budget deficits and adverse economic conditions. Using a data set that consists of detailed characteristics of 6,407 urban households of 10 provinces of the People's Republic of China, this paper investigates the determinants of the demand for medical care. Descriptive statistics reveal that 28% of the households report zero spending on medical care. Most members of these households are covered by publicly financed health insurance. The average expenditure on medical care for the households that report positive spending is 71.5 yuans; it is 51 yuans per household per year for all households. Thus, the share of medical care spending is about 1% of total household income from all sources.

We fit both a two-part model, and a discrete factor model to the data, which provide consistent results. The discrete factor model allows for selection, but estimates a semi-parametric distribution for the error terms between the participation and spending equations.

The estimated income elasticity is about 0.3, and treating income as an endogenous variable does not impact this result. This estimate indi-

Table 5. *Estimated log-sending equation discrete factor model identification through nonlinearity*

Variable	Coefficient	*t*-Stat.
CONSTANT	1.043**	2.27
PUBFIN	0.029	0.37
PARTPAY	0.307***	3.76
ALLPAY	0.423***	5.22
OTHERCARE	0.25***	3.02
MALE0–1	0.262	1.33
MALE2–5	0.151	1.26
MALE6–10	−0.055	−0.54
MALE11–18	−0.134	−1.51
MALE19–24	−0.135	−1.43
MALE60+	−0.007	−0.06
FEMALE0–1	0.669***	3.33
FEMALE2–5	0.1	0.84
FEMALE6–10	−0.161	−1.60
FEMALE11–18	−0.195**	−2.24
FEMALE19–24	−0.217**	−2.24
FEMALE25–60	0.028	0.24
FEMALE60+	0.135	1.22
SPOUSE	−0.021	−0.21
EDUCATION	0.01	0.94
MINORITY	−0.024	−0.46
DISABLED	0.131	0.25
IRONRICE	−0.003	−0.08
OWNER	−0.084	−0.67
TECHNICAL	0.085*	1.93
GOVERNMENT	0.109	1.45
FTRYDIRECTOR	−0.142	−1.23
OFFICEWORKER	0.033	0.93
WORKEAT	0.04	1.42
WORKBATH	−0.059**	−2.22
Ln(TOTINCOME)	0.255***	3.15
Ln(MEDPRICE)	0.193***	5.30
Ln(FOODPRICE)	−0.197***	−2.66
ρ_1	0.161	0.32
ρ_2	6.05	27.38
	Mass points	Probabilities
	0	0.05
	0.33	0.26
	0.59	0.01
	0.60	0.66
	1	0.02
	$n = 6{,}407$	$\log L = -11{,}204$

* Indicates significance at the 10% level.
** Indicates significance at the 5% level.
*** Indicates significance at the 1% level.

cates that medical care is a necessity in urban China. The demand for medical care is price inelastic. Price elasticity gets larger in absolute value for poorer households. This result suggests that although total revenue from the provision of health care can be increased by raising the price of care (as long as the increase in price is not extraordinary in percentage

terms), poor households would reduce their demand for medical care more than rich households. This in turn would increase the inequality in access to medical care.

NOTES

1. Hu, Michael, Lin, and Li (1999) analyzed the determinants of out-of-pocket medical expenditures. Their data set did not include price.

2. For a detailed derivation of these equations see Grossman (1972a), Muurinen (1982), Wagstaff (1986), or Mocan, Tekin, and Zax (2000).

3. The sample provinces are Beijing, Shanxi, Liaoning, Jiangsu, Anhui, Henan, Hubei, Guangdong, Yunnan and Gansu. Khan, Griffin, Riskin, and Renwai (1992) discuss the sampling procedures in more detail.

4. This survey was funded by the Ford Foundation, and conducted with extraordinary care under difficult circumstances by economists at the Institute of Economics, Chinese Academy of Social Sciences, led by Zhao Renwai and Li Shi. Western economists led by Keith Griffin, then of Oxford University, and Carl Riskin of Queens College, CUNY, assisted. This survey and a companion survey of rural households are available in SAS format from the Inter-University Consortium for Political and Social Research as data set 9,836.

5. The medical spending corresponds to outlays in 1988. The fee question pertains to a clinic visit that took place during the month prior to the interview, which is typically early 1989. Hence, we can have households that reported zero spending in 1988, but provided fee information in the questionnaire.

6. The data set contains 980 households that paid all their medical expenses and reported a nonzero price for a clinic visit. With respect to other households, these households, on the average, have half fewer members that are covered by publicly financed medical care (1.5 *vs.* 2.0), and more than twice as many members who pay all their medical expenses (1.3 *vs.* 0.6). Their annual medical expenditures are more than twice as high (115 yuans *vs.* 52 yuans), their labor incomes are lower (326 yuans *vs.* 350 yuans). Despite the arguments made in this paragraph, one cannot completely rule out the possibility that the measured price is endogeneous.

7. It should be cautioned that there are only seven disabled individuals in the whole sample.

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