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Valuing the Benefit of Reducing Adverse Effects from Household Solid Fuel Combustion in Rural China

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Selected Poster prepared for presentation at the 2015 Agricultural & Applied Economics Association and Western Agricultural Economics Association Joint Annual Meeting, San Francisco, CA, July 26-28

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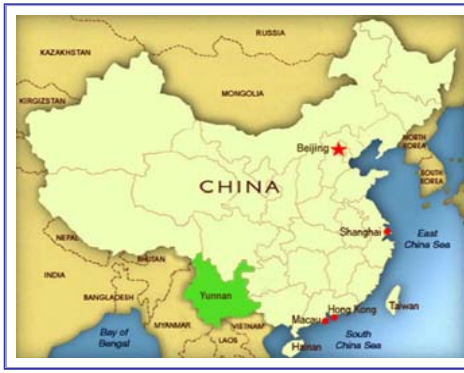
Part I Introduction and Objectives

Introduction

Indoor air pollution (IAP) is a public health problem in both developed and developing countries. There is growing research to state that IAP from solid fuels (such as wood, charcoal, crop residues, dung and coal) combustion has been linked to many different diseases, including acute and chronic respiratory diseases, cardiovascular disease and perinatal health outcomes. Most of current research belongs to epidemiologic, physiologic or sociological research, with relatively little attention to assessing the health benefits of reduced indoor air pollution, which hinder the optimal choice of related policy. By using the survey data collected in rural China, this research seeks to make some contributions for the gaps.

Objectives

- Explore the relationship between the use of solid fuel and the medical care consumption
- Determine the extent to which medical care expenses are related to individual's demographic and socioeconomic characteristics
- Estimate the economic benefit (reduced medical care expenses) from improving energy system (shift to low-polluting fuels or use improved appliances)



Part II Methodology

A modified health capital production function approach will be used for the econometric analysis. The medical care consumption equation, an alternative specification of the health production function, will be used as the basic model. It can be expressed as $M = M(H; \alpha, \delta)$ where medical consumptions M measured by the frequency of medical service received annually; health indicator H is valued by whether people have some chronic disease; indoor air quality α is represented by whether the respondent uses some polluting cooking fuel (PCF); the exogenous variable set δ, which explains the number of medical services received, includes some demographic, social-economic, and lifestyle variables. Since the dependent variable M is a count variable, a Poisson Count Model was initially applied. However, the existence of over-dispersion of the dependent variable led to the specification of a Negative Binomial Count Model.

Based on Gerking and Stanley (1986), a compensating variation (CV) type marginal individual's willingness to pay (WTP) for improved air quality can be derived: $\partial A / \partial \alpha = -H_\alpha q_M / H_M = (-H_\alpha / H_M) q_M = M_\alpha q_M$

Therefore, we can use the partial derivative of medical consumption with respect to environmental quality M_α multiplied by the full price of medical care q_M to obtain the marginal willingness to pay (WTP) for the improvement of air quality (improved energy use), which is the savings in medical expenses annually.

Part III Data

The survey data collected in rural area of Yunnan Province of China (it is a typical area where the household use wood and coal as the main energy resource) in 2015 were used for the analysis. There were 149 observations. The information includes the individual's personal status (race, gender, income, education, etc.), health conditions, and some medical screening and risk factors (including choice of energy use, medical service received, etc.).

Table 1. Descriptive Statistics of Variables Used in the Analysis

Variable	Mean	Median	Std Dev	Minimum	Maximum	Definition
AGE	48.72	49	13.69	21	80	continuous; age of the respondent
MINORITY	0.44	0	0.50	0	1	dummy; = 1 if ethnic minority people
MALE	0.42	0	0.50	0	1	dummy; = 1 if male
EDUY	6.15	5	2.96	0	13	continuous; years of education
HHINCOM	26.69	20	32.85	0.45	300	continuous; household total yearly income
PCF	0.48	0	0.50	0	1	dummy; = 1 if use polluting cooking fuel
COOKER	0.64	1	0.48	0	1	dummy; = 1 if main cooker in the family
BBQ	0.04	0	0.20	0	1	dummy; = 1 if make & eat BBQ food often
CHRO	0.44	0	0.50	0	1	dummy; = 1 if suffer some chronic disease
SMOKER	0.30	0	0.46	0	1	dummy; = 1 if has ever used tobacco products
MED	4.34	2	11.57	0	101	count; number of medical service received in the last year
N=149						

Part IV Empirical Results

Table 2. Coefficient Estimates for Number of Medical Service Received

Variable	Coefficient	Standard Error
Constant	0.933	0.990
AGE	0.005	0.015
MINORITY	-0.687**	0.311
MALE	-0.002	0.462
EDUY	-0.056	0.059
HHINCOME	-0.011	0.006
PCF	0.461*	0.251
COOKER	0.390	0.362
BBQ	1.287*	0.680
CHRO	0.913***	0.293
SMOKER	0.306	0.437
Dispersion parameter for count data model		
Alpha	1.771***	0.267

*, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively

Table 3. Marginal Effect of Explanatory Variables

Variable	Coefficient	Standard Error
Constant	2.982	3.976
AGE	0.016	27.815
MINORITY	-2.141	48.117
MALE	-0.007	0.203
EDUY	-0.179	0.224
HHINCOME	-0.034	13.857
PCF	1.700	1.179
COOKER	1.189	137.353
BBQ	7.953	96.145
CHRO	3.202	35.447
SMOKER	1.044	7.181

Willingness to Pay (WTP) calculation :

Based on the health production function approach, using the marginal effect of "MED" with respect to "PCF"(polluting cooking fuel use) obtained in estimation for the number of medical service received , also the full price of medical care q_M (= office visit charge + [wage rate × (commuting time + office waiting time)]) , we can calculate that people may pay about RMB 217.17 ($ 35.03) annually, which is the saving in medical expenses annually, for an improved household energy use (use clean energy or better appliances).

Part V Conclusions and Discussions

- Compared to non-polluting cooking fuel users, polluting cooking fuel (solid fuel) users received more medical services and thus spent more on medical care
- People suffering some chronic disease are more likely to seek medical services
- Ethnic minority people are less likely to see doctors probably due to the unique socioeconomic conditions they have
- People who make and eat BBQ food often have more doctor visits
- Individuals may pay a positive amount to improve energy use given the medical expenses saving

Since most of the residents in these areas are in lower income groups and rely on some form of public insurance, based on the above results, government could consider subsidies to encourage these people to shift to clean fuels or use improved technology (i.e., better appliances) in order to reduce the public insurance cost. Further equilibrium analysis can be conducted for policy decision making.