The Effect of China's New Cooperative Medical Scheme on Rural Utilization of Preventive Medical Care and Rural Households' Health Status

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Abstract

In 2003, the Chinese government implemented a pilot program called the New Cooperative Medical Scheme (NCMS) to replace the old healthcare system in rural China. It aims to enhance the health status of rural households and improve local medical infrastructure. Although the new scheme is claimed to have notably increased the utilization of preventive care, complaints were heard from households about the poor quality and inefficiency of the care provided. As a result, this paper not only looks at the accessibility of the medical care under NCMS, but also it examines if such care successfully ameliorates people's health status as it is designed. We will briefly introduce the background of NCMS implementation, and proceed to complete regression analysis based on a survey data set that contains 3510 households in 36 counties across nine provinces in 2000, 2004, and 2006. Both Linear Probability and Probit models are employed to predict the marginal treatment effect on household utilization of preventive care. The results indicate that NCMS significantly increases preventive care utilization by 3.3%. However, by using a two-way Fixed Effects model, the regression results suggest no significant impact on people's health status. In the end, the paper provides robustness checks and gives a conclusion on the successes of NCMS policy implementation.

Key words: China health care reform, rural China, preventive care, health status, Fixed Effects

Background Introduction

Evolution of Health Care in Rural China

Prior to China's economic reform and market opening up (*gaige kaifang*), the old Cooperative Medical Scheme (CMS) was implemented in rural China dating to the 1950s. It was organized at the village level and managed by the CMS Management Committee, consisting of village administration representatives and the village clinic (Lei et al, 2007). The CMS experienced dramatic development in its early years, and at its peak in 1978 it covered as many as 90% of rural residents (Liu and Cao, 1992). The public concerns on rural health emerged when the old commune Cooperative Medical Scheme collapsed in the late 1970s, as the economic reform broke down the centrally planned system. As a result of the collapse, most rural households were exposed to the full financial risk of major illnesses. It is estimated that, in rural areas, 80% of people were without health insurance of any kind (Wagstaff et al, 2009). As a result, during the 1990s, a lot of attention was put on the inequality of health resources, the growing cost of health care, and the quality and safety of medical care in rural China (Wagstaff et al, 2009). In response to the healthcare problems, the Chinese government launched the New Cooperative Medical Scheme in 2003.

Establishment and development of NCMS in Rural China

The 2002 State Council Policy Document No. 13, Decisions of the State Council on Strengthening Rural Healthcare (State Council, 2002) states that NCMS is a voluntary health insurance program that gradually phases in starting in the beginning of 2003. Its goal is to put the whole country under coverage by 2010. The treatment policy, unlike its predecessor which was implemented on the village level, is offered on the county level, providing for a larger risk pool and economies of scale in organization and management (Wagstaff, et al. 2007, 4). In addition, to reduce adverse selection, the NCMS also requires full household participation, with either all or none of the members in a

family participating in the program[1] (Lei, et al. 2007, 5). The NCMS would focus on catastrophic illnesses, receiving funding from both the government subsidies (central and local) and individual's contributions. On the condition that a county government follows the aforementioned guidelines, the proportion of individual contribution and subsidies from local and central governments can vary across counties[2] (Lei, et al. 2007, 5).

By contributing insurance premiums, the insured households are entitled with reimbursements that cover inpatient and outpatient cost. In addition, the healthcare plan also includes preventive care coverage, making it more affordable and accessible to rural households. According to report by Ni Junjie, et al., the factual utilization proportions of NCMS fund is 53% for outpatient reimbursement, 45% for inpatient reimbursement, and around 1.15% for preventive care in the counties Jiading, Jinshan and Fengxian of Shanghai City (Mao. 2005:8).

By the end of 2004, 333 of China's 2,862 counties (including cities and districts) were implementing NCMS. The number of participating counties increased steadily over time: from 21.7 percent at year-end 2005 to 50.7 percent at year-end 2006 and to 86 percent by year-end 2007 (Wagstaff, et al. 2009, 58). However, as with other policies in China, even though with fast expansion of implementation, many complaints were heard about low medicine efficiency and poor medical facilities. As a result, we not only need to analyze how much more medical care is provided to people quantitatively, but also we need to understand the quality of the treatment, that is if people are getting better treated and thus have better health conditions than before.

Literature Review

1 Lei suggests in his research despite this requirement, we find that partial-household participation does in fact exist, albeit constituting a small proportion. Our data shows that among individuals in NCMS households (i.e., households with at least one member had enrolled in NCMS), 6.7% did not participate in NCMS in 2004.
2 Detail government subsidy rate see Appendix Table 1.

Early after the implementation of NCMS, many policy analysis studies have been completed. Most of these analyses do not include rigorous quantitative argumentation, but are focused on the policy making process, such as the official reports of WHO (2004), which introduces the health conditions in rural China. Mao (2005) described the design of the NCMS and the implementation progress of the pilot program in great detail, and Yunping Wang (2008) explained the political process of the policy.

Later studies were done using impact evaluation and causal effects analysis of the treatment. Yip, et al. (2008) conducted a random experiment in which some counties were randomly assigned to control groups and others were randomly assigned to a healthcare reform program. They found that the healthcare program increased the utilization of outpatient services and reduced self-medication. The research of Wagstaff, et al. (2009) is based on the 2003 iteration of the National Health Service Survey, from which they picked out 10 counties that had implemented the NCMS. Using difference-in-differences with propensity score matching (DDPSM), they found that NCMS enrollment was lower among poor households and higher among households with chronically sick members, and the NCMS had increased overall utilization of inpatient and outpatient services.

Although these studies all provide well-argued empirical analysis of the NCMS treatment effect, most of their effort is on explaining the causal effect on inpatient and outpatient utility or out-of-pocket expense. However, it should be clear that the fundamental goal of NCMS health program is not to have more people go to see doctors, but to efficiently cure or prevent their illness. Thus, with the treatment being provided, there are two questions that should be answered: first, does it offer more preventive care to people, and more importantly, has people's health status been improved thanks to the care.

Empirical Analysis

Data and Summary Statistics

The data set used in this paper is collected from a long-lasting survey project called Chinese Nutrition and Health Survey conducted by the Carolina Population Center at the University of North Carolina at Chapel Hill. The survey has six waves in total, which were conducted separately in 1991, 1993, 1997, 2000, 2004 and 2006. It contains nine provinces with four counties in each province that vary in terms of geography, economy and resources.[3] The total 36 counties made staggered entry into the NCMS, with 16 counties in 2004 and 27 in 2006.[4] Because there were major changes in questionnaire design since 2000, the paper will only utilize data after 2000.[5] Based on the theoretical structure introduced in last section, the paper employs two dependent variables, Preventive Care and Self-reported Health Status. Preventive Care is a binary variable signifying if a household took preventive care in the survey year or not. Self-reported Health Status is a discrete variable with four levels.[6]

Similar to many other self-selected programs, the voluntary selection at the household level violates randomization and thus the study of the treatment effect has severe endogeneity problems if the treatment variable is on household level. To solve such problem, the hierarchical data structure allows the use of a treatment variable at the county level that signifies if NCMS is offered in the county. As the NCMS implementation at county level is randomized and is not affected by individual households,[7] the endogenity problem is eliminated. Participation rates in pilot counties are for the most part high, with an average in excess of 80% (Wagstaff 2007, 4). The high level of participation means that the substitution of county level treatment variable is based on solid theoretical ground and the main questions of the paper evolves to become: are the households in a

3 For detailed data composition see Appendix Table 2.
4 For the staggered entry process see Appendix Table 3.
5 Liaoning Province was taken out of the survey in previous year, but rejoin the survey in 2000.
6 For detailed variable description see Appendix Table 4.
7 More evidence of randomization is provided in Robustness Check Section.

treated county likely to have more preventive care or better health status than those in an untreated county? By asking this question, we can find out the treatment effect of NCMS on rural households. Other key independent variables include Average Age of Household, Education Level, Smoking, Sport Activities, and so forth.

Impact on Basic Preventive Care

In order to see how NCMS changes the utilization of preventive care in rural China, I'm interested in the marginal treatment effect. Since the dependent variable is binary, a Linear Probability Model is adopted only controlling for year trend as the baseline model. Due to the problem of heteroskedasticity, robust standard errors are employed. Moreover, because the treatment variable (county level) is one level above other variables (household level), and households in the same county should share a high degree of similarity with each other, clustered standard errors on the county level should be adopted. In the second model, to eliminate Omitted Variable Bias, I further control for age, education level and smoking. In order to check the result generated by Linear Probability Model, I also adopt a probit model and report the average marginal effect in the regression table.[8] The notation "i" indicates household level variation; "c" stands for county level variation and "t" for time variation. This provides us with the regression models as follow:

$$prevent_{ict} = \beta_0 + \beta_1 NCMS_{ct} + \sum_{2000}^{t} \delta year_t$$

$$prevent_{ict} = \beta_0 + \beta_1 NCMS_{ct} + \sum_{2000}^{t} \delta year_t + \beta_2 age_{ict} + \beta_3 smok_{ict} + \sum_{1}^{5} \gamma edu\_level_{ict} + u_{ict}$$

8 Regression results see Appendix Table 5.

Impact on Health Status

Health status is implicitly affected by many unobservable conditions across households, such as genetic health quality and hygiene habits. Such characteristics are constant over time and hard to be controlled for, so this might create omitted variables bias in regression models. Under such a situation, in order to eliminate the biases in the treatment effect, I adopt a two-way Fixed Effects model as the baseline. Two-way Fixed Effects allows me to rule out the noise from the unobserved and time-invariant characteristics of each household, and the estimators are unbiased even without strict exogeneity between the unobserved variations and control variables. However, compared to two way Fixed Effects, a Random Effects model will yield more efficient estimators, however this should be based on the condition that the unobserved variations are orthogonal to the control variables ($a_i \perp x_{it}$). To decide which effect to use, both Fixed Effects and Random Effects are both run and their estimators are compared by conducting a Hausman Test.[9] The test result rejects the hypothesis that the unobserved variations are orthogonal to the control variables at a 95% confidence level, so Fixed Effects should be adopted.

I first applied Fixed Effects on the household level to remove the undesired heterogeneity. In case there is trending in the households' health status, I add in year dummies. Furthermore, I also controlled for household average age, whether household members smoke, and their sport activities. Again, as the household observations are clustered at county level, clustered standard errors should be used in following regression models.

However in this case, the Fixed Effects on household level only removes the heterogeneity across households, but as the policy is implemented at the county level, there is still worry that heterogeneity across different counties can also bias the treatment effect. Thus, a higher-level Fixed Effects model is needed.[10]

9 For test results see Appendix Table 6.
10 Both household and county level results reported in Appendix Table 7.

Household level FE:

$$hlth_{ict} = \beta_0 + \beta_1 NCMS_{ct} + \sum_{2000}^{t} \delta year_t + \beta_2 age_{ict} + \beta_3 smoke_{ict} + \beta_4 sport_{ict} + a_i + u_{ict}$$

County level FE:

$$hlth_{ict} = \beta_0 + \beta_1 NCMS_{ct} + \sum_{2000}^{t} \delta year_t + \beta_2 age_{ict} + \beta_3 smoke_{ict} + \beta_4 sport_{ict} + a_c + u_{ict}$$

Regression Results

The regression results show that households in NCMS treated counties have 3.3% more utilization of preventive care than those in untreated counties, and such a difference is constantly significant at a 99% confidence level in both LPM and Probit Model. For the health status however, the coefficient of NCMS is slightly bigger than 0, but insignificant on a 90% confidence level in all regression models. This means that NCMS successfully increases household utilization of preventive care, nevertheless, easier and more access to health care doesn't significantly improve household health status, which leaves doubts about the quality of the medical care provided.

Robustness Checks

The most substantial problem for the Linear Probability Model that might make the regression results unreliable is the heteroskedasticity in residuals. Adopting robust standard error adjusts the standard error to the right level by allowing heterosekedasticity in the regression, so a false rejection is prevented and the efficiency of the estimators is corrected. However, as the detailed policy implementation process is unknown, in order to justify the Fixed Effects regression results, a few further tests are required.

First, the Fixed Effects results are only valid if the treatment group and control group are randomly assigned, that is, the treatment entry isn't decided by any baseline factors but pure randomized probability. As a result, we need to ask the question that of whether or not a county adopts NCMS earlier only because its preventive care utilization or health status is poorer than other counties, and if so, if the government thinks NCMS would help to change the situation? To test whether this is true, a cross-sectional regression is run based on the data in 2000, with year as the dependent variable and preventive care and health status as the independent variables. Again the clustered standard errors should be employed. Although the results suggest the coefficient of health status is significant at a 95% confidence level,[11] the cross sectional regression relationship doesn't claim causality, and if the identifying assumption of Fixed Effects holds, this cross sectional difference will be eliminated by Fixed Effects and the regression results will be robust.

As a result, for the next step, it is important to test the identifying assumption of the Fixed Effects Model. This means that the preventive care utilization and the health status in both treatment group and control group would grow at the same rate if the treatment were absent. To test whether this is true, we need two pre-treatment periods to obtain the growth in the dependent variables. Due to the fact that the data set only includes 3 years, I split the treated counties into two groups that made staggered entry in 2004 and 2006, and only compared the counties that entered in 2006 as the treatment group (totally 11 counties) to the ones that never adopted the treatment as the control group (totally 9 counties). The total number of these counties is 20, taking up 56% of the total sample size. The regression results suggest that the growth of health status and preventive care utilization in both treatment group and control group is not significantly different from each other in pretreatment periods.[12] This means any change in the two dependent variables in the treatment group after the entry into treatment in 2006 is likely due to the NCMS treatment effect but not because the treatment group has an original growth rate higher than the control group.

11 For regression results see Appendix Table 8.
12 See Appendix Table 9.

However, the regression test is only based on 56% of the sample counties, so the power of the explanation might be low. However, with the best effort under current data conditions, we can support that the identifying assumption of the Fixed Effects model is valid, thus there are no biases in the treatment effect estimators coming from the identifying assumptions.

Now that the biases of Fixed Effects model have been tested, we should look further into the efficiency of the estimators. Even though the insignificant estimation of treatment effect on health status confirms initial expectations, however is it truly efficient? It is possible that there is in fact significant treatment effect on health but it is only due to autocorrelation problems that the effect is falsely rejected. To verify this assumption, the residuals are predicted and regressed on their lags.[13] The results show that the Fixed Effects models on both household and county level have autocorrelated residuals. This might have resulted in the treatment effect estimators becoming insignificant. In attempt to solve the problem, I adopted Newey-West Standard Errors allowing for two periods of autocorrelation in the regression.[14] After the standard error adjustment, however, the coefficient of the treatment variable is still insignificant. Now, with the evidence, there is more confidence with the claim that NCMS shows no significant impact on household health status.

Conclusion

For a household, being healthy means the ability to work and to maintain stable family income; for a nation, a healthy society means an abundant labor force and a strong impetus for economic development. However, merely expanding medical care provisions to people does not guarantee any of these. It is the ultimate improvement in the households' health status that shows more importance to the nation. The paper's major argument is based on this concept.

13 For regression results see Appendix Table 10 & Table 11.
14 For adjusted regression results see Appendix Table 12.

In the first step, it uses Linear Probability and Probit models to investigate the treatment effect of Chinese New Cooperative Medical Scheme on rural utilization of preventive care. The results show that households in NCMS treated counties have 3.3% more utilization of preventive care than those in untreated counties, and such a difference is constantly significant at a 99% confidence level in both the LPM and Probit models. Apart from the treatment effect, there are also other factors that show significant impact on the utilization of preventive care. For example, older household average age makes the family less likely to take preventive care, while households whose members smoke tend to seek more preventive care.

With this finding, it then necessitates us to ask the question of whether such a medical care expansion achieves its aim to cure more people or improve people's health. With many complaints heard from news reports, the hypothesis held by the paper is that NCMS has not effectively improved households' health status due to the poor quality of the medical care provided. To test whether it is the case, the paper adopts Fixed Effects estimators. Fixed Effects rules out the unobserved and time-invariant characteristics of each household or county that might affect the household health status and the estimators are unbiased without requiring the unobserved variation being orthogonal to the control variables. The finding supports the paper's original hypothesis. To verify if the estimators are biased or with wrong efficiency, the paper conducted robustness checks, and found the identifying assumption to be valid, although the residuals are autocorrelated. However, by adopting the Newey West Standard Error to correct the autocorrelation, the treatment effect still appears insignificant.[15]

Based on all the evidence provided through the data analysis, it is concluded that even though NCMS successfully makes preventive care more available to rural households, such care doesn't effectively ameliorate households' health status. There are many possible reasons leading to such a result, such as inefficient medicine provided and low medical proficiency among the doctors,

15 For regression results see Appendix Table 12.

however, more specific reasoning is required, and it is expected in the future studies that we can not only discover the treatment effect of NCMS but also find out what leads to such an effect.

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Appendix

Table 1: NCMS funding structure in 2004 (RMB/enrollee)

County	Individual contribution	Local Government	Central Government
Central/Western	¥10	¥10	¥10
Eastern/Coastal	¥10	¥20	¥0

Note: Data source from Wagstaff, 2009; Figures for 2004, the government subsidies have increased enormously as time passes by.

Table 2: Composition of survey data

Province	**Pid**	Total County Number	Total Household Number
Liaoning	21	4	399
Heilongjiang	23	4	376
Jiangsu	32	4	406
Shangdong	37	4	362
Henan	41	4	394
Hubei	42	4	384
Hunan	43	4	397
Guangxi	45	4	389
Guizhou	52	4	403

Note: Data source from CHNS survey available online at http://www.cpc.unc.edu/projects/china

Table 3: Implementation of NCMS in counties across province

Province	**Pid**	**2000**	**2004**	**2006**
Liaoning	21	0	0	4
Heilongjiang	23	0	3	3
Jiangsu	32	0	4	4
Shandong	37	0	3	4
Henan	41	0	1	1
Hubei	42	0	2	3
Hunan	43	0	3	3
Guangxi	45	0	1	3
Guizhou	52	0	0	2

Note: 4 counties are interviewed in each province. The table shows the staggered entry of the treatment.

Table 4: Description of Main Variables		
Variable	Type	Description
NCMS	Binary	1=county where NCMS is offered; 0=county where NCMS is not offered
hhid	Discrete	ID numbers of households
cid	Discrete	ID numbers of counties
pid	Discrete	ID numbers of provinces
prevent	Binary	1=household take prevent care; 0=household doesn't take preventive care
hlth_stat	Categorical	Measures average health status of a household: 1=Very Good; 2=Good; 3=Fair; 4=Poor
year	Discrete	Survey years: 2000, 2004, 2006
age	Continuous	Average age of household
age_group	Discrete	Calculated based on average age of household: 1=(0,30); 2=(30,50); 4=above 50
edu_level	Discrete	Average education level of a household: 1=Illiterate; 2=Primary School; 3=Middle School; 4=High School; 5=College or higher
smoke	Binary	1=member(s) in the household smoke(s); 0=none of the household members smokes
familysize	Discrete	Numbers of family members
total_inc	Continuous	Total income of the household
dist_bike	Continuous	Minutes of travel to nearest medical facility by bike
sport	Discrete	Measures how often the household have sports: 1=Rarely; 2=Sometimes; 3=Frequently;
ill_month	Binary	1=Household members feel ill during the last month; 0=none of the household members feel ill during the last month

Table 5: Treatment Effect on Preventive Care Utilization

	LPM-Model 1	LPM-Model 2	Probit-Model 3	Probit-Model 4
VARIABLES	Preventive Care Utilization			
NCMS	0.034***	0.032***	0.033***	0.032***
	-0.006	-0.006	-0.006	-0.005
age	-0.001***	-0.001***	-0.001***	-0.001***
	0	0	0	0
smoke_		0.014**		0.011***
		-0.006		-0.004
Year 2004	0.027***	0.026***	0.031***	0.030***
	-0.006	-0.006	-0.007	-0.007
Year 2006	0.008	0.01	0.013*	0.014**
	-0.007	-0.007	-0.007	-0.007
Edu Level 1		0.009		0.011*
		-0.006		-0.007
Edu Level 2		0.014*		0.015*
		-0.008		-0.008
Edu Level 3		0.017		0.019
		-0.012		-0.013
Edu Level 4		-0.006		-0.005
		-0.018		-0.019
Edu Level 5		0.025		0.026
		-0.028		-0.035
Constant	0.068***	0.045***		
	-0.007	-0.011		
Observations	8924	8877	8924	8877
R-squared	0.009	0.011		
rmse	0.233	0.233	.	.

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: Hausman Tests

	FE	RE	Difference	SE
NCMS	0.002	-0.008	0.01	0.0125
Year 2004	0.162***	0.154***	0.008	0.0043
Year 2006	0.175***	0.166***	0.008	0.0079

Chi2=8.41, Prob>Chi2=0.0382

Table 7: Fixed Effect Regression Table – Treatment Effect on Health Status				
	Model 1- Household Level	Model 2- Household Level	Model 3 – County Level	Model 4- County Level
VARIABLES	Health Status			
NCMS	0.002	0.006	0.012	0.015
	-0.036	-0.037	-0.036	-0.037
Age		0.006		0.015***
		-0.004		-0.001
Smoke		-0.078***		-0.085***
		-0.021		-0.015
Sport Activity		-0.019		0.019*
		-0.012		-0.01
Year 2004	0.162***	0.143***	0.146***	0.101**
	-0.045	-0.05	-0.048	-0.049
Year 2006	0.175***	0.131**	0.147***	0.066
	-0.037	-0.049	-0.039	-0.04
Constant	2.234***	2.093***	2.244***	1.669***
	-0.026	-0.155	-0.028	-0.06
Observations	8906	8749	8906	8749
R-squared	0.026	0.031	0.011	0.109
Number of Household	3476	3458		
rmse	0.457	0.456	0.676	0.642
Number of cid			36	36
Robust standard errors in parentheses		*** p<0.01, ** p<0.05, * p<0.1		

Table 8: Determinants of Entry Time

VARIABLES	Entry Time
Health Status	0.238**
	-0.097
Preventive Care	-0.11
	-0.209
Constant	2,004.223***
	-0.246
Observations	2130
R-squared	0.027
Rmse	0.955

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 9: Test for Growth in Pre-treatment

	Model-1	Model-2
VARIABLES	Difference in Health Status	Difference in Preventive Care
Treated in 2006	0.209*	-0.065
	-0.108	-0.043
Constant	0.113**	0.044***
	-0.049	-0.012
Observations	1913	1920
R-squared	0.01	0.007
rmse	0.846	0.323

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 10: Test for Autocorrelation – Fixed Effect on Household Level

VARIABLES	uhat
uhat lag 1	0.204***
	-0.071
uhat lag 2	0.134**
	-0.057
Constant	-0.034
	-0.049
Observations	367
R-squared	0.062
rmse	0.677

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 11: Test for Autocorrelation – Fixed Effect on County Level	
VARIABLES	uhat
uhat lag 1	0.189**
	-0.073
uhat lag 2	0.124**
	-0.058
Constant	-0.019
	-0.05
Observations	367
R-squared	0.05
rmse	0.678
Robust standard errors in parentheses	
*** p<0.01, ** p<0.05, * p<0.1	

Table 12: FE on County Level-Correct for Autocorrelation with Newey West Standard Error

VARIABLES	Health Status
NCMS	0.014
	-0.022
Age	0.015***
	-0.001
Smoke	-0.082***
	-0.013
Sport Activity	0.023***
	-0.007
Year 2004	0.054***
	-0.017
Year 2006	0.029
	-0.02
Constant	1.664***
	-0.054
Observations	8643
rmse	.

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1