Int J Health Econ Manag (2015) 15:407–431
DOI 10.1007/s10754-015-9175-z

RESEARCH ARTICLE

Under regional characteristics of rural China: a clearer view on the performance of the New Rural Cooperative Medical Scheme

Dan Liu[1,2,5] · Daniel Tsegai[2,4] · David Litaker[3,5] · Joachim von Braun[2]

Received: 2 October 2013 / Accepted: 5 September 2015 / Published online: 24 September 2015

Abstract The New Cooperative Medical Scheme (NCMS) was implemented in 2003 in response to the poor state of health care in rural China. Considering the substantial differences in regional socioeconomics, preferences for health care needs, and concurrent implementation of other health-related policies, the extent to which the impact of the NCMS differs in rural communities across China is unclear. The objective of this paper, therefore, was to explore the variation in the determinants of household enrolment and the impact of enrolment on health care utilization and medical expenditures in three large geographic regions in China. A quasi-experiment study was designed based on the panel data of the China Health and Nutrition Survey. The bounding approach was used to conduct a robust check of impact estimation under the assumption of unobserved bias. A major finding is that household income plays no significant role for enrolment, which indicates the equity of program coverage in income terms. However, regional circumstances matter. In the generally poorer western regions, households with a high ratio of migrant workers are less attracted to the NCMS program, and adoption of the program is related to the regional infrastructure environment variables in the eastern and western regions. The NCMS has improved medical care utilization for poor income groups and regions (western regions). The NCMS's impact on reducing the incidence of catastrophic expenditures is not shown for all regions.

✉ Dan Liu
liudanren@googlemail.com

1 Institute of Regional Economics and Finance, Sichuan Agricultural University, No. 211 Huiming Rd. Wenjiang District, Chengdu 611130, China

2 Center for Development Research (ZEF), University of Bonn, Walter-Flex-Str.3, 53113 Bonn, Germany

3 Department of Medicine, Epidemiology and Biostatistics, Case Comprehensive Cancer Center, Case Western Reserve University, Cleveland, OH, USA

4 UN-Water Decade Programme on Capacity Development (UNW-DPC), United Nation University, UN Campus, Platz der Vereinten Nationen 1, 53113 Bonn, Germany

5 Mannheim Institute of Public Health, Social and Preventive Medicine, University of Heidelberg, Ludolf-Krehl-Strasse 7-11, 68167 Mannheim, Germany

Keywords Regional characteristics of rural China · Health care access · Health care expenditure · Propensity score matching · Bounding approach

JEL Classification D12 · H55 · C23 · C14 · I18

Introduction

Far-reaching economic reforms in China in the early 1980s resulted in the collapse of the rural Cooperative Medical Scheme (CMS). Since then, rural residents have been excluded from the social security system. A major consequence of these events was the creation of financial barriers, which resulted in a substantial reduction in access to basic health services, especially for the rural poor. For example, a national health survey reported that 38 % of the respondents did not seek medical services when they were sick, and 70 % refused hospitalization despite a physician's recommendation, which creates concern that excessive cost is the primary reason for these decisions (MOH, 2003). In response, a new program—the New Cooperative Medical Scheme (NCMS)—was introduced in 2003 to provide a government-subsidized health insurance scheme that is intended to promote health care utilization in rural China and interrupt a cycle of illness-based poverty. The potential distributional gains from such subsidized health insurance schemes are, however, usually accompanied by efficiency losses, which occur because of distortions in both the participants' behavior and in the allocation of resources to the health care sectors as a whole (Trujillo et al. 2005). As a result, it is imperative for us to carefully evaluate the effectiveness of these programs concerning the extent to which they achieve their desired objectives.

Previous works have examined the effectiveness of the NCMS in improving health care access and reducing the economic burden in small pilot studies and in large population-based samples. These studies, however, yielded mixed results. A study that assessed NCMS pilot programs in 2003 in selected counties, for example, found that enrolment in the NCMS was associated with a 20–30 % increase in the use of outpatient and inpatient services but was not associated with lower overall out-of-pocket expenditures (Wagstaff et al. 2007). A second study that used hospital financial accounting data (Gu and Fang 2007) found that medical expenditures did not decrease significantly following NCMS implementation. A third study observed similar findings but could not confirm an overall increase in the use of formal medical services[1] or an improvement in the health status of the population (Lei and Lin 2009).

Program effectiveness is often assessed by using outcome measures that are summarized across all participants, yet the impact may differ in meaningful ways according to key characteristics in the population (Khandker et al. 2010). Rural China has been previously rendered a 'three-world' characterization that reflects its diversity concerning geography, economic development, public resources, society and culture, population health indicators and demand. This characterization includes the coastal, high-income region (the first world), the central, middle-income region (the second world), and the western, low-income region (the third world) (Liu and Rao 2006). The people who live in poor rural areas experience difficulties in accessing basic health care services, and even a relatively low amount of medical expenses can cause financial hardship and aggravate poverty. By contrast, people from the central

[1] Here, formal medical services are contrasted with services that are provided by traditional folk doctors. Chinese folk doctors refer to individuals who work in private clinics, are not officially licensed and have only limited medical training.

regions have the greatest variation in levels of income and financial vulnerability to health care costs, whereas the people from the eastern regions tend to protect themselves against catastrophic medical expenses that often result from episodes of hospitalization. Given the diverse socioeconomic conditions and health care demands in each region, the NCMS has not been designed as a universal rural health insurance program. With central guidelines, local governments are authorized to retain considerable discretion over the benefit package design and local implementation of the NCMS. An expectation that differential effects may arise following implementation of the NCMS in rural China is further supported by regional heterogeneities. The extent to which important differences in NCMS effectiveness exists in these socially and culturally distinct regions of China, however, has not yet been established. This study explores the potential for the NCMS's policy differences in its impact across rural China and thus provides valuable feedback to facilitate future planning and policy development.

The objectives of this paper, therefore, are to explore the variation in the determinants of enrolment and the impact of the NCMS in each of China's three large geographic regions, specifically in promoting health care utilization and reducing outpatient and inpatient expenditures through insurance reimbursement. We also explore the differences in both the utilization and expenditures by income groups. The remainder of this paper is organized in sections with the second section devoted to the descriptions of the NCMS program. The third section elaborates the analytical methods, data source and study sample, and the fourth and fifth sections present the results and discussion, respectively. A final section concludes this paper.

The New Cooperative Medical Scheme in rural China

The central government issues three broad guidelines[2] as basic rules for the NCMS nationwide. (1) Participation in the NCMS is voluntary and based on household unit. (2) The NCMS is conducted at the county-level[3] rather than the village or township levels. (3) The NCMS focuses on catastrophic illnesses and receives contributions from both governments (central and local) and individuals. After following these guidelines, local governments can arrange the implementation of the NCMS based on their fiscal conditions and local needs.

Financing mechanism of the NCMS

The financing of the NCMS contains both individual and government contributions. In the early stages of the NCMS, the premium of each enrollee was a minimum of 10 Yuan (per year), which was contributed by households. Enrollees who lived in the central and western provinces of China received a subsidy of 20 Yuan[4] on the premium (US$ 3.1) (per enrollee, per year); 10 Yuan is from the local government and another 10 Yuan was a matching subsidy from the central government. For the relatively more affluent eastern provinces, the

[2] The 2002 State Council Policy Document No. 13, *Decisions of the State Council on Strengthen Rural Healthcare* (State Council, 2002).

[3] County-level governments in China include urban districts (suburbs), county-level cities and counties. The new program is targeted at rural residents. Most (but not all) rural residents reside in counties; urban districts and county-level cities that contain rural residents also receive the program. In China, most rural counties have a population that ranges from 200,000 to 300,000 people.

[4] 1US$ = 6,38 Yuan (September, 2011).

local governments were required to subsidize the same amount of 20 Yuan (MOH, 2003). Since 2006, the government's subsidies were raised to 40 Yuan per enrollee per year, and simultaneously, the subsidy program was extended to include the eastern provinces (China Ministry of Health and Ministry of Finance, 2008). In 2009, the government's subsidies were revised to 80 Yuan for all three provinces and the per capita premium was formally required to be no less than 20 Yuan per year.

Localities have the right to adjust their own insurance protection levels according to the local economy and specific needs. The central government only formulates the minimum requirement on individual contributions. The financial levels across different regions have shown significant discrepancies at the initial stage of implementation of the NCMS, followed by distinct per capita net income levels (see Table 1).

Reimbursement modes of the NCMS

There are four major reimbursement modes in the NCMS, but only one mode can be adopted in one county; therefore, an enrollee cannot freely choose. The reimbursement can only be claimed in the county where a person is enrolled. The most commonly adopted mode, which is implemented in approximately 66 % of the rural counties in China, is "*inpatient and household medical saving accounts*"[5] mode. Under this mode, inpatient services are reimbursed according to a certain formula (that is set by each county), whereas only registration or threshold fees for entering hospitals are paid for by household medical saving accounts. The second mode is "*inpatient only*", which accounts for 17 % of the counties. This type is popularly used in the majority of economically developed areas, such as the Jiangsu, Fujian and Zhejiang provinces. The third mode is "*inpatient and catastrophic care*", with separate deductibles and caps in inpatient and catastrophic expenditure reimbursement. This third mode is used in 11 % of the counties. The fourth mode is "*inpatient and outpatient pooling*", which has been adopted in 6.7 % of the counties. Under this mode, the reimbursement of inpatient care is the same as the first mode, but the outpatient services are compensated according to a certain formula through collective funds, usually with no deductible and no reimbursement cap (Du and Zhang 2007). In addition, some counties provide extra free physical check-ups (once per year) for the enrollees who have not used any medical services in that year.

All of the modes reflect "catastrophic illness-oriented" policy requirements (see Table 2). Because of limited financing levels, the reimbursement ratio is still not high; nationally, the average level is approximately 25 %. However, the actual amount of reimbursement that is obtained by the enrollees in the eastern regions is approximately two times the reimbursement of the central regions and approximately three times the reimbursement of the western regions. Overall, the financing of the NCMS is still low, and reimbursement is not high. Under this small budget, a concern is whether and how effectively the NCMS can achieve its goals. For the past 30 years, the Chinese government has provided no financial support to rural residents for the purchase of health care services (Liu and Rao 2006). Theoretically, health insurance can lower the effective prices of health care at the time when the consumer purchases it. Therefore, given these considerations, we would like to expect that the NCMS, to some extent, can promote medical utilization in rural residents, especially in the western regions. However, the role of the NCMS in reducing out-of-pocket expenses may be very limited.

[5] Each household has its own medical savings account, with household members who deposit their contributions (a very small ratio of the premium) into this account and then spend money from it only to offset minor expenditures. This account has no risk-sharing function; instead, it only plays a role in stimulating the enthusiasm of rural people to enroll in the NCMS.

Table 1 Resources of funding in the NCMS

	Per capita net income (Yuan)	Personal contribution (Yuan)	Per capita funds (Yuan)	Personal contributions as % of total funds	Provincial finance (Yuan)	Municipal finance (Yuan)	County finance (Yuan)	Other funds (Yuan)
Eastern	5295.51	32.04	83.15	38.53	4.76	3.77	12.99	26.20
Central	2517.14	10.45	32.30	32.35	3.37	2.92	5.01	0.91
Western	1824.86	10.24	34.77	29.45	5.19	3.14	4.27	0.04
Nationwide	3322.24	18.70	51.94	36.00	4.89	3.30	7.76	11.28

"Other funds" contain funding from village-level governments contribution and collective funds
Source Mao and Jiang (2004)

Table 2 Inpatient reimbursement in the NCMS

	Beneficiaries as % of enrollees	Costs per person per inpatient (Yuan)	Reimbursement per person per inpatient (Yuan)	Actual reimbursement ratio %
Eastern	3.44	5375.5	1378.1	25.64
Central	2.56	3061.9	740.2	24.17
Western	2.18	1805.5	466.0	25.81
Nationwide	2.77	3508.0	887.8	25.31

Source Mao and Jiang (2004)

Data and methods

Data source and study sample

The panel data from the 2004 and 2006 waves of the China Health and Nutrition Survey (CHNS) were used in this study. The CHNS is jointly conducted by the Carolina Population Center at the University of North Carolina, the National Institute of Nutrition and Food Safety, and the Chinese Center for Disease Control and Prevention. A stratified, multistage, random cluster process was used to obtain a study sample from nine of the 34 provincial administrative regions[6] (Fig. 1). The counties were stratified by income, and a weighted sampling scheme was used to randomly select four counties in each province. Then, three randomly chosen villages were selected in each county. In the CHNS, three of the provinces (*Liaoning, Jiangsu* and *Shandong*) are in eastern China,[7] four provinces (*Heilongjiang, Henan, Hubei* and *Hunan*) are in the central areas, and two provinces (*Guizhou* and *Guangxi*) are western provinces.

The CHNS sample was not designed to be representative of China but to be randomly selected, to capture a range of economic and demographic circumstances and to provide data from randomly selected households in each province (Popkin et al. 2010). The CHNS provided uniquely rich details for our analysis, and the data to create a representative provincial level sample could be obtained. Although in the text of this paper we refer specifically to these provinces, previous studies have shown that the characteristics of CHNS households and individuals are comparable with the characteristics of the national sample (Entwisle and Chen 2002; Du et al. 2002).

Because the NCMS targeted at rural residents only,[8] the residents of urban areas and county-town neighborhoods in the CHNS data were excluded. In the analysis of health care utilization, we further restricted our sample to individuals in a household who are aged $\geq$15 years and reported that they currently have no other forms of health insurance. Children's health would be difficult to interpret, given that the intensity of regular check-ups naturally decreases as they get older. Moreover, the CHNS survey did not distinguish insurance types

[6] China is composed of 23 provinces, 5 autonomous regions, 4 municipalities and 2 special administrative regions for a total of 34 distinct provincial administrative regions.

[7] According to the interpretation of China's National Development and Reform Mission in 2003, the division of regions in China is based on policy criteria rather than an administrative or geographical concept.

[8] Rural residents are identified through formal registration in the "*hukou*" systems in China. Residents of county-town neighborhoods are categorized as urban dwellers and are therefore not eligible for enrolment in the NCMS.

Fig. 1 CHNS survey in China (Shadow areas). *Source* China Health and Nutrition Survey www.cpc.unc.edu/projects

from service usage; therefore, we lack sufficient information to determine whether health care utilization relates to the NCMS or other health insurance types.

A quasi-experimental design

"What would have happened to the people who enrolled in the NCMS if they had not enrolled?" Because one cannot simultaneously observe the outcomes of an individual who is both a 'participant' and a 'non-participant' in the same program, one must create a state of *unconfoundedness*[9] to enable statistical comparisons. Propensity score matching (PSM) is a tool that is commonly used in quasi-experimental studies to reduce selection bias in observational data, assuming that all observations are randomly selected for participation.

The propensity score is defined as the conditional probability of participating in a program given certain observable variables (Rosenbaum and Rubin 1983). In our study, the propensity score that is generated for each household by using a logit model with potential confounders may have affected the choice to enroll in the NCMS. Based on the estimated score, Kernel

[9] '*Unconfoundedness*', a term coined by Rubin (1990), refers to circumstances in which adjusting for differences in a fixed set of covariates reduces selection bias and balances the differences between treated and untreated units, which enables the researcher to draw causal inferences that are independent of these differences.

matching (KM), a process of non-parametric estimation that uses the weighted averages of all individuals in the control group, was used to construct the counterfactual outcome. Kernel weight is a decreasing function of the absolute difference in propensity score between the treated and untreated units (Smith and Todd 2005); a major advantage of kernel matching is the lower variance that is achieved because of more information that is used as a result (Caliendo and Kopenig 2008). However, this 'advantage' could turn into a drawback because of 'bad matches'. Therefore, the proper imposition of the common support[10] condition is significant for kernel matching (Heckman et al. 1997, 1998), which increases the accuracy of the matching.

The Propensity Score Matching (PSM) estimator is thus the mean difference in outcome over the common support, which is appropriately weighted by the propensity score distribution of the participants. In particular, we are interested in the *average treatment effect on the treated* (ATT), because it refers to the difference between the expected outcomes value with and without the treatment for the people who actually participate in the treatment. The calculation of kernel weights (ω) is specified as follows (Khandker et al. 2010):

$$\omega(i, j)_{KM} = \frac{K\left(\frac{P_j - P_i}{a_n}\right)}{\sum_{k \in C} K\left(\frac{P_k - P_i}{a_n}\right)},$$

In this equation, P_i and P_j are the propensity scores for the participant (in this study, enrolled-household) i and for the non-participant, j. The $K(.)$ is a kernel function, and a_n is a bandwidth parameter. P_k is the propensity score of the 'matched' participant from the control groups. In our study, the Gaussian kernel and a bandwidth of 0.06 are used.

The analysis considers only the individuals who were actually enrolled in the NCMS program at the time of the survey in wave 2006 as the treatment group because the CHNS questionnaire does not ask enrollees whether they have remained in the program without interruption between 2004 and 2006. Moreover, the insurance period of the NCMS relates to an annual basis. Therefore, the evaluation excludes all of the observations from the NCMS-pioneer counties (piloted in 2003/2004) in wave 2006 and uses enrollees from the 'follow-up NCMS' counties (piloted in 2005/2006) as a treatment group to obtain a better (although a more conservative) measure of the impact. In this way, by using wave 2004 information as the pre-intervention variables to predict the probabilities of enrolment, this method also guarantees that all covariates were strictly exogenous in the propensity score estimation equation.

The control group is constructed from the non-NCMS counties in wave 2006. Given that no information involves whether the NCMS affects behaviors of both non-enrollees and health care providers in NCMS counties, we therefore use observations from non-NCMS counties in 2006 as the only control group to avoid any mixed impact interference. In effect, it is appropriate to adopt PSM in a setting where both groups (treatment and control) come from their respective economic environment (Jalan and Ravallion 2003). The identification of the treatment and control groups are shown in Table 3.

In addition, considering the time interval between the actual interview in the CHNS each round and the coverage period of the NCMS every year,[11] our analysis reflects only the short-

[10] Common support region ensures that the individuals with similar covariates have a positive probability of being either participants or non-participants (Heckman et al. 1999). Implementing the common support condition ensures that any combination of characteristics that are observed in the treatment group can also be observed in the control group (Bryson et al. 2002).

[11] The insurance period for the NCMS is one year. In the last quarter of every year, individuals may choose whether they will remain enrolled in the coming year.

Table 3 Identification of treatment and control group

	Wave 2004		Wave 2006		
	NCMS-pioneer counties piloted in 2003/2004	Non-NCMS counties	NCMS-pioneer counties piloted in 2003/2004	Follow-up NCMS counties piloted in 2005/2006	Non-NCMS counties
Enrollment				Treatment group	
Not-enrollment					Control group

The treatmet group only takes enrollees from the follow-up NCMS counties in wave 2006. The control group is from Non-NCMS counties in wave 2006. For more details, please refer to the content

term impact of enrolment and makes no attempt to estimate the effects on health because these may take longer to realize.

Bounding approach

Matching and balancing remove biases because of the non-overlapping support region and the differences in the propensity score distributions of the treatment and control households (Johar 2009). However, matching and balancing do not remove bias that results from unobserved and, therefore, unmeasured variables. If unobserved variables simultaneously affect participation and the outcome variable, a 'hidden bias' may arise for which matching estimators are not robust (Rosenbaum 2002). To address whether the inferences that are derived from our propensity-matching analysis of the participation effects may be affected by unobserved factors, we adopt the bounding approach that is proposed by Rosenbaum (2002).

If a hidden bias u exists, in theory, two individuals (i and j) with the same observed covariates (say x) would have differing chances of participation. The odds ratio for receiving participation is given by the following:

$$\frac{P_i(1-P_j)}{P_j(1-P_i)} = \frac{\exp(\beta x_i + \gamma u_i)}{\exp(\beta x_j + \gamma u_j)}$$

where u is the unobserved variable, and γ is the effect of u on the participation decision. Therefore, if there are either no differences in the unobserved variables ($u_i = u_j$) or if the unobserved variables have no influence on the probability of participation ($\gamma = 0$), the odds ratio is one, which implies the absence of hidden or unobserved selection bias (Becker and Caliendo 2007). Rosenbaum (2002) suggests that the following bounds on the odds-ratio, that either of the two matched individuals will choose to participate is given by:

$$\frac{1}{e^{\gamma}} \leq \frac{P_i(1-P_j)}{P_i(1-P_i)} \leq e^{\gamma}$$

Both matched individuals have the same probability of participating only if $e^{\gamma} = 1$. Using this logic, e^{γ} is a measure of the extent to which a study is free of 'hidden bias'. In practice, for binary outcomes, Aakvik (2008) suggests the use of the non-parametric Mantel–Haenszel (MH, 1959) test statistic Q_{MH} in assessing the null hypothesis $\gamma = 0$ for binary outcomes. The test involves comparing the number of participants who benefited from program attendance and whether the program has no effect:

$$Q_{MH} = \frac{\left|Y_1^D - \sum_s^S E(Y_{1s}^D)\right| - 0.5}{\sqrt{\sum_{s=1}^S \text{var}(Y_{1s}^D)}}$$

where Y_{1s}^D is the number of positive outcomes for participation in stratum s of the sample and is the total number of positive outcome in stratum s. Under the null hypothesis, there is no participation effect, and a positive outcome is equally likely for participant and non-participant units. The strata reflect the estimated propensity score. For a fixed $e^{\gamma} > 1$ and $u \in \{0, 1\}$, Rosenbaum (2002) shows that the test statistic can be bounded by two known distributions, which move apart from one another and reflect uncertainty regarding the test statistic in the presence of unobserved selection bias.

Dependent variables

Enrollment status is from the report of the household heads, which is set as a binary variable to capture the probability of household unit participation in the NCMS. With the outcome evaluation, we consider the following three dichotomous variables that relate to the previous 4 weeks to measure health care utilization: (1) whether the individual has used outpatient care;[12] (2) whether the individual has been in the hospital; and (3) whether the individual has used preventive care.[13] Meanwhile, the study investigates the discrepancy of outpatient utilization among different medical service providers[14] and income groups.

Health care expenditures were estimated at the household level and calculated as net out-of-pocket expenses after excluding reimbursement. A catastrophic health expenditure (CHE),[15] which is used to indicate economic vulnerability to impoverishment that is related to excessive health care expenses, was considered present when household health care costs exceeded a specific proportion of total household income (Wagstaff and van Doorslaer 2010). Thresholds of both 10 and 20 % of income were used in the sensitivity analyses, which are described in further detail below.

Independent variables

Household and individual level characteristics were obtained from the responses to the CHNS survey to predict the probability of household enrolment in the NCMS. These variables included household head attributions, household socio-economic and socio-demographic characteristics, household opportunity cost to access health care, and household risk attributes. (For the details of each variable group, please see Table 6.) Household sanitary conditions, including access to safe sources of drinking water and toilet facilities, and the location of the household may also affect the health status of household members and the likelihood that health care services must be accessed (Gertler et al. 1987; Dor et al. 1988). Each of these variables was represented by using a dummy indica-

[12] Here, outpatient care is medical care that is provided on an outpatient basis, including diagnosis, observation, consultation, treatment, intervention, and some rehabilitation services.

[13] Preventive care involves measures that are taken for disease prevention instead of disease treatment, such as a physical check-up (once per year), family planning instruction, psychological counseling, and immunity services.

[14] Considering only 4-week references, we do not go in-depth here to detect inpatient utilization.

[15] Here, we do not use "ability-to-pay" as a denominator because this number can be zero or negative in rural households. In the case where "ability-to-pay" is zero, the ratio of health care spending to income is undefined, and households with negative values of "ability-to-pay" will result in smaller (in numerical size) values of the ratio than the households with small health care spending and/or large incomes.

tor. The economic status of the household was measured by using household per capita income[16] and a computed index of household assets, which served as a proxy for accumulated wealth[17] (Trujillo et al. 2005). The index was based on a factor analysis of items that assessed the availability of 28 household goods, including household electrical appliances, a mode of transportation (e.g., car, motorcycle, bicycle, and tractor), equipment, and farm machinery.

In rural China, young adults, males, and people with higher educational attainment or good health are more likely to migrate to urban areas for employment (Wu 2010). In many cases, these people are the primary breadwinners of their households. Both potential incentives and disincentives to enroll in the NCMS may exist for these people, and the potential of the NCMS scheme to households with migrant workers has not yet been researched. Administratively, these people are not permitted to register for employer-based health insurance in the urban areas because of the limitations of the Chinese registration system (called "*Hukou*"), nor are they eligible in other rural areas where they are not registered. Migrant workers can only enroll in the NCMS in their home district (where their *Hukou* is located) and can only claim reimbursement for medical expenses in their home district. High opportunity costs (e.g., transportation costs, lost working days) and a complicated procedure of declaration on the reimbursement would result in a lower willingness to enroll for migrant workers; their decision will further affect household enrolment. However, to the contrary, enrollment in the NCMS may help the vulnerable groups (such as females, the elderly, and children) that are left at home to obtain better financial protection from induced medical expenditures, which would ease the concerns on the families of migrant workers. Given these considerations, we generated a binary indicator to examine whether the households with migrant workers are more likely to enroll in the NCMS.

Results

As a result, restricted to the followed households with complete enrollment information, we end up with a sample of 738 households in the treatment group and 1320 households in the control group (all from wave 2006). On average, the household enrolment rate across all three regions in the NCMS at the time of the follow up in 2006 is 69.78 %. Table 4 provides comparisons of the features of the NCMS in eastern, central and western rural China. Table 5 describes the percentage distribution of the NCMS enrollees (treatment group) with households that are ranked by per capita income. Approximately 21 % of the individuals from the lowest income group are enrolled in the NCMS. For people in the two middle groups, the number is approximately 60 % together. This pattern indicates that the richest class does not capture the coverage and accords with the NCMS initiative to cover rural residents.

Overall (across three regions in 2006), the average 4-week out-patient and inpatient utilization were 11 and 0.1 %, respectively, and were similar for both the enrolment and non-enrolment groups. The descriptive statistics for the selected independent variables that were studied in the three regions are listed in Table 6.

[16] The CHNS survey collected income information for each interviewee (except children) from all sources, including income from agriculture, animal husbandry, sales, earnings and pensions. The household per capita income is calculated by dividing total household income by household size.

[17] Both medical expenditures and household income were expressed in Yuan and adjusted to 2006 values. The consumer price index from the Liaoning province was the reference that was used by the CHNS.

Table 4 Regional distribution of the 'follow-up' NCMS counties (piloted in 2005/2006) in wave 2006

	Wave 2006		
	Eastern regions	Central regions	Western regions
Number of counties have NCMS	6	7	4
Number of suburban villages have NCMS	1	3	2
Number of households in NCMS counties (05/06)	384	501	293
Number of individuals in NCMS counties (05/06)	944	1305	849
Average outpatient reimbursement ratio (%)	28.80	16.59	48.91
Average inpatient reimbursement ratio (%)	41.85	51.72	40.84
Enrolment rate (%)[a]	70.83	77.45	55.29
Overall enrolment rate		69.78 %	

[a] Household level enrollment rate within NCMS counties. Concerning the calculation of reimbursement ratio (outpatient and inpatient) is derived from individual-level since the CHNS survey only asks reimbursement information from individual-level

Table 5 Percentage of rural people living in households enrolled in the NCMS program in wave 2006, by per capita income

	Percentage
Lowest (20 %)	21.07
Lower middle (30 %)	31.08
Upper middle (30 %)	30.22
Highest (20 %)	17.64
N	2098

Sources CHNS data, wave 2006

Propensity score estimation

Given the rule of 'household enrollment as a unit' in the NCMS, the members of a household should have identical propensity scores because they have the same exposure status. Households in the treatment group are matched to households in the potential control group, and the matching equation is a function of the conditions in wave 2004 (pre-intervention). The propensity score is separately estimated for the three regions in our sample. Table 7 presents the propensity score that forms the basis of the matching that is subsequently conducted. The Pseudo R-squared for the regional models ranged between 0.112 and 0.589. The sample size of the treatment and matched groups—concerning individuals—are different because the household sizes vary. Our samples for the three regions passed the balancing test as described by Becker and Ichino (2002).[18] The marginal effects of the coefficients in the logit

[18] The Passing Balancing test means that observations with the same propensity score must have the same distribution of observable (and unobservable) characteristics independent of treatment status. For a given propensity score, the exposure to treatment is random and, therefore, the treated and control units should be on average observationally identical (Becker and Ichino 2002). The results are available on request.

Table 6 Descriptive statistics for independent variables between treated groups and control groups across three regions in China

Variables	Eastern China		Central China		Western China	
	Treatment Mean	Control Mean	Treatment Mean	Control Mean	Treatment Mean	Control Mean
Household head attributions						
Female head of household	0.136	0.227	0.137	0.209	0.199	0.224
Head of household employed	0.732	0.559	0.850	0.655	0.845	0.689
Married	0.928	0.840	0.871	0.878	0.795	0.824
Age of head	48.746	56.011	49.064	50.816	55.121	53.639
Age square of head (ref: illiterate or semi-literate)	2478.451	3281.664	2558.536	2726.415	3245.679	3054.554
Primary school	0.341	0.363	0.425	0.409	0.437	0.455
Junior high school	0.438	0.302	0.349	0.327	0.331	0.324
Senior high school and above	0.189	0.208	0.144	0.175	0.049	0.114
Household socio-economic and -demographic characteristics						
Household size	3.368	3.142	3.588	3.506	3.863	4.236
Asset index	−0.140	0.574	−0.301	0.078	−0.296	−0.224
Ln Hh per capita income[a]	7.905	8.896	8.025	7.795	7.975	7.654
Someone in household own other type of health insurance	0.108	0.233	0.050	0.113	0.089	0.131
Share of household members who are migrant workers	0.098	0.036	0.119	0.112	0.086	0.119
Drinking water for household is not from water plant	0.888	0.194	0.847	0.698	0.545	0.574
Toilet facilities in household is earth or cement open pit	0.819	0.310	0.768	0.634	0.752	0.537
Household opportunity cost to access to health care						
Travel time (min) by bike to household ordinary used facility	15.404	15.333	11.505	16.663	13.854	11.437
Average waiting time to be seen by health worker	5.754	13.964	6.531	10.367	8.431	8.829
Household risk attributes						
Share of household members under 14 ($\leq$14)	8.760	6.652	12.941	10.643	15.179	17.089
Share of household members over 60 ($\geq$60)	13.767	30.352	15.902	17.854	29.462	23.169
Share of household members with chronic (age $\geq$ 12)	16.033	21.375	10.945	11.934	9.817	7.170
Share of household members with self-assessed bad health (age $\geq$ 12)	5.513	5.524	6.116	7.287	7.329	7.870

Table 6 continued

Variables	Eastern China		Central China		Western China	
	Treatment Mean	Control Mean	Treatment Mean	Control Mean	Treatment Mean	Control Mean
Share of household members with self-assessed fair health (age ≥ 12)	32.780	31.999	28.879	34.154	38.573	40.761
N (Nr. of households)	250	331	342	646	146	343

[a] Income and expenditures are inflated to year 2006 and adjusted based on Liaoning province

models are also shown; thus, a change in any one of the independent variables impacts the probability of the willingness to be enrolled.

As expected, we found discrepancies in the household determinants to enroll in the NCMS. In eastern China, the results indicate that household heads who have a 'married' status, poor sanitation environment (drinking water and toilet), high ratio of children, chronically ill family members and more family members who report their health as 'fair' are more likely to enroll in the NCMS. These results reflect health-related adverse selection. In particular, the living environment can affect health status significantly; for example, a one percent increase in households with a poorer condition of drinking water would increase the enrollment rate by 31 % in the eastern regions. In the central regions, economy-related adverse selection was observed. However, relatively wealthy households are found to have a higher likelihood of enrollment in the NCMS. In 2009, the rural per capita net income in the central regions was 4864.8 Yuan, which accounts for 72 % of the eastern regions and is 1.32 times the rural per capita net income of the western regions (Green book of China's Rural Economy, 2011). A 'middle-level-economic' position may cause people from the central regions to have the greatest variation in the levels of financial vulnerability to health care costs. Meanwhile, other types of health insurance industry in the central regions (even in the western regions) lag far behind the eastern areas; therefore, wealthier households in the middle regions seek more protection by enrolling in the NCMS.

In the western regions, the households with a poor living environment (e.g., no toilet facilities) preferred to enroll in the NCMS. However, income is not a strong determinant, although considered household head with employment, it would increase the probability of enrollment by 17.6 %, two other income-related factors (asset index and household per capita income) have no significant role in promoting enrollment. In fact, under the strong support of government subsidies, more low-income households in the western regions have little difficulty in paying the premium.[19] Enrolment in the NCMS reduces the threshold fees when accessing rural healthcare services; therefore, it may promote health care utilization. In addition, the households with a higher ratio of migrant workers are found to be less likely to enroll in the NCMS in the western regions. The results indicate that a one percent point increase on migrant workers in the household would decrease the probability of enrollment by 26 % in the western regions. Because of limited earnings, 74 % of the migrant workers in China have no health insurance. Only 32 % of migrant workers will seek formal medical care utilization when they are sick, 38 % of them will buy medicine from pharmacies, and 20 %

[19] For the poorest households, the local government will provide special financial assistant and cover their premium.

Table 7 Propensity score estimation (logit), by regions

Variables	Eastern China			Central China			Western China		
	Coef.	SE	Marginal effect	Coef.	SE	Marginal effect	Coef.	SE	Marginal effect
Household head attributions									
Female head of household	0.610	0.456	0.053	−0.274	0.254	−0.058	−0.015	0.386	−0.011
Head of household employed	−1.124**	0.441	−0.097	1.050***	0.232	0.211	0.955**	0.375	0.176
Married	1.644***	0.572	0.141	−0.558*	0.293	−0.114	−0.204	0.401	−0.036
Age of head	0.066	0.148	0.006	−0.101*	0.058	−0.021	−0.147**	0.074	−0.027
Age square of head	−0.001	0.001	−0.000	0.001	0.001	0.000	0.001**	0.001	0.000
Education of household head (ref: illiterate or semi-literate	2.177***	0.668	0.187	−0.284	0.361	−0.057	−0.344	0.438	−0.064
Primary school	2.745***	0.709	0.236	−0.237	0.394	−0.048	−0.220	0.501	−0.044
Junior high school	2.870***	0.784	0.247	−0.405	0.429	−0.082	−0.680	0.707	−0.128
Senior high school and above									
Household socio-economic and -demographic characteristics									
Household size	−0.541***	0.178	−0.047	0.100	0.072	0.018	0.059	0.105	0.006
Asset index[a]	0.220	0.188	0.019	−0.503***	0.144	−0.101	−0.007	0.215	0.003
Ln Hh per capita income[b]	−0.877***	0.221	−0.076	0.146**	0.060	0.030	0.166	0.118	0.030
Someone in household own other type of health insurance	−0.815	0.518	−0.070	−0.846***	0.316	−0.171	−0.259	0.430	−0.055
Share of household members are migrant workers	−0.019	1.153	−0.002	−0.136	0.193	−0.038	−0.593**	0.298	0.256
Drinking water for household is not from water plant	3.614***	0.426	0.311	0.203	0.232	0.041	−0.681***	0.258	−0.124
Toilet facilities in household is earth or cement open pit	1.838***	0.397	0.158	0.112	0.200	0.023	1.212***	0.308	0.217

Table 7 continued

Variables	Eastern China			Central China			Western China		
	Coef.	SE	Marginal effect	Coef.	SE	Marginal effect	Coef.	SE	Marginal effect
Household opportunity cost to access to health care									
Travel time (min) by bike to household ordinary used facility	0.001	0.009	0.000	−0.026***	0.007	−0.005	0.031***	0.013	0.006
Average waiting time to be seen by health worker	−0.041***	0.016	−0.004	−0.011	0.008	−0.002	−0.002	0.005	−0.002
Household risk attributes									
Share of household members under 14 (≤14)[c]	0.038***	0.015	0.003	−0.006	0.006	−0.001	−0.007	0.008	−0.001
Share of household members over 60 (≥60)	−0.012	0.008	−0.001	−0.001	0.004	−0.000	0.002	0.006	0.000
Share of household members with chronic (age ≥ 12)	0.024***	0.007	0.002	0.001	0.004	0.000	0.007	0.006	0.001
Share of household members with bad health (age ≥ 12)	−0.000	0.010	−0.000	−0.002	0.004	−0.000	−0.013*	0.007	−0.002
Share of household members with fair health (age ≥ 12)	0.008*	0.005	0.001	−0.005**	0.002	−0.001	−0.008**	0.004	−0.002
Constant	2.302	4.110	–	1.000	1.506	–	0.581	1.979	–
Pseudo R-squared	0.589			0.112			0.127		
N	498			830			402		

*, **, *** respectively denotes statistical significance at 10, 5 and 1 %

[a] The index was created using a factor analysis technique based on a list of 28 household asset items, including household electrical appliances and other goods, household transportation tools and equipment, and farm machinery

[b] Per capita income is measured on the basis of equal weights for household member. Income and expenditures are inflated to year 2006 and adjusted based on Liaoning province

[c] "Share of household members…" points at percentage

Table 8 Propensity score matching results—estimated average treatment effect on the treated (ATT)

Outcome variables	Eastern China		Central China		Western China	
	ATT	SE[b]	ATT	SE	ATT	SE
Health care utilization						
Outpatient utilization in the last 4 weeks[a]	0.081***	0.015	0.011	0.017	0.074***	0.025
Outpatient utilization in village-level clinics	0.034***	0.008	0.028**	0.012	0.022	0.015
Outpatient utilization in town-level hospitals	0.008	0.010	−0.006	0.007	0.026*	0.014
Outpatient utilization in county-level hospitals	0.008*	0.004	0.009*	0.005	0.007	0.008
Outpatient utilization in municipal-level hospitals	0.005	0.004	−0.007	0.005	−0.000	0.004
Inpatient utilization in the last 4 weeks	0.005	0.004	0.001	0.004	0.017*	0.009
Preventive care in the last 4 weeks	0.007	0.005	−0.003	0.007	0.052***	0.013
Medical expenditures						
Outpatient expenditure in last 4 weeks	116.783	155.85	−67.653	70.48	2.310	17.31
Inpatient expenditure in last 4 weeks	−39.777	55.14	−106.581	87.74	38.788	30.55
Incidence of catastrophic expenditure						
10 % as threshold	0.018	0.25	−0.022	0.06	0.162**	0.08
20 % as threshold	−0.057	0.26	−0.067	0.052	0.102*	0.06

*, **, *** respectively denotes statistical significance at 10, 5 and 1 % level
[a] Considering only 4-week references, here we do not go into depth of detecting inpatient utilization
[b] Bootstrapped standard errors with 100 replications

will visit private doctors[20] (Jia 2008). The high health care costs in coastal cities (eastern regions), an inconvenient reimbursement procedure and small repayment make the NCMS less attractive to migrant workers. Moreover, because of regional heterogeneities, source areas and destination areas could issue different NCMS policies, and normally, destination areas can provide preferential conditions. Obviously, migrant workers are more likely to choose the NCMS of destination areas. However, because the household members of migrant workers are not covered in the insurance and because of the rule of 'household enrolled as a unit', this again limits migrant workers' options.

Impact estimation

After estimating the propensity score for the treated and control groups, we restricted the observations in common support areas to calculate the ATT.[21] Table 8 reports the impact estimates of the NCMS on medical care utilization and medical expenditures. Table 8 includes the percentage average change on the treated group (ATT) under different regions.

[20] The private doctor in China is different than in western countries and does not always have a doctor's license.

[21] Please see Appendix to see the common support areas for the three regions.

Derived from individual-level information (adult, age $\geq$ 15), the NCMS has a statistically significant positive impact on promoting the overall outpatient utilization for both the eastern (8 %) and western regions (7 %). By contrast, the NCMS in the central regions showed less impact on outpatient utilization because there are slight positive impacts on outpatient utilization in village-level (3 %) and county-level (1 %) medical care institutions. The NCMS has a relatively larger positive impact on the western regions and not only increases outpatient utilization (7 % increase in outpatient utilization as a result of the NCMS enrollment) but also promotes inpatient utilization (2 % increase) and preventive care (5 % increase). Concerning the choice of different health care providers, the result of outpatient utilization in the western regions indicates that the NCMS can only significantly promote rural people's return to town-level hospitals (3 % increase), not to village-level or county-level institutions, which is shown in the other regions.

In contrast, the NCMS has no statistically significant impact on reducing either outpatient or inpatient expenditures. The NCMS has not only failed to diminish the financial burden that is caused by paying for healthcare services but also increased the incidence of catastrophic expenditure for the western regions. However, it is difficult to judge whether a higher or lower incidence is good without comparing the medical quality that is provided. The higher incidence may be induced by services that were not previously covered; thus, the cost improves survival. Alternatively, this result can be explained by reasons such as moral hazard or inappropriate policy formulation. For example, an inappropriate deductible or coinsurance could result in the poor being excluded from the benefit while it incentivizes the rich to use more health care services.

Table 9 reflects the selected impacts by household per capita income. Given our propensity score estimation, which was separately derived for the different regions to analyze heterogeneous impact based on income groups, we implemented *nearest neighbor* matching with a radius of 0.01. For each household in the treatment group, we selected a control-household with the nearest value of the propensity score. In this way, we try to limit the matched groups that come from the same regions. Table 9 indicates several interesting differences in each income centile concerning the impact of the NCMS on medical care utilization, cure expenditures and the incidence of catastrophic expenditure. The NCMS seems to favor the richest groups, considering that statistically significant impacts are found in reducing inpatient expenditures and decreasing the incidence of catastrophic expenditures (24 %, when 20 % is used as a threshold).

Sensitivity test results

Considering that the main impacts are mostly found in the binary outcomes, here we do not check the sensitivity for continuous outcome variables.[22] The bounds are calculated by using the routine of Becker and Caliendo (2007), and the matched groups are found by radius matching with a radius of 0.01.[23] The test may be unsuitable for kernel matching, which uses the entire sample as the matching pair (Johar 2009). The upper bounds adjust the MH test statistics downwards when the ATT is overestimated, and the lower bounds adjust the MH test statistics upwards when the ATT is underestimated.

[22] In our estimation, the only statistically significant impact of a continuous variable is found in inpatient expenditure for centile 4; otherwise, we do not have significant impacts. For continuous outcome variables, we did not check sensitivity in our paper, but we propose to use "bounds" by DiPrete and Gangl (2004).

[23] As indicated in the paper of Becker and Caliendo (2007), the test is suitable for k-nearest neighbor matching without replacement and for stratification matching.

Table 9 Estimated average treatment effect on the treated (ATT) on medical care utilization and medical expenditure, by income group

Outcome variables	Income group	Kernel weights	
		ATT	SE[a]
Outpatient utilization in the last 4 weeks	Lowest (20 %)	0.026	(0.04)
	Lower middle (30 %)	0.057**	(0.02)
	Upper middle (30 %)	0.013	(0.02)
	Highest (20 %)	0.051	(0.03)
Inpatient utilization in the last 4 weeks	Lowest (20 %)	−0.004	(0.01)
	Lower middle (30 %)	0.013**	(0.01)
	Upper middle (30 %)	0.006	(0.01)
	Highest (20 %)	−0.010	(0.01)
Outpatient expenditure in last 4 weeks	Lowest (20 %)	−19.520	(22.31)
	Lower middle (30 %)	−122.763	(84.30)
	Upper middle (30 %)	−131.142	(−131.14)
	Highest (20 %)	487.685	(473.70)
Inpatient expenditure in last 4 weeks	Lowest (20 %)	−326.365	(381.31)
	Lower middle (30 %)	−6.507	(15.67)
	Upper middle (30 %)	−72.007	(58.29)
	Highest (20 %)	−138.800**	(116.20)
Incidence of catastrophic expenditure			
10 % as threshold	Lowest (20 %)	0.006	(0.19)
	Lower middle (30 %)	−0.061	(0.11)
	Upper middle (30 %)	0.006	(0.16)
	Highest (20 %)	−0.280*	(0.22)
20 % as threshold	Lowest (20 %)	−0.071	(0.20)
	Lower middle (30 %)	−0.146*	(0.12)
	Upper middle (30 %)	−0.135	(0.14)
	Highest (20 %)	−0.240*	(0.23)

*, ** respectively denotes statistical significance at 10 and 5 % level
[a] Bootstrapped standard errors with 100 replications in brackets

For the NCMS program, the direction of the hidden bias is not obvious. The true effect may be the reverse of the estimated impact if the hidden bias dominates in the opposite direction. Nevertheless, given that most of the ATT for medical care utilization have positive signs and assuming that we have underestimated the true treatment effect, the bounds are somehow less interesting. If individuals with a low value of unobserved variables are overrepresented in the treatment samples, then the true effects will be larger and more significant than estimated, which is undesirable. Therefore, we shall focus on the overestimation cases.

The tests[24] for medical care utilization suggest that at the small level of e^{γ}, the enrollment of individuals in the NCMS will have significant positive effects on outpatient utilization (in the eastern region), outpatient utilization at village-level clinics (both in the eastern and central regions), and inpatient utilization and preventive care utilization (in the western regions).

[24] The results are available on request.

However, the significant impact of the NCMS on outpatient utilization at county-level hospitals no longer exists in both the eastern and central regions even when $e^{\gamma} = 1$. This result means that there are definitely unobserved characteristics between the treatment and control groups. In the western regions, the significant impact on outpatient utilization and the outpatient utilization at town-level hospitals are still found when $e^{\gamma} = 1$, but the positive results may be reversed if the treatment groups are allowed to differ from their counterparts in the control groups concerning the unobserved bias by 25 and 20 % or more, respectively.

Our estimation is robust regarding the significant and positive effectiveness of the NCMS on the incidence of catastrophic expenditure in the western regions. This effect is because only when the unobserved bias between the treatment and control groups achieves 35 % or more, the estimated impact will be reversed. Meanwhile, for the heterogeneous impacts on income groups, the test indicates that the significant positive impacts of the NCMS on outpatient and inpatient utilization for the second-poor income group (centile = 2) are robust, especially for inpatient utilization even when $e^{\gamma} = 2$ is stable. However, significant impacts of the NCMS on reducing catastrophic expenditures for the richest and second-poor groups disappear at $e^{\gamma} = 1$. These checks suggest that it is unlikely that the results of the significant positive impacts on medical care utilization are reversed.

Discussion

The implementation of the NCMS is a major reform in rebuilding the health security system in rural China. This paper attempts to investigate the NCMS's likelihood of achieving its stated goal of promoting medical care utilization and reducing financial burdens based on heterogeneous regional characteristics and income groups. Propensity score matching is used to alleviate the bias that arises from observed heterogeneity, and the bounding approach answers whether the inference concerning treatment effects may be altered by unobserved factors.

The results confirm that the NCMS has promoted outpatient utilization for rural residents, especially for relatively poor groups and in the western regions of China. The NCMS can promote poor rural households to visit a doctor for minor diseases at their early stages before they turn into serious diseases; therefore, the NCMS helps to control health risks. Because poor households normally face larger negative health shocks (Ursula 2005; Lindelow and Wagstaff 2005), the financial loss of the poor regarding disease incidence will cause higher welfare loss. The poor should have relatively more benefits in the security system that is provided by the NCMS than their wealthy counterparts. Similar to all insurance schemes, the NCMS program has no significant positive impact on promoting medical care utilization in the poorest group, which implies that the development of the NCMS may still need the support from the medical assistance scheme.

The results also present the different utilization structures of medical care institutions. China has a six-tiered structure of government, health administration and health care. From county to village, the health service system is the so-called 'rural three-tier' system.[25] At the village level, there are usually one to three village doctors who provide outpatient care for common diseases, maternal and child health care, and immunization services. Village health stations are normally the first places where rural patients seek medical care. Given

[25] In China, the rural three-tier health system includes county-hospitals, township hospitals (THC) and village clinics. The county hospitals have overall responsibility for managing the county's health services delivery, and they provide both health care directly to people and technical support to the THC. The THC provide preventive and curative care and supervise health staff in the village clinics. The village clinics provide people with essential clinical services and organize preventive care programs.

transaction costs and timeliness of medical treatment, rural people are more likely to seek health care services from basic medical care institutions in their communities. In this regard, the estimation results in the eastern and middle regions show a positive impact of NCMS enrollment in promoting outpatient services in village-level clinics. However, because of differences in regional development, the village-level institutions in the western regions still have a serious shortage of health resources (MOF, 2006), which may lead to the dysfunction of village health stations. Therefore, in the western regions, the positive impact of the NCMS on improving outpatient services is shown in town-level hospitals.

Our estimation of improving outpatient utilization at county-level hospitals for the eastern and central regions is not robust to hidden bias. However, this finding is still somehow consistent with the allocation of funds on the ground. Because funds are distributed and concentrated more at the village-level clinics in the central regions and at town-level hospitals in the western regions, our results indicate that more health care utilization occurred at the village-level clinics in the central regions and at town-level hospitals in the western regions. Therefore, policy formulation that refers to reimbursement levels can play an important role in influencing consumer behavior and can guide the rational utilization of health care resources.

Generally, the results suggest that given its relatively restricted financing and narrow benefit coverage, the NCMS has positively improved the utilization of medical services. This result is not surprising and more generally consistent with international experiences on subsidized and community-based health insurance programs. Examples include the SUBS program in Colombia, which has been estimated to increase preventive and ambulatory care, and the health insurance program in Vietnam is associated with higher rates of utilization (Sepehri et al. 2006). A program in rural Senegal also appears to have increased utilization (Jütting 2003). By contrast, there is little evidence that the NCMS has reduced outpatient or inpatient expenditures or the incidence of catastrophic expenditures. Concerning this point, the international experiences also report very mixed results. The impact research regarding health insurance schemes in three African countries, namely, Kenya, Senegal and South Africa, shows that insured households are less likely to face catastrophic expenditures than uninsured households in Senegal; however, in South Africa, this result only occurs for the richest quintile, and in Kenya, no significant impact emerges (WHO 2006). The SEWA program in Gujarat (India) has decreased the incidence of catastrophic expenditures from 35.6 to 15.1 % (Krause 2000), whereas the Seguro Popular program in Mexico has reduced the risk of catastrophic out-of-pocket expenditures (Gakidou et al. 2006).

The results still show that the NCMS not only failed to reduce the financial burden for rural residents, but it also increased the incidence of catastrophic expenditures for the western regions. The following reason may rationalize the findings. Health insurance can lower the effective prices of health care at the time when consumers purchase it, which induces the incentives of both consumer and health care supplier to over-pursue or over-provide medical care (Arrow 1963; Zeckhauser 1970; Culyer and Newhouse 2000). In this study, one possible explanation may lie on the supply-side: healthcare providers in China are paid by a 'fee-for-service' and face a fee schedule that strongly encourages demand shifting to expensive drugs and high-tech care for which the payment margins are higher (Yip and Hsiao 2008; Liu and Mills 1999). Therefore, although the NCMS can help to reduce the price of health care services, in fact it increases the cost of medical care through the providers' immoral behavior, such as an unnecessarily longer hospitalization and the use of more high-tech care. Given such a scenario, as the NCMS develops, the access to healthcare for a majority of low- and middle-income groups will again be impeded at different levels. Our estimation concerning reducing the incidence of catastrophic expenditures shows consistency in that higher income households receive disproportionately more benefits, which would imply that low-income

participants in the NCMS subsidize the rich. Although these results in our study are sensitive to unobserved variables, if not checked, the sustainable development of the NCMS program will be in question.

If the key rationale behind the introduction of the NCMS program were to promote medical care utilization and relieve the financial burden of households that is caused by illness, then the results that are presented here suggest little improvement regarding welfare. The theory suggests that the welfare gains concerning access and risk reduction that come from reducing the cost of care must be weighed against the potential welfare losses that arise from demand- and supply-side moral hazards (Wagstaff et al. 2007). Although the data used in the paper did not explain the extent of unnecessary care, concerns remain from the supply-side. Therefore, it is necessary for the NCMS to find better ways to control health care suppliers' moral hazards, such as the reform of fee-for-service (FFS) payment systems to Diagnosis Related Group (DRG) payment methods for hospitals and the risk-adjusted capitation method for primary-care providers. Other controls are to seek more effective third-party purchasers and specify standardized drug lists and regulatory regimes.

Nevertheless, the study has some limitations. First, because of data limitations, we focus on a limited set of outcome variables. Notably, we do not consider the impact of the NCMS on health outcomes per se because the reference period is only 4 weeks. Second, we do not examine how the impact of the scheme varies with the design and implementation characteristics because of ambiguous information regarding the reimbursement modes and the fact that both the design and implementation are likely to vary endogenously along many dimensions. Finally, the estimates that are reported in the paper may not be an accurate reflection of the gross impact of the scheme. Despite these limitations, however, we believe the study makes an important contribution to the existing literature regarding the impact of the NCMS scheme that is differentiated by regions and income groups. This study will serve as a background to address in future research the issues that are raised here.

Conclusions and policy implications

The findings of this study have several important policy implications. First, there is a need to continuously increase financing for the NCMS program and improve the benefit package design of the NCMS. Current financing levels of the NCMS remain at a comparatively lower level. Government subsidies have demonstrated strong contributions in reducing the access barriers, which promote health care utilization for rural people, not in reducing either outpatient or inpatient expenditures. Thus, the NCMS has not achieved effective coverage yet. Local governments are mainly responsible for the collection and management of funds and designing the benefit packages. Therefore, local governments should have better knowledge on how to mobilize possible financial and health resources and establish suitable reimbursement coverage that is based on healthcare needs and utilization. Notably, it is possible for governments to attempt to integrate NCMS policies in regions, which helps to establish a broader financing pool and favors the enrollment of households with migrant workers. Consequently, NCMS policies can achieve the gradual transition of integrating policies from a 'local-level' NCMS policy to a 'regional-level' policy and then to a national policy.

In addition, given that the value of health insurance is rooted in the unpredictability of medical spending (Culyer and Newhouse 2000), the reimbursement of the NCMS is also required to be dynamically evolutional following economic changes and development. The central government is encouraged to provide more financial support to less developed areas to supply social protection for poor people. Our findings also show an increase in prices that

is induced by a possible over-pursuing or over-providing medical care. Although our paper did not examine this aspect in depth, the necessity for the employment of more effective measures to conduct risk management and cost control in the NCMS has been foreseeable.

Appendix: Histogram of estimated propensity score: common areas

See Figs. 2, 3 and 4.

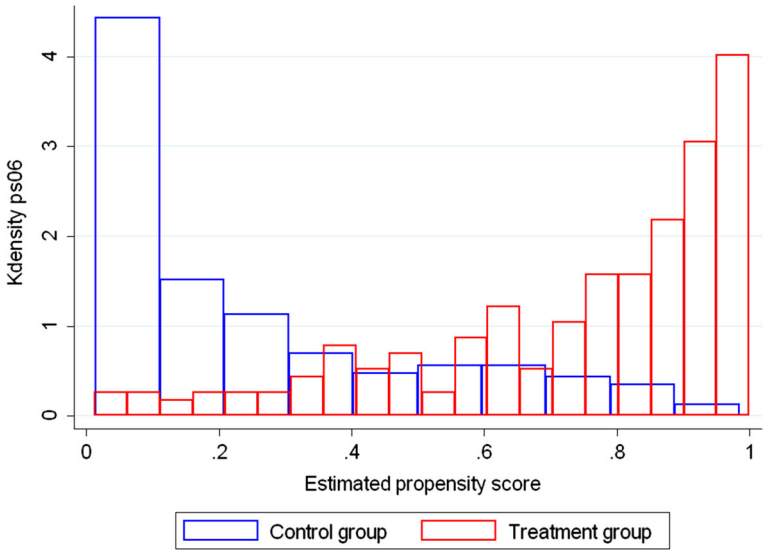

Fig. 2 Histogram of estimated propensity score for eastern regions

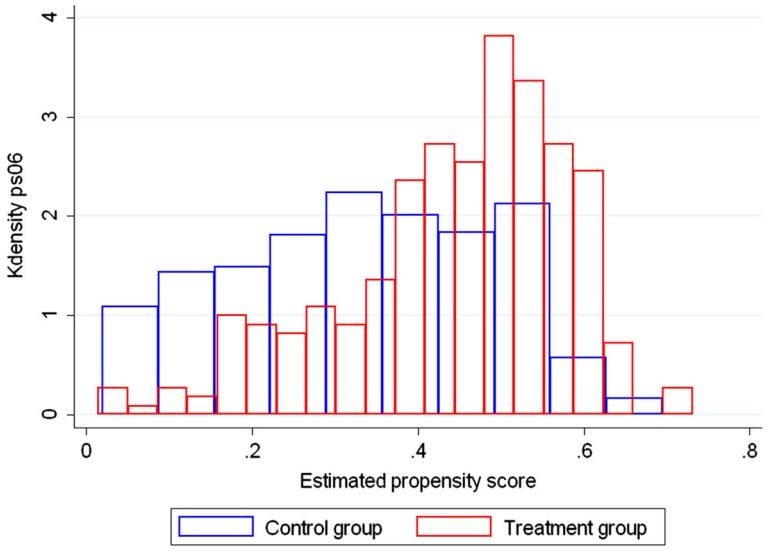

Fig. 3 Histogram of estimated propensity score for central regions

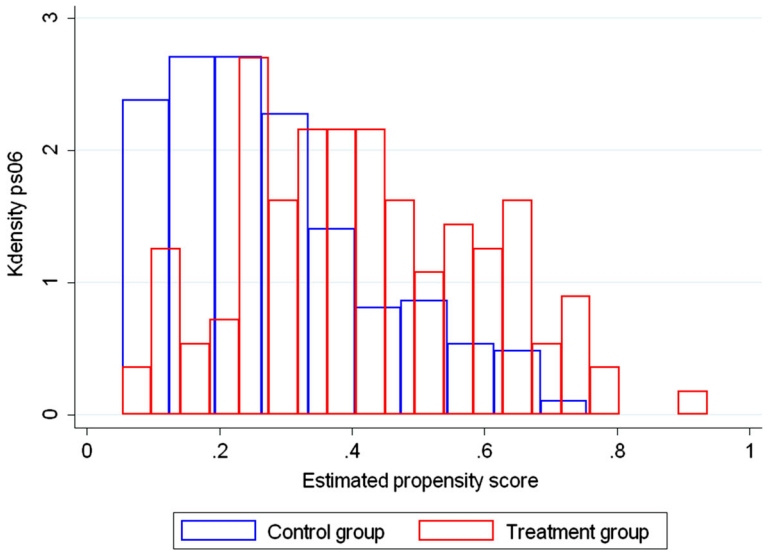

Fig. 4 Histogram of estimated propensity score for western regions

References

Aakvik, A. (2008). Bounding a matching estimator: The case of a Norwegian training program. *Oxford Bulletin of Economics and Statistics*, *63*(1), 115–143.

Arrow, K. J. (1963). Uncertainty and the welfare economics of medical care. *American Economics Review*, *53*(3), 941–973.

Becker, S. O., & Caliendo, M. (2007). Sensitivity analysis for average treatment effect. *The Stata Journal*, *7*(1), 71–83.

Becker, S. O., & Ichino, A. (2002). Estimation of average treatment effects based on propensity score. *The Stata Journal*, *2*(4), 358–377.

Bryson, A., et al. (2002). *The use of propensity score matching in the evaluation of labor market policies*. Working Paper No.4, Department for Work and Pensions.

Caliendo, M., & Kopenig, S. (2008). Some practical guidance for the implementation of propensity score matching. *Journal of Economic Surveys*, *22*(1), 31–72.

Culyer, A. J., & Newhouse, J. P. (2000). *Handbook of health economics*. Amsterdam: Elsevier.

DiPrete, T., & Gangl, M. (2004). Assessing Bias in the Estimation of Causal Effects: Rosenbaum Bounds on Matching Estimators and Instrumental Variables Estimation with Imperfect Instruments. *Sociological Methodology*, *34*(1), 271–310.

Dor, A., et al. (1988). Non-price rationing and the choice of medical care providers in rural Cote D'Ivoire. *Journal of Health Economics*, *6*(4), 291–304.

Du, S. F., et al. (2002). A new stage of the nutrition transition in China. *Public Health Nutrition*, *5*, 169–174.

Entwisle, B., & Chen, F. (2002). Work pattern following a birth in urban and rural China: A longitudinal study. *European Journal of Population-Revue Europeenne De Demographie*, *18*, 99–119.

Gakidou, E., et al. (2006). Assessing the effect of the 2001–2006 Mexican health reform: An interim report card. *The Lancet*, *368*, 1920–1935.

Gertler, P., et al. (1987). Are user fees regressive? The welfare implications of health care financing proposals in Peru. *Journal of Econometrics*, *36*(1–2), 67–80.

Gu, X., & Fang, L. M. (2007). Cost control and sustainable development of the New Rural Cooperative Medical Scheme. *Study & Exploration*, *168*(1), 137–141. In Chinese.

Heckman, J., et al. (1997). Matching as an econometric evaluation estimator: Evidence from evaluating a job training program. *Review of Economic Studies*, *64*(4), 605–654.

Heckman, J., et al. (1998). Matching as an econometrics of active labor market programs. *Review of Economic Studies*, *65*(2), 261–294.

Heckman, J., et al. (1999). The economics and econometrics of active labor market programs. In O. Ashenfelter & D. Card (Eds.), *Handbook of Labor Economics* (Vol. III, pp. 1865–2097). Amsterdam: Elsevier.

Jalan, J., & Ravallion, M. (2003). Estimating the benefit incidence of an antipoverty program by propensity-score matching. *Journal of Business & Economic Statistics*, *21*(1), 19–30.
Jia, L. E. (2008). Issues on the enrollment of the New Cooperative Medical Scheme for migrant workers. *Population & Economics*, *4*(S), 209–210. In Chinese.
Johar, M. (2009). The impact of the Indonesian health card program: A matching estimator approach. *Journal of Health Economics*, *28*(1), 35–53.
Jütting, J. (2003). Health Insurance for the poor? Determinants of participation in community-based health insurance schemes in rural Senegal. Technical Paper No. 204. Paris: OECD Development Center.
Khandker, S., et al. (2010). The poverty impacts of rural roads: Evidence from Bangladesh. *Economic Development and Cultural Change*, *57*(4), 685–722.
Krause, P. (2000). The non-profit health insurance schemes in unorganized sectors in India [M]. Deutscher gesellschaft fuer Technische Zusammerarbeit (GTZ) GmbH.
Lei, X., & Lin, W. (2009). The new cooperative medical scheme in rural China: Does more coverage mean more service and better health? *Health Economics*, *18*, S25–S46.
Lindelow, M., & Wagstaff, A. (2005). Health shocks in China: Are the poor and uninsured less protected? World bank policy research working paper 3740.
Liu, X., & Mills, A. (1999). Evaluation payment mechanisms: How can we measure unnecessary care? *Health Policy and Planning*, *14*(4), 409–413.
Liu, Y. L., & Rao, K. (2006). Providing health insurance in rural China: From research to policy. *Journal of Health Policies, Policy and Law*, *31*(1), 71–92.
Mantel, N., & Haenszel, W. (1959). Statistical aspects of the analysis of data from retrospective studies of disease. *Journal of the National Cancer Institute*, *22*(4), 719–748.
Mao, Z., & Jiang, J. (2004). Comparative research on the New Rural Cooperative Medical Scheme. *Journal of Chinese Health Service Management*, *7*, 426–428.
Popkin, B., et al. (2010). Cohort profile: The China Health and Nutrition Survey—Monitoring and understanding socio-economic and health change in China, 1989–2011. *International Journal of Epidemiology*, *39*, 1435–1440.
Rosenbaum, P. R. (2002). *Observational studies* (2nd ed.). New York: Springer.
Rosenbaum, P. R., & Rubin, D. (1983). Central role of the propensity score in observational studies for causal effects. *Biometrika*, *70*(1), 41–55.
Rubin, D. (1990). Formal models of statistical inference for causal effects. *Journal of Statistical Planning and Inference*, *25*(3), 279–292.
Sepehri, A., et al. (2006). The influence of health insurance on hospital admission and length of stay—The case of Vietnam. *Social Science and Medicine*, *63*(7), 1757–1770.
Smith, J., & Todd, P. (2005). Does matching overcome Lalonde's critique of nonexperimental estimators? *Journal of Econometrics*, *125*(1–2), 305–53.
Trujillo, A. J., et al. (2005). The impact of subsidized health insurance for the poor: Evaluation the Colombian experience using propensity score matching. *International Journal of Health Care Finance and Economics*, *5*(3), 211–239.
Ursula, G. (2005). Health and Poverty Linkages: Perspectives of the chronically poor. Background paper for the chronic poverty report 2008-09, the UK.
Wagstaff, A. M., et al. (2007). Extending health insurance to the rural population: An impact evaluation of China's new cooperative medical scheme. World Bank Policy Research Working Paper No. 4150.
Wagstaff, A., & van Doorslaer, E. (2003). Catastrophe and impoverishment in paying for health care: With applications to Vietnam 1993–1998. *Health Economics*, *12*(11), 921–934.
WHO. (2006). What is the impact of social health protection on access to health care, health expenditure and impoverishment? A comparative analysis of three African countries. Discussion paper. Department "Health System Financing", cluster "Evidence and information for policy" (EIP).
Wu, Z. (2010). Self-selection and Earning of Migrants: Evidence from Rural China. *Journal of the East Asian Economic Association*, *24*(1), 23–44.
Yip, W., & Hsiao, W. C. (2008). The Chinese health system at a crossroads. *Health Affairs*, *27*(2), 460–468.
Zeckhauser, R. (1970). Medical Insurance: A case study of the tradeoff between risk spreading and appropriate incentives. *Journal of Economic Theory*, *2*(1), 10–26.