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Dan Liu and Daniel Tsegai

The New Cooperative Medical Scheme (NCMS) and its implications for access to health care and medical expenditure: Evidence from rural China

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Walter-Flex-Straße 3
D – 53113 Bonn
Germany
Phone: +49-228-73-1861
Fax: +49-228-73-1869
E-Mail: zef@uni-bonn.de
www.zef.de

The authors:
Dan Liu, Center for Development Research. Contact: liudanren@yahoo.com.cn
Daniel Tsegai, Center for Development Research. Contact: dtsegai@uni-bonn.de

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Abstract

The New Cooperative Medical Scheme (NCMS) program was implemented in response to 'illness-led poverty' and poor state of healthcare in rural China. Supported by government subsidy, more and more poor rural households are now enrolled in the NCMS. This paper investigates the impact of the NCMS program on improving health care utilization and reducing medical expenditure with a specific focus on the endeavors to unravel the heterogeneous effects of the program for the different regions and income groups. We utilize the China Health and Nutrition Survey data (CHNS) to provide prolific cross section and longitudinal information. A total sample of 6,293 individuals and 2,058 households are included in the analysis. Propensity score matching method and bounding approach are used to infer the causal effect of NCMS and examine the influence of unobservable factors respectively. Major findings indicate that there is a systematic adverse selection in the NCMS program, both in health- and economic-related aspects. Especially in western regions, households with high ratio of migrant workers are less attracted to the NCMS program. The NCMS program improved medical care utilization for the poor and regionally, western regions benefitted more from the program. The NCMS program also induces a moral hazard problem in western regions.

Keywords: Rural China, health insurance, impact evaluation, propensity score matching

1. Introduction

Health care is one of the major determinants for a rewarding health status, which is generally defined to encompass those goods and services whose primary purpose is to improve health situations or prevent health deterioration (Hurley, 2000). In many developing countries, people working in the informal sectors and rural dwellers are usually excluded from health insurance programs. Various interventions have been introduced by governments in an attempt to minimize unbalanced distribution of health services. Community based health insurance scheme (CBHIS) is one of the interventions that is becoming an increasingly important health financing mechanism in low-income countries (Carrin *et al*., 2001; Bennett *et al*., 2004). CBHIS does not only mobilize additional financial resources, but also saves governments from expensive business of providing subsidies for health care, thereby, releasing funds for public health scheme and preventive and primary services that benefit the poor (Jiang, 2004). 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 policy makers to carefully evaluate the effectiveness of these programs in terms of the extent to which they achieve their desired objectives.

This paper evaluates the impact of the Chinese government-subsidized health insurance scheme, henceforth, New rural Cooperative Medical Scheme (NCMS), on the level of medical care utilization and medical expenditure for rural residents. In China, ever since the collapse of the Cooperative Medical Scheme (CMS) after the economic reforms of the early 1980s, rural residents have been excluded from the social security system. Many difficulties impede the poor in trying to access basic health services; the financial barriers are perhaps the most acute. According to China's National Health Survey in 2003, 38% of those who did not seek medical attention while sick and 70% of those who refused hospitalization after doctor's referral reported 'excessive cost' as the primary factor for their decisions. As a result, health shocks and poor healthcare are correlated with increases in poverty (Smith, 1999; Wagstaff, 2005), as those who seek care may incur medical debt while those who forego medical care lose productivity. As one of the Chinese government's major efforts -the NCMS proposed in 2002- is a demand-side government subsidy insurance scheme intended to resolve illness-led poverty and the poor state of healthcare in rural China.

There is a growing body of literature which evaluates the NCMS programs (Du *et al*., 2006; Jiang *et al*., 2008; Yan *et al*., 2006; Gu and Fang, 2007). Unlike most of the previous studies mentioned, this paper adopts micro-econometric analysis to investigate the impact of the NCMS differentiated across regions and income groups. Given the diverse socioeconomic conditions and health care needs in the vast rural communities, many of China's recent economic and social policies have been developed and tailored to the special regional needs and institutional characteristics. Regional heterogeneities render a 'three-world' characterization of China's vast rural areas: 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). People living in poor rural areas experience difficulties accessing basic health care services, and a relatively small amount of medical expenses can cause financial hardship and aggravate poverty status. By contrast, those in the middle- and high-income regions are more likely to suffer from other aspects. People from central regions have the greatest variation in income levels and in levels of financial vulnerability to health care costs, while people from eastern regions prefer to protect themselves against catastrophic medical expenses often incurred as a result of episodes of hospitalization. Therefore, comparing with other NCMS literatures which limit their analysis for a whole nation or only a single province (Wagstaff*et al*., 2007; Li *et al*., 2009; Lei *et al*., 2009; Zhang *et al*., 2010); this study underscores the importance of regionally differentiated impact analysis and thus provides a valuable feedback to policymakers and suggests accordingly appropriate region-specific directions for future policy.

In addition to addressing regional heterogeneity, this paper adds value to the existing literature by analyzing distributional gains among different income groups. The main justification for income-related equality in health is the belief that all people should have equal right to a long and healthy life. The distribution of health care may also be examined to assess whether there is equity in the allocation of health care resources (Doorslaer& O'Donnell, 2008). If the poor are deprived of effective health care interventions, income-related inequalities in health will be exacerbated. Not only is this of immediate concern, it will strengthen the health-poverty trap that can slow down economic growth in the long run (Sala-i-Martin, 2005). Therefore, it is also very useful for policy makers to understand how program benefits are distributed among different income groups.

Besides, the study also focuses on the broader issue of applying non-experimental methods to evaluate social program in health care sector. The central question in impact evaluation refers to counterfactual analysis; that is, what would have happened to those receiving the intervention if they had not received. Since one cannot simultaneously observe situations of

an individual being both a 'participant' and 'non-participant' in the same program, we have to develop *unconfoundedness*[1] which is comparable to those receiving the intervention, both in observable and unobservable dimensions. Due to the self-selection problems associated with non-experimental data, we apply recent advances in propensity score matching (PSM) methods, following Rosenbaum and Rubin (1983), to draw a statistical comparison group. The PSM has two practical advantages: firstly, it helps to successfully reduce systematic differences between the control and treatment groups by matching on a set of observed characteristics; secondly, it allows one to estimate the effect of a program without explicitly accounting for the relationship between the individual characteristics and the outcome of interest (Trujillo *et al*., 2005). This may be particularly useful when assessing the NCMS program because modeling the consumption of medical care for the poor would be an extremely complex task. It is important to note that other methodologies are not always feasible for the assessment of a program. For example, instrumental variables estimation (IVs) requires strong assumption about the distribution of the unobservable and it does not separate variables which could both be a cause for treatment and a potential cause for outcome.

The rest of the paper is organized as follows. The second section gives detailed overview of the NCMS program. In the third section, data and variables are elaborated. Estimation results are presented and discussed in the fourth and fifth sections respectively. Section six concludes.

2. The New Cooperative Medical Scheme in rural China

The New Cooperative Medical Scheme (NCMS) is a new policy tool that establishes a rural health insurance system targeted for rural residents in China. Given China's decentralized fiscal system and diverse needs in different regions, the NCMS has not been designed as a universal rural health insurance program. The central government issues three broad guidelines[2] as basic rules for the NCMS nationwide. (1) Participation in the NCMS is voluntary and required households to be enrolled as a unit. This is done to prevent adverse selection problem which comes with voluntary nature of participation. (2) The NCMS is

[1] 'Unconfoundedness' is a term coined by Rubin (1990), which refers to the case where (non-parametrically) adjusting for differences in a fixed set of covariates biases in comparisons between treated and control units, thus allowing for a causal interpretation of those adjusted differences.

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

practiced at county-level[3] rather than village or township levels. In such instances, the NCMS can provide for a larger risk pool and economies of scale in organization and management (Wagstaff*et al*. 2007). (3) The NCMS would focus on catastrophic illnesses, receiving funding from both governments (central and local) and individuals. On the condition that local governments follow the aforementioned guidelines, they are authorized to retain considerable discretion over the benefit package design and implementation of the NCMS locally.

2.1 Financing mechanism of the NCMS

It is important to note that for the past 30 years, the Chinese government has provided no financial support to the purchase of health care services for rural residents. Considering this background, the NCMS presents a historic breakthrough and a fundamental shift towards a more equity-oriented social policy (Liu and Rao, 2006). In the early stages of the NCMS, enrollees living in central and western provinces of China would receive health insurance subsidies (premium subsidy) of more than 20 Yuan[4] (US$ 3.1) (per enrollee, per year) with matching funds provided by central and local governments, and premium of each enrollee is at the minimum 10 Yuan (per year) contributed from households. And for the relatively more affluent eastern provinces, local governments themselves are required to subsidize the same amount of 20 Yuan (MOH, 2003).

After Wu Yi [the vice premier of China (2003-2007)] stressed to accelerate the process of establishment of the NCMS in the national conference of "NCMS pilot work in 2005", (which started in 2006), the government's subsidies was raised to 40 Yuan per enrollee per year, and simultaneously the subsidy program was extended to include eastern provinces (China Ministry of Health and Ministry of Finance, 2008). In 2009, the government's subsidies were revised upwards to 80 Yuan for central, western and eastern provinces. In 2009, the government formally required per capita premium to be raised to no less than 20 Yuan per year.

It is worth noting that localities have the right to adjust their own insurance levels according to local economy and location specific needs. The central government only formulates the lower limit on individual contributions. The financial levels across different regions have

[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) reside in counties; urban districts and county-level cities containing rural residents will also receive the program. In China, most rural counties have a population ranging from 200,000 to 300,000 people.

[4] 1US$ = 6.38 Yuan (September, 2011)

shown great discrepancy at initial stage of implementation of the NCMS, followed by distinct per capita net income levels (Table 1). As shown in Table 1, the level of per capita financing in eastern regions is much higher (83 Yuan) than central and western regions (average 33 Yuan). By contrast, government funding (transfer payments) accounting for 68.5% and 67.1% respectively in central and western regions, is a little higher than eastern regions. Therefore, it is very clear that governmental financial support is an important guarantee for the establishment of the NCMS in central and western regions.

Table 1 about here

2.2 Coverage and operationalization procedure of the NCMS

The implementation of the NCMS is a complex process. Originally, in order to ensure stable promotion and to learn a lesson from local experience, the NCMS was fed into the scaling-up process. And from 2003 onwards the NCMS has been piloted in the whole country. Under the institutional backgrounds of establishing harmonious society, the NCMS program was significantly speeded up, and gradually transited from a pilot phase into a full promotion phase.

Until March 2006, there were 1369 counties (including sub-urban villages, accounting for almost 50% of the eligible counties in China) which launched the NCMS program. And one year later (September 2007), 2448 counties (including suburban villages, accounting for almost 85.5% counties in China) implemented the NCMS and 7.26 hundred million rural people were enrolled nationwide with the enrollment rate reaching 86% (MOH, 2009). In 2008, the NCMS had already covered the whole country, which is two years ahead of scheduled national policy. Table 3 presents overview of development of the NCMS program nationwide.

As shown in Figure 1, the NCMS scheme achieves a nationwide great leap forward. This is logical given the urgency of the problem being addressed. However, competition among local governments to win a “welfare championship” and the diminished heavy burden caused by welfare overspending on local finance puts a big question mark over the sustainability of such social security programs (Zhu ling, 2010).

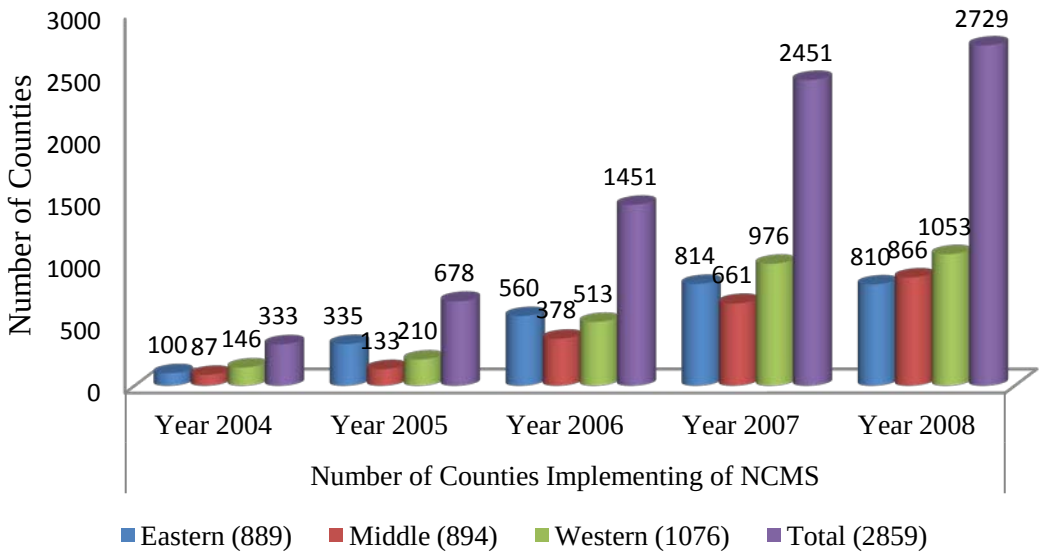

Figure 1 Counties joining the NCMS program

Source: Computed from the data extracted from China Health Statistics Yearbook (2008 and 2009); Hu (2007); The Standard Management of Health Services under the NCMS

Table 2 about here

2.3 Reimbursement models of the NCMS

There are four major reimbursement models throughout China. The most common adopted model, which is implemented in about 66% of rural counties in China, is "*inpatient and household medical saving accounts*[5]" model. Under this model, inpatient services are reimbursed according to a certain formula, while outpatient services are paid by household medical saving accounts with some deductibles and cap lines. The second model is "*inpatient only*" model, which accounts for 17% of the counties. This type is popularly used in majority of economically developed areas such as Jiangsu, Fujian and Zhejiang provinces. The third model is "*inpatient and catastrophic care*", with separate deductibles and caps in inpatient and catastrophic expenditure reimbursement. This is used in 11% of the counties. The fourth model is "*inpatient and outpatient pooling*" model, which is adopted in 6.7% of the counties. Under this model, the inpatient reimbursement is the same as the first model, 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). Besides, some counties provide extra free physical check-up (once per year) for those enrollees who have not used any medical services within that year.

[5] Each household has its own medical saving account, with household members depositing their contributions into this account and then spending money from it.

All models reflect "catastrophic illness-oriented" policy requirements (Table 2). Owing to limited financing level, the reimbursement ratio is not high; nationally, the average level is around 25%. Yet, the actual amount of reimbursement obtained by enrollees in eastern region is about two times that of central regions and about three times of western regions. Besides, medical institutions of various levels are also set by different reimbursement levels in order to rationally guide patients to consume health care resources.

Table 3 about here

2.4 Previous studies about the NCMS program

There are several empirical studies that evaluate the NCMS program; nevertheless, most of these studies are descriptive in their nature. Qualitative analysis mainly includes two aspects: one is to evaluate the NCMS operation by constructing the performance index system. Du *et al* (2006) adopts AHP (Analytic Hierarchy Process) and Delphi methods to set up performance index and weights to evaluate the operation of the NCMS. Jiang *et al* (2008) employs improved Delphi method to confirm weights and establish index to assess the financing mechanisms and benefits of NCMS, and find government subsidies are not achieved in time for western China and the reimbursement rate is still low. The other feature is to do with descriptive analysis based on various data bases. Yan *et al* (2006) utilize the survey data to assess NCMS operation states from the perspective of the rural people's demand, participation, knowledge about NCMS and benefits. And they found rural people to have a strong demand on the NCMS and have high enrollment rate in the NCMS pilots, and the NCMS was also found to improve the medical care utilization, but rural people were shown not to have clear knowledge about the contents of NCMS. However, the study of Gu and Fang (2007) indicates that the NCMS could not effectively control medical expenditures based on the analysis of hospital's financial accounting data.

A few studies adopt micro-econometric analysis to evaluate the NCMS program. Wagstaff *et al.* (2007) survey 15 counties among 12 provinces and assess the performance of the initial NCMS (piloted in 2003), adopting Difference in Differences with Propensity Score Matching (DID-PSM) method. Their study showed that NCMS increases both outpatient and inpatient utilization (by 20-30%), but has not reduced out-of-pocket expenditure. Another noteworthy study is from the research of Lei and Lin (2009), using the CHNS dataset (used also in this study) find that, overall, the NCMS does not reduce medical expenditure, nor does it increase utilization of formal medical services[6] or improve health status. The impact of a program

[6] Here, formal medical services are relative to traditional folk doctors. Chinese folk doctors refer to those who work in

might, nevertheless, differ in different regions and income groups. More so, in the matching process, the study mentioned above employs a sampling strategy at individual level, which does not adhere to the enrollment rules which is at household level and these, in our view, results are in an inappropriate estimation of the propensity score. The study here emphasizes on the degree of NCMS impact difference across regions and income groups. We argue that a necessary precursor to a robust evaluation on the impact of a program is to consider carefully evaluation design, implementation and actual program operations as well as data characteristics used in analysis.

3. Data and Methodology

3.1 Data

The study benefits from the China Health and Nutrition Survey (CHNS) data, which is conducted jointly 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. A multi-stage, random cluster process was used to draw household and individual samples - nine provincial administrative regions out of a total of 34[7] (Figure 2) which are spread across eastern, central and western regions of China and vary substantially in terms of geography, economic development, public resources and health indicators. Counties in the nine provinces were stratified by income (low, middle and high) and four counties were randomly selected in each province. The first round of the survey was conducted in 1989 and seven subsequent rounds were conducted in 1991, 1993, 1997, 2000, 2004, 2006 and 2009. In each of the rounds, the survey was carried out from August to December. This survey not only collects a wide range of socio-economic indicators along with a measure of consumption, but also contains detailed information in health-related issues, such as self-reported illness, utilization of health care and health care expenditures, insurance coverage and opportunity costs for accessing to medical care.

private hospital are not licensed and have only limited medical training.

[7] In China, there are 23 provinces, 5 autonomous regions, 4 municipalities and 2 special administrative regions. In total, there are 34 provincial administrative regions.

Figure 2: CHNS survey in China (Shadow areas)

Source: China Health and Nutrition Survey www.cpc.unc.edu/projects

Since the NCMS pilots launched in 2003, there are three potential post-exposure periods: wave 2004, 2006 and 2009. However, given few counties that started the NCMS in 2003/04 and they might have certain specificities[8] which differ from most other counties. In addition, wave 2009 cannot provide complete data; we restrict our econometric analysis to wave 2006, and take matched data from wave 2004 as baseline information[9]. Since the NCMS targets at rural residents, we do away with all urban residences and county town neighborhoods[10], and we consider in the analysis counties and suburban villages only.

[8] For counties which started NCMS pilots in 2003/04, they normally have better economic, social and cultural environment to accept and execute the NCMS. Started from 2003/04, they already accumulated some local experiences on how to carry out the NCMS by 2006, so they can appropriately adjust their policy in the implementation of the NCMS, which will affect the enrollment probability of individuals.

[9] Given the rapid development of economics and society in China since 2000, we believe wave 2000 may be not suitable as the baseline survey for the NCMS program because there are too much unobserved time-variant factors which may induce inaccurate predictions.

[10] For people, who live in the country town neighborhood, their identification is mostly no longer the 'rural' but the 'urban'. So, they are not allowed to be enrolled in the NCMS.

3.2 Methodology

3.2.1 Propensity score matching

To adopt counterfactual analysis to estimate the impact of the NCMS program, we need to identify an eligible comparison group assuming that all the observations (households in this case) are similar and randomly selected for intervention. Owing to the selection bias in non-experimental data, we use propensity score matching (PSM) to achieve this identification.

The propensity score is the conditional probability of participating in the program given certain observable variables (Rosenbaum and Rubin, 1983). It helps reduce the dimension of observable variables so that the *unconfoundedness* could be straightforward to hold. Given the estimated propensity score, we could use different matching algorithm to construct comparison groups. In practice, matching is a weighted average of effects for each value of the causing variable, where the weights reflect the propensity score (Wagstaff*et al*. 2007). In order to ensure that treatment observations have comparable observations in the "nearby" propensity score distribution, it is required a sizeable common support region[11] (Heckman, LaLonde and Smith, 1999). PSM estimator is, thus, the mean difference in outcome over the common support, appropriately weighted by the propensity score distribution of 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' treatment for those who actually participate in the treatment.

PSM estimators differ not only in the way the neighborhood for each treated individual is defined and the common support problem is handled, but also with respect to the weights assigned to these neighbors (Caliendo and Kopeinig, 2008). There are several matching algorithms but no clear explanation to show which matching method is better, except that the choice of algorithms has to combine the data. In this study, considering a high enrollment rate in the NCMS program, we adopt kernel matching, which is non-parametric matching estimator that uses weighted averages of all individuals in the control group to construct the counterfactual outcome. The kernel weight is a decreasing function of the absolute difference in propensity score between the treated and untreated units (Smith and Todd, 2005). One major advantage of kernel matching is the lower variance achieved owing to

[11] Common support region ensures that person with same covariates have a positive probability of being both participants and non-participants (Heckman, LaLonde and Smith, 1999). Implementing the common support condition ensures that any combination of characteristics observed in the treatment group can also be observed among the control group (Bryson, Dorsett and Purdon, 2002).

more information used as a result (Caliendo and Kopeinig, 2008). However, this 'advantage' could turn into a drawback of kernel matching due to 'bad matches'. Hence, the proper imposition of the common support condition is of major importance for kernel matching (Heckman *et al*. 1998b & 1997a). Following World Bank (2010), the specific kernel weight's type is specified as follows:

$$\omega(i,j)_{KM} = \frac{K\left(\frac{P_j - P_i}{a_n}\right)}{\sum_{k \in C} K\left(\frac{P_k - P_i}{a_n}\right)}, \tag{1}$$

Where P_i and P_j are the propensity scores for participant 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' one from control groups. In our study, the normal (Gaussion) kernel and a bandwidth of 0.06 are used.

The analysis considers only those enrollees (treatment group) who were actually enrolled in the NCMS program at the survey time in wave 2006, because the CHNS questionnaire does not ask enrollees whether they stayed program without interruption. Moreover, the insurance period of the NCMS is on an annual basis. Therefore, we exclude all observations from NCMS-pioneer counties[12] (piloted in 2003/04) in wave 2006 and take enrollees from the 'follow-up NCMS' counties (started in 2005/06) as treatment group to get better "albeit a more conservative" measure of the impact. In doing so, by using wave 2004 information as pre-intervention variables to predict probabilities of enrollment, we also guarantee all covariates to be strictly exogenous in propensity score estimation equation.

The control group is constructed from the Non-NCMS counties in wave 2006. Given that we have no information if the NCMS affects behaviors of non-enrollees and health care providers within NCMS counties, we decided to take observations from Non-NCMS counties in 2006 as the only control group in order to avoid any mixed impact interference. In effect, it is well suited to adopt PSM in a setting where both groups (treatment and control) come from the same economic environment (Jalan and Ravallion, 2003).

As a result, restricted within followed-households with complete enrollment information, we end up with a sample of 738 households in the treatment and 1320 households in the

[12] If no special explanations, in the following part, we always use "pioneer-NCMS counties" to represent counties which piloted NCMS in 2003/04, and use "following-NCMS counties" to represent counties which started NCMS in year 2005/06.

control group (all from wave 2006). In addition, considering the time interval between actual interview time in the CHNS each round and the coverage period of NCMS[13] each year, our analysis reflects only the short-run outcome of enrollment and no attempt is made to estimate the effect on 'health' per se since serious health effects are likely to take longer to realize.

A valid propensity score requires the covariates to be strictly exogenous (Johar, 2008). Lagged variables may be a way of achieving this (Caliendo and Kopeinig, 2008). In our case, an abundant longitudinal data, which is the 'China Health and Nutrition Survey' data (CHNS), allows us to apply pre-intervention variables – that are not influenced by participation in the program – to predict the probabilities. Moreover, we restrict the matching process into an area of common support so that the performance and quality of PSM estimation can be guaranteed[14].

However, since PSM does not balance the unobservable variables, one could argue that relevant unobservable confounding differences may still exist between groups. While the data at hand allows us to observe only short-term (less than 1 year) impact, whereas DID estimation procedure usually requires fairly long time series data and the treatment variable changes very little over time (Bertrand *et a.,* 2004). As time-variant unobserved variables like individual or community heterogeneities are still out of control of the DID (Khandker SR, 2009), we opted for a combination of PSM and 'bounding approach' instead of the DID. Bounding approach is proposed by Rosenbaum (2002) to detect how strongly an unmeasured variable ('hidden bias') influence the selection process in order to undermine the implications of the matching analysis. By using the 'bounding approach', both variant and invariant unobserved factors can be tested.

3.2.2 Bounding approach

Matching and balancing removes biases due to the non-overlapping support and differences in the propensity score distributions of the recipient and control households (Johar, 2009). However, they do not remove bias resulting from unobservable variables. If there are unobserved variables which simultaneously affect assignment into treatment and the

[13] The insurance period of the NCMS is one year: In the last quarter of each year, individuals have right to choose whether they enroll in the NCMS next year or not and make payment if they are still in.

[14] Under the PSM distributional assumption, two factors have been suggested in the literature that may comprise the performance of PSM estimates: the quality of the data and the ability to impose a common support condition (Smith and Todd, 2001).

outcome variable, a 'hidden bias' might arise for which matching estimators are not robust (Rosenbaum, 2002). To answer whether or not inference about treatment effects may be altered by unobserved factors, we adopt bounding approach proposed by Rosenbaum (2002) to check sensitivity of matching analysis.

In theory, assuming there is hidden bias *u*, two individuals (*i* and *j*) with the same observed covariates (say *x*) would have differing chances of receiving treatment. Their odds ratio of receiving treatment is given by:

$$\frac{P_i(1-P_j)}{P_j(1-P_i)} = \frac{\exp(\beta x_i + \gamma u_i)}{\exp(\beta x_j + \gamma u_j)} \tag{2}$$

Where u is the unobserved variable and γ is the effect of *u* on the participation decision. So, if there are either no differences in unobserved variables ($u_i = u_j$) or if unobserved variables have no influence on the probability of treatment ($\gamma = 0$), the odds ratio is one, implying the absence of hidden or unobserved selection bias (Becker & Caliendo, 2007). Rosenbaum (2002) implies that the following bounds on the odds-ratio, that either of the two matched individuals will receive treatment:

$$\frac{1}{e^{\gamma}} \le \frac{P_i(1-P_j)}{P_j(1-P_i)} \le e^{\gamma} \tag{3}$$

Both matched individuals have the same probability of participating only if $e^{\gamma} = 1$. With this logic, e^{γ} is a measure of the degree of departure from a study that is free of 'hidden bias'.

In practice, for binary outcomes, Aakvik (2001) suggests to use non-parametric Mante and Haenszel (MH, 1959) test statistic Q_{MH} to check null hypothesis $\gamma = 0$. The test involves comparing the number of recipient units who benefited from the program exposure and its expected number if the program has no effect:

$$Q_{MH} = \frac{|Y_1^D - \sum_s^S E(Y_{1s}^D)| - 0.5}{\sqrt{\sum_{s=1}^S \mathrm{var}(Y_{1s}^D)}} \tag{4}$$

Where Y_{1s}^D is the number of positive outcomes for the recipient sample in stratum *s* of the sample and Y_{1s} is the total number of positive outcome in stratum *s*. Under the null hypothesis, there is no treatment effect, and a positive outcome is equally likely for recipient

and control 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 Q_{MH} can be bounded by two known distributions, which move apart from each other reflecting uncertainty about the test statistic in the presence of unobserved selection bias.

3.3 Variables

3.3.1 Dependent variables

Information about enrollment status is obtained from the household heads. To measure health care utilization, we consider three dichotomous variables: (1) whether or not the individual has used outpatient care in the last four weeks; (2) whether or not the individual has been in hospital in the last four weeks; (3) whether or not the individual has used preventive care in the last four weeks. Here, the practice of preventive care is used to reflect a positive attitude and attention to health, no matter what type of preventive care is covered by the NCMS. Then, we investigate the discrepancy of outpatient utilization on different medical service providers[15]. We restrict individual samples to only adult individuals (>=15 year olds) in the households and also excluding individuals who simultaneously have other type of health insurance. Children's health would be tricky to interpret: as they get older, the intensity of regular check-up naturally falls. On the other hand, as the CHNS survey did not distinguish insurance types with their usage, we lack sufficient information to determine whether health care utilization is because of the NCMS or other health insurance types. Hence, we do not include in the analysis individuals who have several health insurance types.

As far as medical expenditure (which includes outpatient and inpatient expenditure) is concerned, the figures are estimated at household level, where household members are asked how much they spent during the last four weeks on health care, and in what specific utilization models, and how much they were reimbursed by the NCMS program. Meanwhile, we pay special attention to the incidence of catastrophic health expenditure (CHE) in order to measure the effect of the NCMS program in reducing poverty of rural households. There are various definitions of CHE, ranging from a health expenditure of about 10% of total household income (Pradhan & Prescott, 2002; Ranson, 2002; Van Doorslaer*et al*., 2006) to a heath expenditure exceeding 40% of 'capacity to pay' (Xu*et al*. 2003; Filmer*et al*. 2002). Here, we use total household income as the denominator to calculate CHE[16]. The incidence of

[15] Considering only four-week references, here we do not go into depth for detecting inpatient utilization.

[16] Here, we do not use "ability-to-pay" as denominator as this number could be zero or negative in rural households. In the

catastrophic expense could be defined as the number (or fraction) of individuals whose health care costs as a proportion of income exceed the threshold (Wagstaff and van Doorslaer, 2003). And in line with the reality of rural China, thresholds of 10% and 20% are separately used.

3.3.2 Independent variables

The CHNS dataset also provides us with abundant individual, household and community information to predict the probabilities of household and individual enrollment in the NCMS and use of medical care services. The health-related variables, such as self-reported health, diagnosis of chronic disease condition and the composition of family members, including age and gender of household head will capture individual and household preferences towards medical care utilization and the expected benefits from participating in the NCMS. For example, households with higher ratio of members having chronic diseases may assign greater value to the NCMS than those with more healthy members. The socio-demographic characteristics will include elements that affect both the costs and benefits of participating in the program. For instance, marital status and household size are assumed to affect family endowment of resources to produce health as well as preferences towards to the program. Households' living environment and location may also affect health status of household members and the cost of accessing to health care services. In addition, we computed an index of household assets, which is used here as a proxy for permanent income, accompanied by household per capita income[17]. 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.

In our dataset, we have additional variable – migration-, which is rarely considered in other 'insurance schemes' impact evaluation literatures. The aim is to examine whether households with migrant workers are likely to enroll in the NCMS or not. In rural China, youths, males, better-educated individuals and those in good health are more likely to migrate to urban areas (Wu, 2010). However, as the migrants cannot formally register in the urban areas ("*hukou*"), by the same token, they are also not eligible for any urban medical insurance system or employee insurance. We hypothesize that the NCMS scheme could

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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 end up with smaller (in numerical size) values of ratio than those small health spending and/or large incomes (Wagstaff *et al*., 2003).

[17] Both of medical expenditure and household income have been adjusted to year 2006 and we took 'Liaoning' province's CPI provided by CHNS as a base.

prove to be an alternative choice. The potential of the NCMS scheme to households with migrant workers is not researched yet. On the one hand, enrollment in the NCMS may help vulnerable groups left at home (source household of the migrant worker) get better health protection which would ease the concerns of the migrant workers. On the other hand, if the migrant worker visits a doctor in urban areas, the reimbursement can be claimed only after the migrant is back to the original localities which would make migrants less inclined to enroll in the NCMS. As migrant workers are usually bread winners (household heads) in their respective source households, their health status directly affects the income of the respective household and thus their NCMS enrollment decision may also directly affect the household's enrollment in the NCMS.

4. Results

4.1 Descriptive statistics

In table 4, we present an overview of the NCMS program in both waves (2004 and 2006). As shown in table 4, the number of NCMS counties is expanded largely in 2006, and the uninsured rural people in the NCMS counties are considerably reduced when compared with the Non-NCMS counties, which reflects the coverage of the NCMS in rural China. The enrollment rate in the NCMS-pioneer counties increases from 67.5% (2004) to 75% (2006). Since we are interested in the impact of the NCMS program for the active enrollees in wave 2006, we exclude all observations from NCMS- pioneer counties. Although data of 2009 is not yet fully available, roughly estimated enrollment rate in 2009 has reached 92.56%.

Table 4 about here

Table 5 about here

Table 6 about here

Further, table 5 gives the sample distribution information referring to the subsequent-NCMS counties (2005/06) across eastern, central and western China in wave 2006. On the whole, the enrollment rate is slightly lower in western regions, but the outpatient reimbursement level is highest among the three regions. The low enrollment rate is unexpected because we consider the NCMS would be more attractive to rural households in western regions since they have relatively worse living conditions and likely to be affected by illness-led poverty. While the setting of outpatient reimbursement in western regions is well reflected and met local health needs, there are little differences in the inpatient reimbursement throughout the three regions.

Table 6 describes percentage distribution of the NCMS enrollees (treatment group) with households ranked by per capita income. 21.07% of the individuals from the poorest group were enrolled in the NCMS. For people in the middle two groups, the number is 61.30%, which is in accordance with the NCMS initiatives that cover as much as rural residents.

Table 7 about here

Table 8 about here

The descriptive statistics for key outcome variables and selected independent variables studied for the three regions are reported in Tables 7 and 8 respectively. For outpatient utilization, the treatment groups have a higher rate than control groups in all regions, but for inpatient utilization, the rate is quite similar. However, there is a difference on the utilization of preventive health care. Treatment groups in western regions have highest utilization rate, while treatment groups in eastern regions have lowest rate. Regarding household medical expenditures, the value in treatment groups are apparently lower than control groups both in outpatient and inpatient expenditures, except in western regions, in which the inpatient expenditures are a little higher in treatment groups. Correspondingly, the incidence of catastrophic expenditure also shows similar trend, which has higher value for treatment groups in western regions and much lower value for treatment groups in the other two regions.

From the attributes of treatment groups, from eastern to western regions, enrolled households gradually show aging characteristics (e.g. in western regions, households with older head and higher ratio of members over 60 years old would like to enroll in the NCMS) and higher health risk (e.g. higher ratio of household members with bad health). In terms of economic status, there is no big discrepancy among enrolled households in all three regions. If we take the case of central and western regions, the rich are more likely to be enrolled, while this true for the poor in Eastern region. The underlying reasons for this could be that the rich in the Eastern regions could afford other types of health insurance. For households with migrant workers in western regions, they have less preference to enroll in the NCMS, but this is not true for eastern and central regions.

4.2 Propensity score estimates

The first part of the empirical strategy computes the propensity score for households enrolled in the wave 2006 NCMS program. Given the rule of 'household enrollment as a unit'

in the NCMS, members of a household should have identical propensity scores as they have the same exposure status. This condition is also consistent with the nature of household-based decision-making mechanism in rural China. Households in the treatment group are matched to households in the potential control group and the matching equation is a function of conditions in wave 2004 (pre-intervention). We estimate the propensity score separately for three regions in our sample. The reason for doing so is that we believe heterogeneous regional characteristics may influence the effect that other variables have on the probability of enrollment in the NCMS program.

Table 9 about here

Table 9 presents the logit regression results used to estimate the propensity score on the basis of which the matching is subsequently conducted. The Pseudo R-squared for the regional models ranged between 0.112 and 0.589. Note that, the sample size of the treatment and matched groups – in terms of individuals – are different as the household sizes vary. Our samples for the three regions already passed the balancing test as described by Becker and Ichino (2002)[18]. The marginal effects of the coefficients in logit models are also shown in Table 9, and thus a change in any one of the independent variables has an impact on the probability of willingness to be enrolled.

As expected, we found discrepancy in the determinants to affect households to enroll in the NCMS. In eastern China, results indicate that households with a working head, higher household per capita income, relatively smaller household size, and with more waiting time (to be seen by doctors) are less likely to be enrolled in the NCMS. All these indicators mentioned reflect a higher economic status which would contribute to lower marginal utility of high-income households on enrollment. As reimbursement in the NCMS is relatively low and the fact that the 'out-of-pocket' for health matters may not necessarily result in economic hardship for rich groups, the NCMS is less attractive to them. However, household heads with 'married' status, households with poor sanitation environment (drinking water and toilet), high ratio of children and chronic members and those with more members reporting their health as 'fair' are more likely to enroll in the NCMS. These results reflect adverse selection in eastern regions, but not quite serious as the marginal coefficients on health-related variables are small. For instance, taking the case of eastern regions, a one percent increase on the share of members under 14, would lead to an increase in probability

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

of enrollment by 0.3 percent. Nevertheless, the living environment could affect health status to a large extent; A one percent increase in households with worse condition of drinking-water, would increase the enrollment rate by 31% In addition, it is also shown that households in eastern regions may have a better knowledge about health insurance or receive better propaganda by local governments as all education-level coefficients are significant positive.

Health-related adverse selection was also apparent in western regions, since households with younger head are less likely to enroll compared with the older head. Households with poor living environment (ex. toilet facilities) preferred to enroll in the NCMS. The NCMS program is designed to help rural residents to improve the poor healthcare status; therefore, it could be more attractive to higher risk groups. It is also worth noting that income is not a strong determinant in western regions, although when head with employment would increase the probability of enrollment by 17.6%, other two income-related factors (asset index and household per capita income) have no significant role on promoting the enrollment. This may deliver a signal that economic condition is one of the determinants but no longer the most important or the only one to restrict people to enroll the NCMS, by contrast, the need for healthcare maybe much more important than ability-to-pay. In fact, under strong support of government subsidies, more and more low-income households in western regions already have little problem on paying premium[19], rather, people are more concerned about the benefits from the NCMS. Relatively small size of NCMS's funds in western regions could be the reason for the lower benefits; therefore, people may hesitate to be enrolled.

On the other hand, economy-related adverse selection was evidenced in the central regions. Notwithstanding, relatively wealthy households in these regions, they are, however found to have higher enrollment probability in the NCMS. In 2009, the rural per capita net income in middle regions was 4864.8 Yuan, which accounts for 72% of eastern regions and 1.32 times of western regions (Green book of China's Rural Economy, 2011). Such 'middle-level-economic' position may lead to people from middle regions have the greatest variation in levels of financial vulnerability to health care costs. In addition, other type of health insurance industry in middle regions (even in western regions) lags far behind the eastern areas; therefore, better-off households in middle regions would like to get more protection by enrolling the NCMS.

For western regions, households with higher ratio of migrant workers are found to be less

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

likely to enroll in the NCMS. Results indicate that one percent increase on migrant workers in household would result in a decrease in probability of enrollment by 26% in western regions. Due to limited earnings, 74% of the migrant workers have no health insurance in China. It is reported that only 32% of the migrant workers will seek formal medical care utilization when they are sick, 38% of them will buy medicine from pharmacy and 20% will visit private doctors [20](Jia, 2008). High health care costs in coastal cities (eastern regions) and inconvenient reimbursement procedure together with e the small repayment make the NCMS less attractive to migrant workers. Moreover, due to regional heterogeneities, source areas and destination areas could issue different NCMS policies and normally the latter could provide preferential conditions. Obviously, migrant workers themselves would more likely choose the NCMS of destination areas. However, as household members of migrant workers are not covered in the insurance, owing to the rule of 'household enrolled as a unit', this would again limit migrant workers' choice.

4.3 Impact estimation

After estimating the propensity score for treated and the control group, we restricted observations into common support areas to calculate ATT[21]. Tables 10 & 11 separately report the impact estimates of the NCMS on medical care utilization and medical expenditures. Included in Table 10 is the percentage average change on the treated group (ATT) under different regions and Table 11 shows results on the incidence of catastrophic expenditure.

Table 10 about here

Table 11 about here

Derived from individual-level information (adult, age>=15), the NCMS has a statistically significant positive impact on improving efficiency of outpatient utilization for both eastern and western regions. By contrast, the NCMS in central regions showed less obvious impacts, since 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 western regions, not only on improving outpatient utilization (7% increase in outpatient utilization as a result of the NCMS enrollment), but also on promoting inpatient utilization (2% increase) and preventive care (5% increase). Concerning the choice of different health care providers, the result of outpatient utilization in western regions indicate that the NCMS can only significantly promote rural people return to town-level hospitals (3% increase), but not to village-level or county-level institutions as shown in the other two regions.

[20] The private doctor in China has different notion with western countries. They are possible with or without doctor license.

[21] Please see appendix A to see common support areas respectively for three regions.

On the other hand, the NCMS has no statistically significant impact on reducing medical burden. The NCMS has not only failed to diminish the burden, but it also increased the incidence of catastrophic expenditure for western regions. It could be explained with the reasons such as moral hazard of the residents or inappropriate policy formulation. For example, if inappropriate deductible or coinsurance is set, it could result in the poor being excluded from the benefit on the one side but also on the other side the rich may have advantages to consume more health care services.

Table 12 about here

Table 12 reflects selected impacts by household per capita income. Given our propensity score estimation as 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 doing so, we try to limit matched groups came from same regions. Table 10 points out some interesting differences within each income centile in the impact of the NCMS on medical care utilization, medical expenditures and incidence of catastrophic expenditure. The NCMS seems to be more favorable to the richest groups, considering that statistically significant impacts are found in reducing inpatient expenditures and decreasing incidence of catastrophic expenditures (24%, when 20% is used as threshold). However, what is gratifying is the NCMS also decreasing incidence of catastrophic expenditure for second-poor groups (15%, when 20% was used as threshold), which is corresponding to limited increase in outpatient and inpatient utilization.

4.4 Sensitivity test results

Considering main impacts are mostly found in binary outcomes, here we do not check sensitivity for continuous outcome variables[22]. The bounds are calculated using the routine of Becker and Caliendo (2007) and matched groups are found by radius matching with a radius of 0.1[23]. The test may be unsuitable for kernel matching, which uses the entire sample as the matching pair (Johar, 2009). For a given e^{γ}, the upper bounds adjust the MH test statistics downwards when ATT is overestimated, and the lower bounds adjust them upwards

[22] In our estimation, the only statistically significant impact of continuous variable is found in inpatient expenditures for centile four, 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.

when ATT is underestimated.

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 the most ATT for medical care utilization have positive signs, the bounds under the assumption that we have underestimated the true treatment effect (Q_{MH}^{-}) are somehow less interesting. In other words, if individuals with 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 not desirable. Hence, we shall focus on overestimation cases.

The tests[24] for medical care utilization suggest that, at small level of e^{γ}, the enrollment of individuals in the NCMS will have significant positive effects on outpatient utilization (in eastern region), outpatient utilization at village-level clinics (both in eastern and central regions), inpatient utilization and preventive care utilization (in western regions). However, the significant impact of the NCMS on outpatient utilization at county-level hospitals no longer exist in both eastern and central regions even under $e^{\gamma}=1$, which means there are definitely unobserved characteristics between treatment and control groups. In western regions, the significant impact on outpatient utilization and outpatient utilization at town-level hospitals are still found under $e^{\gamma}=1$, but the positive results may be reversed if treatment groups are allowed to differ respectively by 25% and 20% or more in terms of unobserved bias with their counterpart in control groups.

Our estimation is robust regarding the significant and positive effectiveness of the NCMS on the incidence of catastrophic expenditure in western regions. This is because only when unobserved bias between treatment and control groups achieves 35% or more, that estimated impact will be reversed. Meanwhile, for 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 under e^{γ}=2 is stable. However, significant impacts of the NCMS on reducing incidence catastrophic expenditures for the richest and second-poor groups are fade away at $e^{\gamma}=1$. In short, these checks suggest that it is unlikely that results of significant positive impacts on medical care utilization are reversed.

[24] The results are available on request.

5. Discussion

Implementation of the NCMS is a major reform to rebuild health security system in rural China. This paper attempts to investigate the NCMS's likelihood of achieving its stated goal of improving medical care utilization and reducing financial burden based on heterogeneous regional characteristics and income groups. Propensity score matching is used to alleviate bias arising from observed heterogeneity and bounding approach is adopted to answer whether or not inference about treatment effects may be altered by unobserved factors.

Results confirm that the NCMS has indeed improved outpatient utilization for rural residents, especially for relatively poor groups and regions in western regions of China. The NCMS could promote poor rural households visit a doctor for minor diseases at early stages before turning into serious diseases; therefore, it helps to reduce health risks. As poor households normally have larger negative health shocks; the financial loss of the poor in the case of disease incidence will thus cause higher welfare loss. Needless to say, the poor should have relatively more benefits in the security system provided by the NCMS than their rich counterparts. As with all insurance schemes, the NCMS program has no significant positive impact on promoting medical care utilization in the poorest group implying that development of the NCMS may still need the support from medical assistance scheme.

Results also present different utilization structure 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. At village level, there are usually one to three village doctors # and 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 transaction cost 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, estimation results in eastern and middle regions show positive impact of NCMS enrollment in promoting outpatient in village-level clinics. However, due to differences in regional development, the village-level institutions in western regions still meet a serious shortage of health resources (MOF, 2006), which may lead to dysfunction of village health stations. Therefore, in the western regions, the positive impact of the NCMS on improving outpatient services is evidenced in town-level hospitals.

Our estimation of improving outpatient utilization at county-level hospitals for eastern and

central regions is not robust to hidden bias. However, this finding is still somehow consistent with the allocation of funds in the ground. As funds are more distributed concentrated on village-level clinic in central regions and on town-level hospitals in western regions, our results indicate more health care utilization occurred respectively in village-level clinic in central regions and on town-level hospitals in western regions. Therefore, policy formulation referring to reimbursement levels can play an important role to influence consumers' behavior and guide rational utilization of health care resources.

By and large, results suggest that given its relatively restricted financing and narrow benefit coverage, the NCMS has impacted positively on improving the utilization of medical service. This result is not surprising and more generally consistent with international experiences on subsidized health insurance programs and community-based health insurance programs. Examples include the SUBS program in Colombia, which has been estimated to increase preventive and ambulatory care (Antonio *et al*, 2005), the health insurance program in Vietnam is associated with higher rates of utilization (Sepehri *et al*, 2006; Jowett *et al*, 2003), and program in rural Senegal also appears to have increased utilization (Jütting, 2003). By contrast, there is little sign to show that the NCMS has reduced outpatient or inpatient expenditure, or the incidence of catastrophic expenditures. Concerning this point, the international experiences also report very mixed results. The research on health insurance schemes' impact in three African countries, namely Kenya, Senegal and South Africa, shows that insured households are less likely to face catastrophic expenditure than uninsured in the case of Senegal. In South Africa, however, it only works for the richest quintile and in Kenya no significant impact was evidenced (WHO, 2006). SEWA program in Gujarat (India) dropped incidence of catastrophic expenditures from 35.6% to 15.1% (Krause, 2000), while Seguro Popular program in Mexico reduced the risk of catastrophic out-of-pocket expenditure (Gakidou *et al*, 2006).

Results, however, also show that the NCMS did not only fail to reduce financial burden for rural residents, but it also increased the incidence of catastrophic expenditures for western regions. The following reason may rationalize the findings. The presence of insurance might lower the price of the medical services, which induces the incentives of both consumer and health care supplier to over-pursue or over-provide medical care (Arrow, 1963; Zeekhauser, 1970; Anthony and Joseph, 2000). In this research, we have not found significant results to show that enrollees use excessive medical services. Nevertheless, one possible explanation lies on the supply-side: healthcare providers in China are paid by 'fee-for-service' and face a fee schedule that strongly encourages demand shifting to drugs and high-tech care on which the margins are higher (Yip and Hsiao, 2008; Liu and Mills, 1999). The situation of over

prescription could occur frequently and thus may push up the cost of medical care. Given such scenario, as NCMS develops, majority of low- and middle-income groups will again be impeded in different levels to have access to health care. Our estimation in the case of reducing the incidence of catastrophic expenditure shows consistently that higher income households receive disproportionately more benefits which would imply that low income participants of the NCMS subsidize the rich. Although these results are sensitive to unobserved variables, if not checked, the sustainable development of the NCMS program will be in question.

If the motivation behind the introduction of NCMS program were to promote medical care utilization and relieve the financial burden of households caused by illness, then the results presented here suggest little about the welfare improvement. Theory suggests that the welfare gains in terms of 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 hazard (Wagstaff et al, 2007). While the data used in the paper did not shed light on 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 hazard, such as reform fee-for-service (FFS) payment system to Diagnosis Related Group (DRG) payment method for hospitals and risk-adjusted capitation method for primary-care providers; seek for more effective third-party purchaser and specify standardized drug list and regulatory regime.

6. Conclusions and policy implications

The findings of this study have several important policy implications. First of all, there is a need to increase financial size of the NCMS program and more importantly improving government's contribution to the program. In the implementation procedure of the NCMS, local governments are mainly responsible for collection and management of funds, and designing the benefit packages. Therefore, local governments should have better knowledge on mobilizing possible resources including financial aspects and health resources and setting a suitable premium. More notably, it is feasible for governments to attempt to integrate NCMS policies within regions. Doing so, helps to establish a broader financing pool and it also favors the enrollment of households with migrant workers. Consequently, the NCMS policies could achieve the gradual transition of integrating policies from a 'local-level' NCMS policy to a 'regional-level' and slowly to a national policy. In addition, given that the value of health insurance is rooted in the unpredictability of medical spending (Anthony and Joseph, 2000),

the NCMS is also required to be dynamic and should adjust following economic changes and development. For central government, it would be viable to provide more financial support to less developed areas in order to supply social protection for poor people.

In particular, the enrollment of migrant workers warrants urgent consideration. As mentioned above, the gradual up scaling of the NCMS policy into the national level could be one possible way out, but has certain geographic constraints; as many migrant workers travel long-distance such as from western to eastern regions. Thus, for long-distance migrants, a 'better' solution from both source and destination areas is necessary. This may range from allowing migrant households to have more choices on which side to enroll in to directly absorb those migrant workers into basic urban employment health insurance. This requires an in depth research.

The study has some limitations worth mentioning. Firstly, owing to data limitation, we focus on a limited set of outcome variables. More notably, we do not consider the impact of the NCMS on health outcomes per se as the reference period is only four weeks. Secondly, we do not shed light on how the impact of the scheme varies with design and implementation characteristics due to ambiguous information regarding the reimbursement models, and the fact that both the design and implementation are likely to vary endogenously along a large number of dimensions. Finally, the estimates 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 differentiated by regions and income groups. This will serve as a background to address the issues raised above in future research.

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. 1996. The Theory of Risk-Bearing: Small and Great Risk. *Journal of Risk and Uncertainty*, 12: 103-111.

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

Becker, S.O. and Ichino, A. 2002. Estimation of average treatment effects based on propensity score. *The Stata Journal*, 2:358-377.

Bennett S. 2004. The role of community-based health insurance within the health care financing system: a framework for analysis. *Health Policy and Planning*, 19: 147-158.

Bertrand, M., Duflo, E. and Mullainathan, S. 2004. How much should we trust differences-in-differences estimates? *The Quarterly Journal of Economics*, 249-275.

Bryson, A., Dorsett, R. and Purdon, S. 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. and Kopenig, S. 2008. Some practical guidance for the implementation of propensity score matching. *Journal of Economic Surveys,* 22(1): 31-72.

Carrin, G., Desmet, M. and Basaza, R. 2001. Social health insurance development in low-income developing countries: new roles for government and non-profit health insurance organization. In: Building Social Security: the Challenge of Privatization, Ch. 10 (ed. X Scheil-Adlung) Transaction Publishers, London, 125-153.

Carrin, G., Waelkens, M.P. and Criel, B., 2005. Community-based health insurance in developing countries: a study of its contribution to the performance of health financing systems. *Tropical Medicine and International Health*, 8: 799-811.

Center for Health Statistics and Information. 2004. An Analysis Report of the National Health Survey in 2003. Ministry of Health, China (in Chinese).

China Ministry of Health, Ministry of Agricultural, National Development and Reform Commission. 2006. Announcement for Accelerating the Establishment of Pilots for the New Cooperative Medical Scheme (in Chinese).

China Ministry of Health and Ministry of Finance. 2008. Announcement for Accomplishing the New Cooperative Medical Scheme (in Chinese).

Culyer, A.J. and Newhouse, J.P. 2000. Handbook of Health Economics. ELSEVIER SCIENCE B.V., The Netherland.

DiPrete, T. and Gangl, M. 2005. Assessing Bias in the Estimation of Causal Effects: Rosenbaum Bounds on Matching Estimators and Instrumental Variables Estimation with Imperfect Instruments. *Sociological Methodology*, 35.

Du L, Zhang W. 2007. The Development on China's Health. Social Science Academic Press, No.3, Beijing, China.

Ekman, B. 2004. Community-based health insurance in low-income countries: a systematic review of the evidence. *Health Policy and Planning*, 19(5):249-270.

Filmer, D., Hammer, J. and Prichett, L. 2002. Weak links in the chain II: a prescription for health policy in poor countries. *World Bank Research Observer*, 17: 44-66.

Gakidou, E., R.Lozano, E. Gonzalez-Pier, J.Abbott-Klafter, J.T.Barofsky, C.Bryson-Cahn, D.M. Feehan, D.K. Lee, H.Hernandez-Llamas and C.J.Murray. 2006. Assessing the effect of the 2001-06 Mexican health reform: an interim report card. *Lancet*.

Heckman, J., Ichimura, H. and Todd, P. 1997a. Matching as an econometric evaluation estimator: evidence from evaluating a job training program. *Review of Economic Studies*, 64(4): 605-654.

Heckman, J., Ichimura, H. and Todd, P. 1998b. Matching as an econometrics of active labor market programs. *Review of Economic Studies*, 65(2): 261-294.

Heckman, J., LaLonde, R. and Smith, J. 1999. The economics and econometrics of active labor market programs. In O.Ashenfelter and D.Card(eds), *Handbook of Labor Economics*, Vol.III, pp.1865-2097, Amsterdam: Elsevier.

Hurley, A.J. 2000. An overview of the normative economics of the health sector. Handbook of Health Economics, Elsevier.

Jalan, J. and Ravallion, M. 2003. Estimating the Benefit Incidence of an Antipoverty Program by Propensity-Score Matching. *Journal of Business & Economic Statistics*, 21(1): 19-30.

Jinlin Du, Yingyan Li and Lusheng Wang. 2006. Comprehensive evaluation index of the New Rural Cooperative Medical System. *Chinese journal of Public Health*, 3.

Jia Li e. 2008. Problems and Strategies for migrant workers to enroll in the New Rural Cooperative Medical Scheme. *Population & Economics*, 4:209-210.

Jin Feng and Zheng Song. 2007. Health Care System in Rural China: A Quantitative Approach Based on Heterogenous Individuals. China Economic Quarterly, 6(3): 841-858.

Johar, M. 2009. The impact of the Indonesian health card program: A matching estimator approach. *Health Economics*, 28: 35-53.

Jowett, M., Contoyannis, P. and Vinh, N.D. 2003. The impact of public voluntary health insurance on private health expenditures in Vietnam. *Soc Sci Med*, 56(2): 333-42.

Jütting, J. 2003. Do Community-based Health Insurance Schemes Improve Poor People's Access to Health Care? Evidence From Rural Senegal. World Development, Vol. 32 (2): 273-288.

Jütting, J. 2005. Health insurance for the poor in developing countries. Ashgate Publishing company. USA.
Khandker, S.R., Koolwal G.B. and Samad, H.A. 2010. Handbook on impact evaluation: Quantitative Methods and Practices. The World Bank, Washington, D.C.

Ling Zhu. 2010. Improving Equity and Sustainability of the Social Security System in China. The Chinese Academy of Social Sciences (CASS) Forum, October 22-24, 201.

Liu, X. and Mills. A. 1999. Evaluation payment mechanisms: how can we measure unnecessary care? *Health policy and Planning*, 14(4): 409-13.

Mantel, N. and Haenszel, W., 1959. Statistical aspects of the analysis of data from retrospective studies of disease 22(4): 719-748.

Ministry of Health of the People's Republic of China, www.moh.gov.cn. As accessed in September 2011.

O'Donnell, O., Van Doorslaer, E., Rannan-Eliya, R.P., Somanathan, A., Garg, C.C., Hanvoravongchai, P., Huq, M.N., Karan, A., Leung, G.M., Tin, K. and Vasavid, C. 2005. Explaining the incidence of catastrophic expenditures on health care: Comparative evidence from Asia. EQUITAP Project: working paper #5.

O'Donnell, O., Van Doorslaer, E., Wagstaff, A. and Lindelow, M. 2008. Analyzing Health Equity Using Household Survey Data: A Guido to Techniques and Their Implementation. The World Bank, Washington, D.C.

Patrick, K. The non-profit health insurance schemes in unorganized sectors in India [M]. Deutscher gesellschaft fuer Technische Zusammerarbeit (GTZ) GmbH. 2000.

Pradhan, M. and Prescott, N. 2002. Social risk management options for medical care in Indonesia. *Health Economics*, 11: 431-446.

Pradhan, M., Saadah, F. and Sparrow, R. 2004. Did the Healthcard Program ensure Access to Medical Care for the Poor during Indonesia's Economic Crisis? Tinbergen Institute Discussion Paper.

Ranson, M.K. 2002. Reduction of catastrophic health care expenditures by a community-based health insurance scheme in Gujarat, India: current experiences and challenges. *Bulletin of the World Health Organization* 80, 613-621.

Rosenbaum, P.R. and Rubin, D.B. 1983. Central Role of the Propensity Score in Observational Studies for Causal Effects. *Biometrika*, 70: 41-55.

Rosenbaum, P.R. 2002. Observational Studies, 2nd ed. Springer-Verlag, New York.

Rubin, D. 1990. Formal Models of Statistical Inference for Causal Effects. *Journal of Statistical Planning and Inference*, 25: 279-292.

Rural Development Institute of Chinese Academy of National Bureau of Statistics and National bureau of Statistics Rural Social Economic Survey. 2011. Green book of China's Rural Economy: rural economy of China analysis and forecast (2010-2011). Social Sciences Academic Press (China).

Sala-i-Martin, X. 2005. 'On the health-poverty trap', in Health and Economics Growth: Findings and Policy Implications. G.Lopez-Casasnovas, B.Rivera and L.Currais. Cambridge, MA, MIT Press.

Sepehri, A., W.Simpson and S.Sarma. 2006. The influence of health insurance on hospital admission and length of stay: the case of Vietnam. *Soc Sci Med*, 63(7): 1757-70.

Smith, J.P. 1999. Healthy bodies and thick wallets: The dual relation between health and economic status. *Journal of Economic Perspectives*, 13(2): 145-166.

Smith, J. and Todd, P.E. 2001. Reconciling Conflicting Evidence on the Performance of Propensity-Score Matching Methods. *American Economic Review*, 91:112-124.

Smith, J. and Todd, P. 2005. Does matching overcome Lalonde's critique of nonexperimental estimators? *Journal of Econometrics*, 125(1-2): 305-53.

Trujillo, A.J., Portillo, J.E. and Vernon, J.A. 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: 211-239.

Van Doorslaer, E. and O'Donnell, O. 2008. Measurement and Explanation of Inequality in Health and Health Care in Low-Income Settings. UNU-WIDER Discussion Paper No. 04.

Van Doorslaer, E., O'Donnell, O., Rannan-Eliya, R.P., Somanathan, A., RajAdhikari, S., Garg, C.C., Harbianto, D., Herrin, A.N., Huq, M.N., Ibragimova, S., Karan, A., Wan Ng, C., Pande, B.R., Racelis, R., Tao, S., Tin, K., Tisayaticom, K., Trisnantoro, L., Vasavid, C. and Yuxin Zhao. 2006. Effect of payments for health care on poverty estimates in 11 countries in Asia: an analysis of household survey data. *Lancet* 368: 1357-1361.

Vyas, S. and Kumaranayake, L. 2006. Constructing socio-economic status indices: how to use principal components analysis. Oxford University Press in associate with The London School of Hygiene and Tropical Medicine: 459-468.

Wagstaff, A and Van Doorslaer, E. 2003. Catastrophe and impoverishment in paying for health care: with applications to Vietnam 1993-1998. *Health Economics*, 12: 921-934.

Wagstaff, A, Lindelow, M, Gao Jun, Xu Ling, Qian Juncheng. 2007. Extending Health Insurance to the Rural Population: An Impact Evaluation of China's New Cooperative Medical Scheme. *World Bank Policy Research Working Paper*, 4150.

Wagstaff, A. 2005. The economic consequences of health shocks. World Bank Policy Research Working Paper: 3644.

Wagstaff, A. and Lindelow, M. 2005. Can insurance increase financial risk? : The curious case of health insurance in China. Washington, D.C., *World Bank Policy Research Working Paper* No. 3741.

Winnie, Y. and Hsiao, W. 2009. China's health care reform: A tentative assessment. China Economic Review, 20:613-619.

Winnie, Y. and Hsiao, W. 2008. The Chinese health system at a crossroads. *Health Affairs*, 27: 460-468.

World Bank, http://go.worldbank.org/BJKZ4ECPP0. As accessed in September 2011.

World Bank. 2010. *Handbook on impact evaluation: Quantitative methods and practices*. Printed in World Bank, Washington D.C.

World Health Organization. 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).

Xiaoyan LEI and Wangchuan LIN. 2009. The New Cooperative Medical Scheme in Rural China: Does more coverage mean more service and better health? *Health Economics*, 18: S25-S46.

Xin Gu and Liming Fang. 2007. Cost control and sustainable development of the New Rural Cooperative Medical Scheme. Study & Exploration, 168(1): 137-141.

Xu K, Evans, D.B, Kawabata, K., Zeramdini, R., Klavus, J., Murray, C.J. 2003. Household catastrophic health expenditure: a multicounty analysis. *Lancet* 362: 111-117.

Yuan-sheng Jiang. 2004. Health Insurance Demand and Health Risk Management in Rural China. Peter Lang GmbH.

YanLing Li and Liqing Li. 2009. The study on Health resource utilization performance of New Rural Cooperative Medical Scheme: Based on Propensity Score Matching Empirical Analysis. *ISSUES IN AGRICULTURAL ECONOMY*, 10.

Yuan-sheng Jiang, Shi-gui Zhang and Zhi-wei Shen. 2008. Survey and Evaluation of the Operation Process and Effectiveness of New Rural Cooperative Medical Schemes: based on 15 Pilot Counties. *Rural Economy*, 10: 74-78.

Yuanli Liu. 2004. Development of the rural health insurance system in China. *Health Policy and Planning*, 19(3): 159-165.

Yuanyuan Yan, Linxiu Zhang, Ross Gao and Hong Wang. 2006. Effectiveness analysis of implementation of the New Rural Cooperative Medical Scheme: empirical study of 101 village from 5 provinces in China. *Chinese Rural Economy*, 5: 64-71.

Yuanli Liu and Keqin Rao. 2006. Providing Health Insurance in Rural China: From Research to Policy. *Journal of Health Policies, Policy and Law*, 31(1): 71-92.

Zhang L, Cheng X, Tolhurts. R., Tang S, Liu X. 2010. How effectively can the New Cooperative Medical Scheme reduce catastrophic health expenditure for the poor and non-poor in rural China. *Tropical Medicine and International Health*, 15(4): 468-475.

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.

Zhengzhong Mao, Jialin Jiang. 2004. Comparative research on the New Rural Cooperative Medical Scheme. *Journal of Chinese Health Service Management*, 7:p426-428.

Zheren Wu. 2010. Self-selection and Earning of Migrants: Evidence from Rural China. *Journal of the East Asian Economic Association*, 24(1): 23-44.

Appendices

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

Notes: "other funds" contain funding from village-level governments contribution and collective funds.

Source: Mao zhengzhong, Jiang jialin *et al*, 2004, *Comparative research on the New Rural Cooperative Medical Scheme*, Journal of Chinese Health Service Management, 7:p426-428.

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 zhengzhong, Jiang jialin *et al*, 2004, *Comparative research on the New Rural Cooperative Medical Scheme*, Journal of Chinese Health Service Management, 7:p426-428.

Table 3 The development progress of the NCMS

Indicator	Year 2004	Year 2005	Year 2006	Year 2007	Year 2008	Year 2009
Number of Counties Implementing of NCMS	333	678	1451	2451	2729	2716
Number of Enrollees (100 Million)	0.80	1.79	4.10	7.26	8.15	8.33
Enrollment Rate (%)	75.2	75.7	80.7	86.2	91.5	94.0
Total Fund Raised at Current Year (100 million Yuan)	40.3	75.4	213.6	428.0	785.0	944.4
Per Capita Premiums (Yuan)	50.4	42.1	52.1	58.9	96.3	113.4
Payout at Current Year (100 million Yuan)	26.4	61.8	155.8	346.6	662.0	922.9
Number of Beneficiaries from Reimbursement (100 million)	0.76	1.22	2.72	4.53	5.85	7.59

Sources: China Health Statistics Digest, 2005-2010; the number of NCMS counties reduces 13 is because those 13counties have already uniform practice Residence basic health insurance.

Table 4 Summary of the NCMS program in CHNS data, wave 2004 and 2006

	Wave 2004		Wave 2006		
	Pioneer NCMS Counties (03/04)	Non-NCMS counties	Pioneer NCMS Counties (03/04)	Following NCMS Counties (05/06)	Non-NCMS counties
Number of Counties	5	31	5	17	14
Number of Suburban villages [a]	4	16	4	6	14
Number of Households	388	2582	389	1178	1458
Number of Individuals	1032	7543	1014	3098	4147
% of Individuals without any health insurance	33.24%	93.90%	25.25%	29.28%	88.21%
Enrollment rate (%) [b]	67.53%	--	74.55%	69.78%	--

Notes: superscript [a]: Suburban villages represent districts and counties located around the city. They are different from traditional definition of those counties in the countryside; superscript [b]: Household level enrollment rate within NCMS counties.

Table 5 Regional distribution of the NCMS program 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
Enrollment rate (%) [b]	70.83%	77.45%	55.29%

Note: superscript [b]: 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 6 Percentage of rural people living in households enrolling 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

Table 7 Descriptive statistics for outcomes between treated groups and control groups across three regions in China, wave 2006

Wave 2006												
Regions	Eastern China				Central China				Western China			
Groups	Treated groups		Control groups		Treated groups		Control groups		Treated groups		Control groups	
Outcome variables	Mean	Std.dev	Mean	Std.dev	Mean	Std.dev	Mean	Std.dev	Mean	Std.dev	Mean	Std.dev
Outpatient utilization in last 4 weeks	0.089	0.29	0.064	0.25	0.120	0.32	0.123	0.33	0.139	0.35	0.118	0.32
Outpatient utilization in village-level clinics	0.032	0.17	0.016	0.13	0.067	0.25	0.043	0.20	0.045	0.21	0.045	0.21
Outpatient utilization in town-level hospitals	0.018	0.13	0.004	0.07	0.022	0.15	0.024	0.15	0.045	0.21	0.028	0.16
Outpatient utilization in county-level hospitals	0.007	0.08	0.007	0.09	0.013	0.11	0.006	0.08	0.011	0.11	0.008	0.09
Outpatient utilization in municipal-level hospitals	0.005	0.07	0.025	0.16	0.008	0.09	0.017	0.13	0.003	0.05	0.006	0.08
Inpatient utilization in last 4 weeks	0.005	0.07	0.006	0.08	0.005	0.07	0.007	0.09	0.014	0.12	0.005	0.07
Preventive care in last 4 weeks	0.010	0.10	0.034	0.18	0.028	0.16	0.027	0.16	0.050	0.22	0.017	0.13
Outpatient expenditure (Yuan)	179.55	2158.00	361.25	4168.69	86.56	594.74	149.96	1184.17	31.867	153.79	42.502	212.91
Inpatient expenditure (Yuan)	20.084	238.43	276.10	2843.21	4.652	74.45	138.368	1829.99	52.473	339.69	17.899	218.09
Incidence of catastrophic expenditure:												
10% as threshold	0.150	0.36	0.171	0.38	0.206	0.41	0.161	0.37	0.211	0.41	0.067	0.25
20% as threshold	0.075	0.27	0.171	0.38	0.063	0.26	0.105	0.31	0.132	0.34	0.017	0.13

Table 8 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	2478.451	3281.664	2558.536	2726.415	3245.679	3054.554
Education of household head (ref: illiterate or semi-literate)						
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 (minutes) 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(<=14)	8.760	6.652	12.941	10.643	15.179	17.089
Share of household members over 60 (>=60)	13.767	30.352	15.902	17.854	29.462	23.169
Share of household members with chronic (age>=12)	16.033	21.375	10.945	11.934	9.817	7.170
Share of household members with self-assessed bad health (age>=12)	5.513	5.524	6.116	7.287	7.329	7.870
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

Notes: superscript [a]: income and expenditures are inflated to year 2006 and adjusted based on Liaoning province.

Table 9 Propensity score estimation (logit), by region

Variables	Eastern China			Central China			Western China		
	Coef.	Std. dev	Marginal Coef.	Coef.	Std. dev	Marginal Coef	Coef.	Std. dev	Marginal Coef
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)									
Primary school	2.177***	0.668	0.187	-0.284	0.361	-0.057	-0.344	0.438	-0.064
Junior high school	2.745***	0.709	0.236	-0.237	0.394	-0.048	-0.220	0.501	-0.044
Senior high school and above	2.870***	0.784	0.247	-0.405	0.429	-0.082	-0.680	0.707	-0.128
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	0.220	0.188	0.019	-0.503***	0.144	-0.101	-0.007	0.215	0.003
Ln Hh per capita income [a]	-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
Household opportunity cost to access to health care									
Travel time (minutes) 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)	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	

Notes: superscript [a]: income and expenditures are inflated to year 2006 and adjusted based on Liaoning province. *, **, ***: respectively denotes statistical significance at 10%, 5% and 1%.

Table 10 Propensity score matching results --- Estimated average treatment effect on the treated (ATT) on medical care utilization

Outcome variables	Eastern China Kernel weights		Central China Kernel weights		Western China Kernel weights	
	ATT	Std. dev	ATT	Std. dev	ATT	Std. dev
Outpatient utilization in the last 4 weeks	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)

Notes: Bootstrapped standard errors with 100 replications in brackets. *, **, ***: respectively denotes statistical significance at 10%, 5% and 1% level

Table 11 Propensity score matching results --- Estimated average treatment effect on the treated (ATT) on medical expenditures

Outcome variables	Eastern China Kernel weights		Central China Kernel weights		Western China Kernel weights	
	ATT	Std. dev	ATT	Std. dev	ATT	Std. dev
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)

Notes: Bootstrapped standard errors with 100 replications in brackets. *, **, ***: respectively denotes statistical significance at 10%, 5% and 1% level.

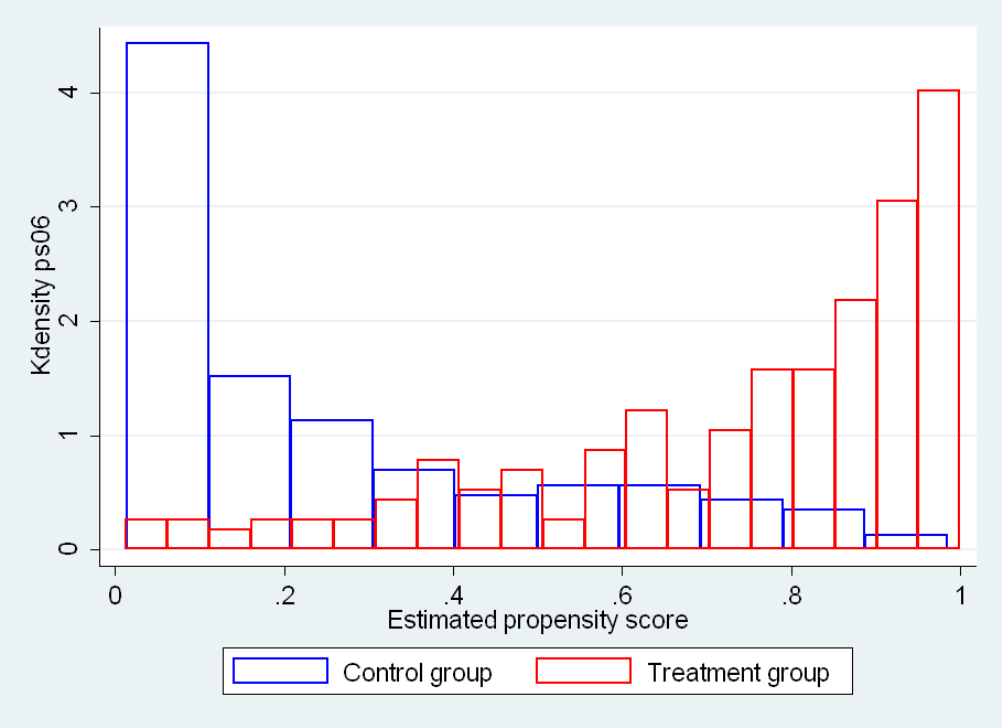
Table 12 Estimated average treatment effect on the treated (ATT) on medical care utilization and medical expenditure, by income group

Outcome variables	Income group	Kernel weights	
		ATT	Std. dev
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)

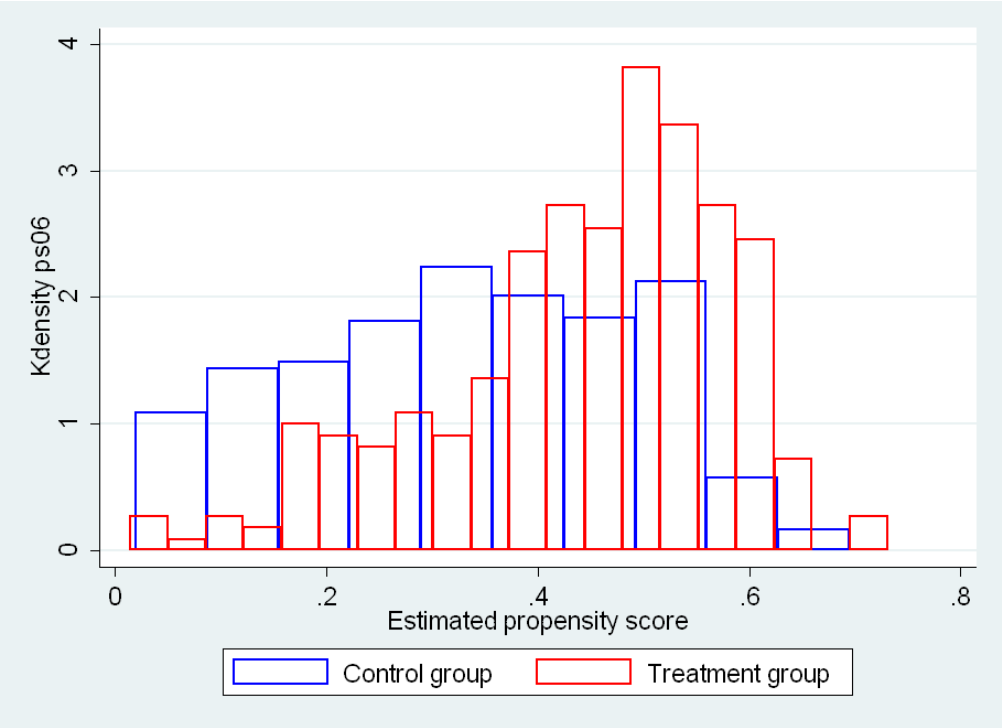
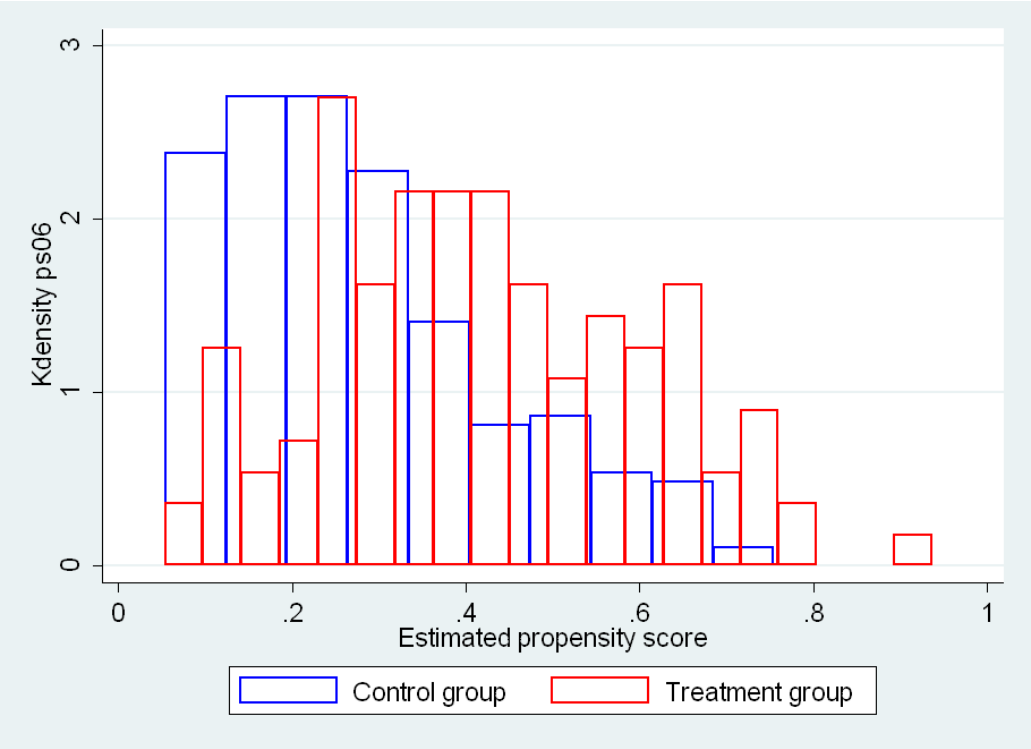
Notes: Bootstrapped standard errors with 100 replications in brackets. *, **, ***: respectively denotes statistical significance at 10%, 5% and 1% level.

Appendix A: Histogram of estimated propensity score respectively for three regions

AA-1: Histogram of estimated propensity score for eastern regions



AA-2: Histogram of estimated propensity score for central regions



AA-3: Histogram of estimated propensity score for western regions