

Catastrophic Payment and Health Protection in Rural China – Impact of New Cooperative Medical Scheme in Shandong Province

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Abstract

Objective: To measure the impact of China's New Cooperative Medical Scheme (NCMS) on catastrophic medical payments of rural households in Linyi County, Shandong Province.

Method: In 2005, from a stratified cluster sample of 3,101 rural households we identified 375 households that might be at risk of catastrophic payments, by searching through NCMS claims and interviewing key informants. We interviewed these 375 households and confirmed that 239 had had catastrophic payments ($\geq 40\%$ of the household's capacity to pay) during 2004. A validity test of our screening method found another 8 cases among immediate neighbours of these 375 households; by extrapolation, we obtained an adjusted total of 289 catastrophic households in the sample of 3,101. We measured the impact of the NCMS on hardship alleviation by counterfactual analysis, comparing catastrophic payments before and after NCMS reimbursements.

Result: The effect was twofold. Before NCMS intervention 9.32% of the sample households had had catastrophic out-of-pocket payments compared to 8.55% after reimbursements. Catastrophic severity dropped by 21.3% for households remaining in catastrophe after reimbursement, to an average of 6.34 times the household's capacity to pay.

Conclusion: Out-of-pocket medical payments remain a burden for rural households. Financial protection from the NCMS was modest with an average reimbursement of 17.8% of total medical costs, and should be restructured to provide better benefits and to target those in most need.

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Sukhan Jackson
School of Economics
University of Queensland
s.jackson@economics.uq.edu.au

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Catastrophic Payment and Health Protection in Rural China: Impact of New Cooperative Medical Scheme in Shandong Province

Xiaoyun Sun¹, Sukhan Jackson², Gordon Carmichael¹ and Adrian C. Sleigh¹

¹ National Centre for Epidemiology and Population Health, The Australian National University, Canberra, Australia

² School of Economics, The University of Queensland, Brisbane, Queensland, Australia

1. Introduction

Community-based pre-payment for medical care could be a viable option of financial protection for farmers in developing countries and people in the informal sector without access to the formal mechanism of health insurance (Preker *et al.* 2001; Commission on Macroeconomics and Health 2002; Preker *et al.* 2002). The Commission of Macroeconomics and Health of the World Health Organization (2002:3-4) states that “community financing can provide an incremental, albeit first, step to improve financial protection and access to health services for the poor” in low and middle-income countries.

Several studies have found community-based health financing to be effective in extending insurance to rural and low-income people who would otherwise be without health protection (Preker *et al.* 2001; Commission on Macroeconomics and Health 2002; Preker *et al.* 2002). For example, Ranson (2002) who evaluated a community-based health insurance scheme in India has concluded that such schemes could protect poor households against the risk of unexpectedly high medical expenses, although some fine-tuning of the scheme design was needed. Ekman (2004: 249) has reviewed several empirical studies on community-based health insurance and found “... strong evidence that such programmes do provide effective protection to the members of the schemes by significantly reducing the level of OOP [out-of-pocket] payment for care.” However, other studies are not so favourable. For example, an International Labour Organization review of 258 community-based health insurance schemes concludes that the evidence did not justify the assertion that community financing had been effective in providing financial protection in health care (ILO 2002). One possible reason for the diverse views is the lack of consistency in the interpretation of the term “financial protection”. The ILO study considered people to be financially protected when they did not have to draw an excessive proportion of their income to afford medical care, whereas Ekman’s study defined financial protection as any sort of reduction in out-of-pocket payments for medical care.

In this study, our definition of financial protection is that households are financially protected if their medical care payments are not catastrophic. Illness or injury is catastrophic when it is necessary for a household to cut its basic consumption for a considerable time in order to pay for medical expenses. Our interpretation of catastrophic payment is consistent with the WHO

definition, which sets the threshold of catastrophic payment at 40% of “capacity to pay” (see Methods).

The purpose of this study is to measure the impact on catastrophic medical payments from the new rural community-based health insurance piloted in China beginning in 2002, known as the New Cooperative Medical Scheme (hereafter: NCMS). We use two indicators. The first is the “catastrophic payment headcount”, where we calculate the percentage in the rural community of households liable for a catastrophic payment; the impact of the NCMS is its capacity to reduce this percentage. The second is the “catastrophic payment gap”, which measures the average severity of catastrophic payment of each affected household. The impact of the NCMS is the reduction in catastrophic medical payments before and after NCMS reimbursements. Inferences for the whole community can be made from our results.

1.1 Community-based health financing in China

Community health financing is not new in China. Indeed China’s rural Cooperative Medical Scheme (CMS), adopted in the 1960s and 1970s by Maoist communes, was once regarded as a successful model for the developing world to ensure health care was accessible to farmers and their families. China abandoned collective farming, the funding source of the CMS, under the post-1979 economic reform; and in 1982 abolished its communes. Consequently the CMS collapsed and coverage fell from 90% at its peak to less than 10% in the 1990s (Liu *et al.* 1996), and out-of-pocket payment for medical care now prevails for rural people.

It is important to know that China’s health system is distinctly separated into urban and rural, and community health financing is only applicable to the rural areas. For urban areas, measures are in place to improve the social-security safety net, including a basic medical insurance scheme which began in 1998 for urban employees. It covers urban employees of enterprises in the state-owned, collective and private sectors, in enterprises with foreign investment, government departments, and various institutions of a non-commercial nature. The richer cities also provide protection to groups not covered by the basic medical insurance scheme; for example, self-employed individuals and free-lance workers.

However, the 70% of China’s total population who reside in the rural areas lack adequate health protection. The Ministry of Health in 2002 reported that more than one-third of sick

farmers did not seek medical treatment because of unaffordable costs, and medical payments are impoverishing many families (Wilkes *et al.* 1997; *China Daily* 2002).

There was an attempt beginning in 1994 to provide health insurance when the Chinese Ministry of Health, in collaboration with international agencies, trialled community-based health financing in a number of rural counties throughout China. However, without financial support from the central government and their own provincial governments, these rural community medical schemes (RCMS) were limited in scale to risk-pooling at the township level, and the premiums charged to farmers were often too low for schemes to be sustainable (Yu *et al.* 1998; Carrin *et al.* 1999). In due course, many broke down owing to insufficient financial and political support, but some were revived and others persisted, especially those in the richer counties (Jackson *et al.* 2005). However, the need to provide financial protection for rural people remains a great challenge.

By 2003, 79% of the rural population were not protected by any kind of health insurance (Centre for Health Statistics and Information Ministry of Health 2004). Medical costs were rising along with China's high economic growth, and were becoming a worrisome burden for farmers. It was reported that the average hospital admission expenditure in rural areas increased from 613 yuan in 1993 to 2649 yuan in 2003 (Centre for Health Statistics and Information Ministry of Health 2004). It is acknowledged in China that medical expenditure is an important cause of rural poverty; a study found that 7.22% of the rural population were living below the locally-defined poverty line¹, and 45% of these households were below the poverty threshold because of out-of-pocket medical expenses (Liu *et al.* 2003).

A priority of the Central Government was to reform rural health financing. A New Cooperative Medical Scheme (NCMS) was initiated in 2003 as a pilot in more than 300 rural counties. The NCMS is defined as a mutual help and risk-pooling health protection system, organized and supported by four levels of government (central, provincial, county and township) and involving voluntary participation by rural people. The NCMS, now expanding beyond the initial pilot areas, is expected to reach the majority of China's 800 million rural population by 2010 (Central Committee of the CPC and the State Council 2002).

¹ The actual poverty line was not specified in this article by Liu *et al.* (2003). Usually, locally classified poverty (i.e., listed by County Civil Affair officials) is more extreme than poverty detected using the national poverty line.

This new millennium model is an improvement on the previous model of the 1990s in two ways. Firstly, provincial governments must contribute financially to the NCMS in counties under their jurisdiction; for the less developed central and western China, the Central Government also provides an annual subsidy of 10 yuan for each person who joins the NCMS. Local governments (provincial, municipal and county or township) in total pay at least 10 yuan per person to match the individual premium of around 10 yuan. Secondly, NCMS subscribers are coming from larger risk-sharing pools at the county level (population 500,000 to 1 million) in contrast to the RCMS of the 1990s, which were pooled at the township level (population 10,000 – 50,000).

One explicit goal of NCMS policy was to “resolve”² the catastrophic medical payments that can impoverish rural households (Central Committee of the CPC and the State Council 2002). The central government expects that implementation of NCMS will alleviate the financial hardship and help to prevent illness-induced poverty. Therefore hospitalization and other catastrophic medical payments are its specific targets.

We report on this new millennium model and focus on catastrophic medical payments. We measured the extent to which the NCMS provided financial protection to rural households, using a case study of a NCMS pilot in Shandong Province. To find out the effectiveness of the NCMS in reducing hardship, we collected statistical evidence to calculate (a) the catastrophic payment incidence and (b) the catastrophic payment intensity of the households before and after NCMS reimbursements.

The next two sections describe the study setting, and present the methods for data collection and analysis. The results section follows and then a discussion. Finally we draw conclusions and discuss policy implications.

1.2 New Co-operative Medical Scheme (NCMS) in Linyi County

The pilot NCMS county of Linyi in Shandong was chosen for several reasons. First, Linyi County is a typical agricultural county with a total population of 519,300, of whom 81% are farmers. Secondly, Linyi’s economy ranks in the middle of the Shandong county range; the net annual income of the agricultural population averaged 3,031 yuan in 2003 (Bureau of

² “*jie jue*” (in Chinese), which can be interpreted to resolve, or eliminate or substantially reduce.

Statistics of Linyi County 2004). Thirdly, funding resources available to the NCMS in Linyi were also around the middle level for the seven Shandong pilot counties at 23 yuan per person per year (10 yuan from the farmer and a total of 13 yuan from governments at different levels (provincial, county and township). Fourthly, coverage of the NCMS in Linyi was relatively high; when it started in August 2003 coverage was 93.5%, and it increased to 94.6% in 2004. Finally, the benefits package of Linyi's NCMS was similar to those of most other counties, covering hospital outpatient and inpatient services. Outpatient reimbursements were about 20% of total expenses. Inpatients were to receive discounts of 20%-80% of total expenses; the higher the expenses, the higher the benefit up to a ceiling of 10,000 yuan per person per year.

2. Methods

2.1 Definitions of capacity to pay (CTP) & catastrophic medical payment (CMP)

Capacity to pay (CTP) is defined as the household's disposable income minus subsistence expenditure (Xu *et al.* 2003). We used food expenditure as a proxy for subsistence expenditure. Data were collected from the catastrophic households on food expenditure, medical care payments and income using a detailed household questionnaire. Medical care payments included all household members' medical expenses for both outpatient and inpatient care during the year of 2004. For this study, we excluded non-medical direct expenses related to treatment seeking like transport and food, and other indirect costs like loss of income due to illness.

Catastrophic medical payment (CMP). Payment is considered catastrophic when a household has to cut its basic living expenses over a period (one year in this study) in order to afford the medical expenses of its household member(s).

Catastrophic medical payment (CMP) threshold. In the literature there is no definitive threshold (based on the relation between payment and income) that distinguishes what is catastrophic and what is not. We adopted the approach used in several WHO studies (Murray *et al.* 2003; Xu, Evans *et al.* 2003; Xu, Klavus *et al.* 2003) which sets the catastrophic threshold at 40% of the household's CTP, but we have also conducted a sensitivity analysis for other thresholds at 20%, 30%, 50% and 60% of CTP.

2.2 Measuring the impact of the NCMS using the catastrophic headcount (incidence) and catastrophic payment gap (excess)

We have followed the approach of Wagstaff and van Doorslaer (2003) in our analysis of CMP in China, and adapted two indices to measure the impact of the NCMS. They are the catastrophic payment headcount (incidence); and mean catastrophic payment gap (excess) which captures the severity of payment above the catastrophic threshold.

Catastrophic medical payment headcount (incidence) [hereafter: CMP headcount] describes the frequency of households with catastrophic medical payment (CMP) in proportion to the sample (3,101 households). We calculate the catastrophic headcount in a situation before NCMS reimbursement [Equation 1] and after NCMS reimbursement [Equation 2].

The impact of the NCMS was reflected in the difference in catastrophic headcount before and after reimbursement [Equation 3]. The reduction of CMP headcount after reimbursement, as a percentage of the CMP headcount before reimbursement [Equation 4] reflects the impact of the NCMS on financial protection. The equations are presented below.

$$\text{Catastrophic headcount before reimbursement: } CH_{before} = \frac{1}{N} \sum CI_{before} \quad [\text{Equation 1}]$$

$$\text{Catastrophic headcount after reimbursement: } CH_{after} = \frac{1}{N} \sum CI_{after} \quad [\text{Equation 2}]$$

Where:

CH = Catastrophic headcount

CI = Catastrophe index. If a household's medical payment as a proportion of its capacity to pay \geq the catastrophic threshold (CPH threshold), then $CI_i = 1$; otherwise

$CI_i = 0$

N = Total number of households in sample (3,101 households)

Difference in the catastrophic headcount before and after reimbursement:

$$D_{CH} = CH_{before} - CH_{after} \quad [\text{Equation 3}]$$

D_{CH} as a percentage of the catastrophic headcount before reimbursement:

$$D_{CH} \% = (D_{CH} / CH_{before}) \times 100 \quad [\text{Equation 4}]$$

Catastrophic medical payment gap [hereafter: *CMP gap*] measures catastrophic severity. It describes how much a household's medical payment (as a percentage of its CTP) is in excess over the catastrophic threshold of 40% of its CTP. The size of the excess reflects severity. The mean *CMP gap* refers to the average of the sum of the total excesses from all the catastrophic households in the sample, before NCMS reimbursement [Equation 5] or after NCMS reimbursement [Equation 6].

Mean catastrophic payment gap before reimbursement:

$$MCG_{before} = \sum CG_{before} / \sum CI_{before} \quad [\text{Equation 5}]$$

Mean catastrophic payment gap after reimbursement:

$$MCG_{after} = \sum CG_{after} / \sum CI_{after} \quad [\text{Equation 6}]$$

Where:

CG = Catastrophic payment gap

CI = Catastrophe index. If a household's medical payment as a proportion of its capacity to pay \geq the catastrophic threshold (CPH threshold), then $CI_i = 1$; otherwise

$CI_i = 0$

MCG = Mean catastrophic payment gap. The sum of all catastrophic payment gaps divided by the total number of catastrophic households

The ability of the NCMS to reduce the severity of catastrophic payment is measured by the change in the mean *CMP gap* before and after NCMS reimbursement as a percentage of the original mean *CMP gap* before reimbursement [Equation 7 and 8].

The group of households that still had catastrophic payments after reimbursement was the observation group. The impact of the NCMS on each of these households was indicated by how much the CMP gap was reduced.

For those households remaining in catastrophe even after reimbursement, the difference in the mean catastrophic payment gap before and after reimbursement is calculated as follows:

$$D_{MCG} = (\sum CG_{before} - \sum CG_{after}) / \sum CI_{after} \quad [\text{Equation 7}]$$

D_{MCG} is also expressed as a percentage of the mean catastrophic payment gap before reimbursement:

$$D_{MCG} \% = (D_{MCG} / (\sum CG_{before} / \sum CI_{after})) \times 100 \quad [\text{Equation 8}]$$

2.3 Data collection

Sampling method

We used the stratified cluster sampling method to obtain a sample of 3,101 households from a total of 19 villages located in the 10 townships under the jurisdiction of Linyi County. The households were randomly selected as follows.

(1) We divided the 10 townships into three groups according to their socio-economic status based on average per capita income estimated by the County Health Bureau: high (two townships), middle (4 townships) and low (4 townships). From each group, we randomly selected one township; thus we studied a total of three townships.

(2) From each of the three townships, we randomly selected its villages until the number of households cumulated to about 1,000 households. Consequently, we obtained a sample of 3,101 households (consisting 12,725 people), accounting for 10.1 percent of the total population in the three study townships. Our study was limited to this sample of 3,101 households, from which we identified households that had potentially incurred catastrophic medical payments.

How did we identify potential catastrophic households in the sample?

We identified a total of 375 potential catastrophic households in this sample of 3,101 households using (i) claims data and (ii) interviews with key informants (village heads, village doctors and women's leaders). We defined potential catastrophic households as those belonging to one or more of the following categories.

The first category, identified by either NCMS claims data or key informants, comprised households whose members had been hospitalized during 2004. The assumption was that hospitalization usually is expensive, so that households with members who had been hospitalized were at high risk of incurring catastrophic medical bills.

The second category, identified by key informants, comprised households not in the first category but which had members who had chronic and/or serious illnesses and were not hospitalized. These households might have consumed multiple outpatient services. Cumulated outpatient costs could be catastrophic for the family.

The third category, also identified by key informants, was the poverty-stricken households that were known in 2004 to have incurred medical payments, but not large enough ones to be listed in the other two categories. Relatively low expenses could be catastrophic for the very poor.

Household interviews

All the 375 potential catastrophic households identified from our sample of 3,101 households were interviewed to establish if they were truly catastrophic. Respondents were either household heads or their spouses. Other adult family members were allowed to attend the interview because they sometimes could provide valuable information. The interviews averaged 1½ hours and were conducted during May 2005 when it was not a busy time for farmers in Shandong.

Demographic data collected from the interviews for all household members included age, relationship to household head, gender, education level, occupation and marital status. Data on whether a member was earning income, household income and expenditure, health service utilization and medical expenses were also collected (Tables 1 and 2).

After the interviews, we found that only 231 of the 375 potential catastrophic households truly had catastrophic medical payments in 2004; the remaining 144 were not catastrophic households by our definition (see section 2.1).

Validity test of our screening method (to ensure we had not missed any catastrophic payment households in the sample)

As the 375 potential catastrophic households were identified through manually screening the NCMS claims data and speaking to key informants, we conducted a validity test of our method to ensure robustness of our results. The test was a rapid appraisal of neighbouring households of the 375 potential catastrophic households and was conducted as follows.

Each of the 375 potential catastrophic households was matched with one screen-negative neighbour (whose dwelling was located nearest to opposite the households that had been interviewed) to confirm that this neighbour did not have a catastrophic medical payment in 2004. Rapid appraisal questions were put to the neighbours to determine if they in fact had catastrophic payments but were missed by our screening method. If rapid appraisal results were positive, then the household head (or spouse) was interviewed using the same questionnaire as used for the 375 potential catastrophic households. Eight (2.1%) households turned out to be false-negative, and this meant that we had to adjust the estimated total number of catastrophic households in our sample.

We extrapolated from the actually detected 8 false-negative households to obtain an estimated total of 58 false-negative households among the remaining 2,726 households in the sample (3,101-375). Consequently the adjusted total number of catastrophic households in our sample of 3,101 households was 289 (231+58). Our analysis of the impact of the NCMS was based on 289 catastrophic households. For the 231 screen-positive households the information was derived from interviews of each household. For the 58 false-negative households the information was derived from a sample of 8 households and was extrapolated to the whole 58.

Figure 1 is a summary of our methods, showing the various stages in the sampling process and data collection undertaken in May 2005.

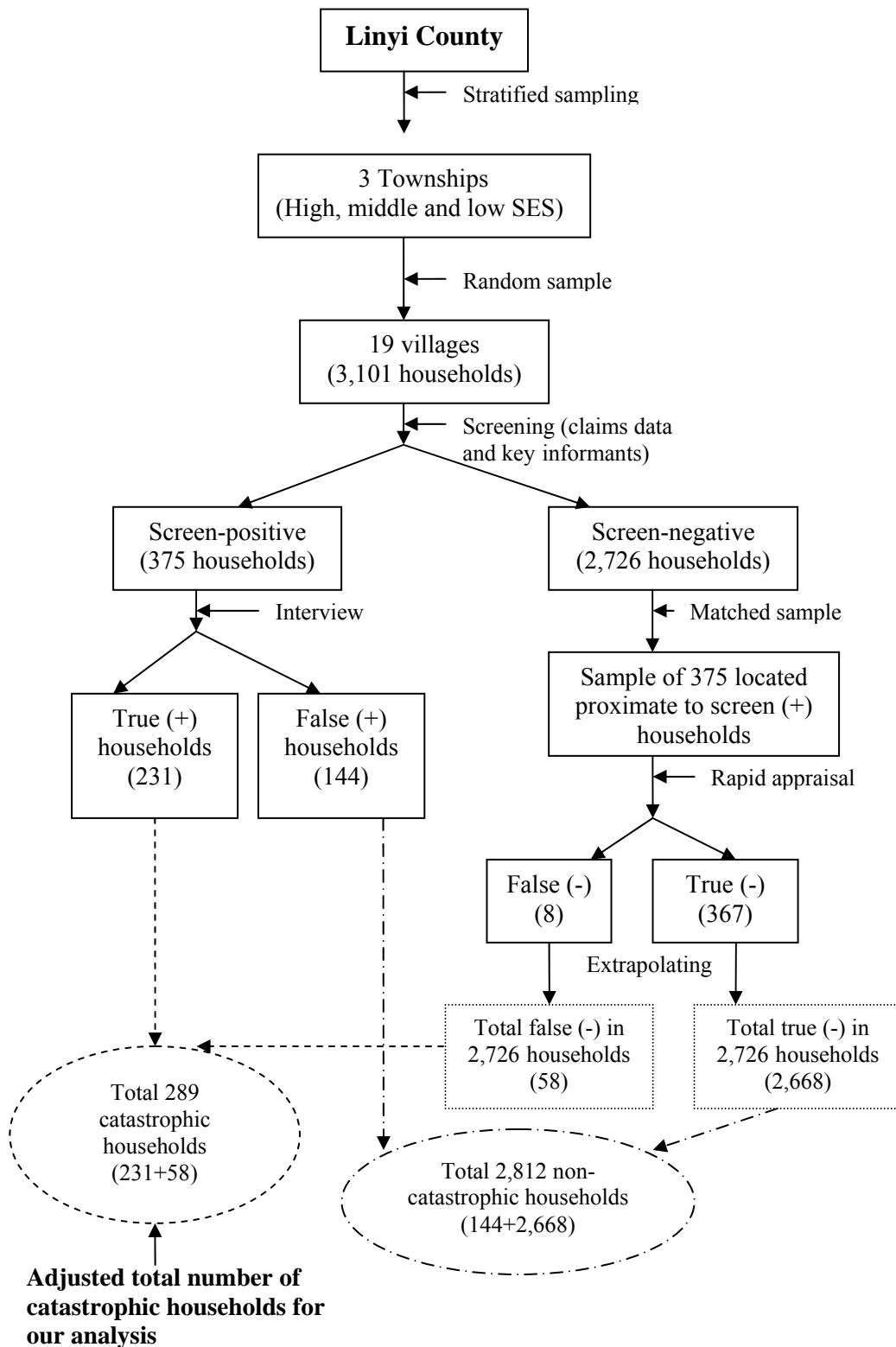


Figure 1. Sampling method and data collection for household survey in Linyi County

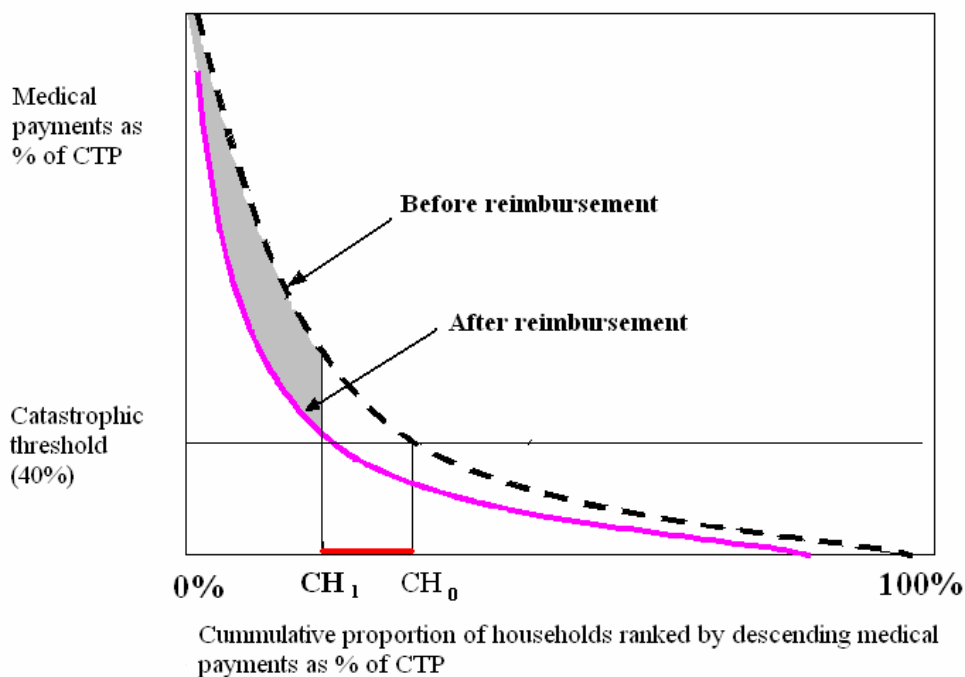
2.4 The conceptual framework of counterfactual analysis

Counterfactual analysis entails comparing the situation of all the catastrophic households before NCMS reimbursement (as if they were not covered by the NCMS) and the situation after NCMS reimbursement. The situation of the households after receiving reimbursements from the NCMS was factual; the “before reimbursement” situation was regarded as a counterfactual situation.

Before reimbursement, the households paid the full costs of medical services and the costs were economically catastrophic. Under the NCMS, part of the medical expenses was reimbursed. As out-of-pocket payments were reduced by the reimbursement, some households ceased to be catastrophic; and the severity of catastrophic payments was alleviated for those households remaining in catastrophe after reimbursement.

Figure 2 illustrates the impact of the NCMS from two perspectives: CMP incidence (headcount) and CMP intensity (gap or excess). The X-axis shows the cumulative proportion of households, ranked in descending order, according to their medical payments as a percentage of their CTP. The Y-axis shows households’ medical payments as a percentage of their CTP above or below the CMP threshold set at 40% of CTP. The dashed curve represents before reimbursement and the solid curve represents after reimbursement.

The impact of the NCMS on the CMP headcount is the reduction from CH_0 to CH_1 . The shaded area, between the two curves above the threshold and left of the line of CH_1 , represents the impact of the NCMS on the severity of catastrophic payment for those households still in catastrophe after reimbursement.



Notes:

CTP: capacity to pay was measured by household's disposable income net of subsistence expenditure

CMP (catastrophic medical payment): household medical payment as a percentage of CTP equalling or exceeding the catastrophic threshold (e.g. 40% of CTP)

CH_0 : the proportion of households with CMP in the community, before reimbursement

CH_1 : the proportion of households with CMP in the community, after reimbursement

Source: based on Wagstaff and van Doorslaer (2003)

Figure 2. NCMS impact on catastrophic medical payments

3. Results

3.1 Characteristics of 239 catastrophic households

Based on the catastrophic threshold of 40% of capacity to pay, we estimated that 289 households were catastrophic among our sample of 3,101 households. However, we actually obtained interviewed-based data from only 239 (231 screen-positive + 8 false-negative) households; their characteristics are presented below.

Demographic profiles

Among the 239 catastrophic household heads, 88.7% were male (Table 1). Most (91.2%) were married, but 17 respondents (7.1%) were divorced or widowed and four (1.7%) were unmarried.

About 70% of household heads had at least primary education, 30.5% reached junior high school level, about 7.1% attained education at high school or above level, and 28.5% had no formal schooling. The majority were farmers (71.1%), followed by casual labourers (17.6%) and self-employed business persons (4.6%). Average household size was 3.75 (SD = 1.602, median = 4). Most households (65.7%) had 3-6 people.

Table 1. Profile of 239 catastrophic households interviewed in Linyi County, 2004

Characteristics	Percentage
Household head	
Sex	
Male	88.7
Female	11.3
Marital status	
Married	91.2
Other marital status	8.8
Education level	
No formal schooling	28.5
Primary school (6 years)	33.9
Junior high school (3 years)	30.5
High school or above (3 years or more)	7.1
Occupation	
Farmer	71.1
Casual labourer	17.6
Self-employed business person	4.6
Other	6.7
Number of persons in household	
1 - 2 persons	29.7
3 - 6 persons	65.7
≥7 persons	4.6

Household income and medical care payment

The average economic status of the 239 catastrophic households was below the average for Linyi County. In 2004, their per capita net income averaged 1,780 yuan (Table 2), compared to 3,031 yuan, the average rural income in the county (*Bureau of Statistics of Linyi County 2004*). Before incurring the health payments of that year, 11.7% of catastrophic households (28/239 households) were below China's national poverty line of 668 yuan per person, and 6.3% (15/239 households) had already been singled out as being in dire poverty by the local government.

These 239 catastrophic households had incurred large medical payments in 2004. Total medical payment (before reimbursement) averaged 5,521 yuan, 3.1 times of the average per capita net income of 1,780 yuan. Average reimbursement from the NCMS was 924 yuan or 17.8% of total medical payment, and thus households paid out-of-pocket at an average of 4,597 yuan. Our results showed a high degree of variation in the rural households' total medical payments, with the implication that financial risks are highly unpredictable for the rural population.

Table 2. Per capita income (in yuan) and NCMS reimbursement (in yuan) on medical payments of 239 catastrophic households, Linyi County, 2004

	Annual per capita income	Total medical payment	Out-of-pocket payment	NCMS reimbursement	Reimbursement rate (%)
Mean	1,780	5,521	4,597	924	17.8
Median	1,400	3,050	2,459	547	20.0
Std. Deviation	1,515	6,493	5,790	1,353	0.1
Minimum	75	190	160	0	0.0
Maximum	15,112	47,200	46,440	8,000	44.0
Quartiles					
25%	912	1,850	1,520	160	9.5
75%	2,156	6,480	5,430	923	25.4

Note: US\$1 = approx 8 yuan

3.2 Measuring the impact of the NCMS using CMP headcount (incidence)

To calculate the CMP headcount (incidence) we firstly defined catastrophic payments at the threshold of 40% of CTP (in Section 3.2.1), and then performed a sensitivity analysis by recalculating the headcount after defining catastrophic payments at thresholds of 20%, 30%, 50% and 60% of CTP (in Section 3.2.2). As mentioned in the Methods (Section 2.3), the adjusted total number of catastrophic households in our sample (3,101 households) was 289. It should be noted that 289 catastrophic households were the basis of our analyses for CMP headcount and CMP gap.

3.2.1 CMP headcount at threshold 40% of capacity-to-pay

At the 40% threshold of CTP, the CMP frequency was 289 catastrophic households; thus the CMP headcount was 9.32% of the sample (3,101 households) before reimbursement. After

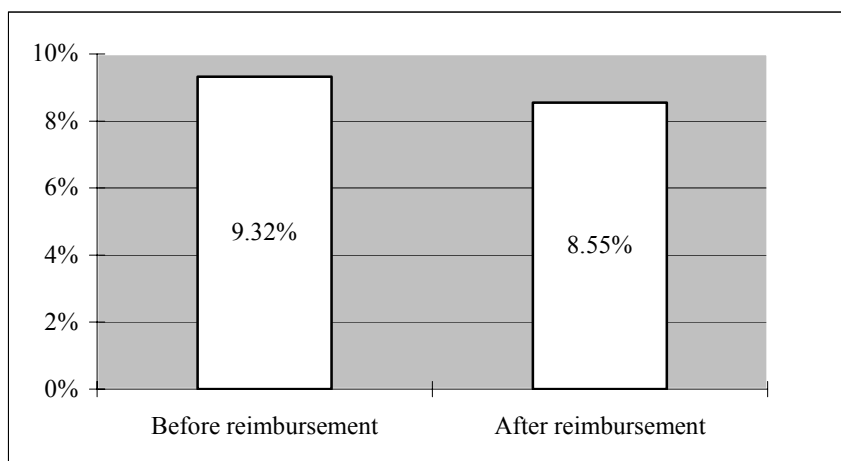


Figure 3. Catastrophic headcount (incidence) as % of the sample (3101 households) before and after reimbursement, at the 40% of CTP threshold in Linyi County, 2004

Notes:

- (1) CTP (capacity to pay) is defined as total household disposable income minus total subsistence expenditure.
- (2) Before reimbursement there were 289 catastrophic households, after reimbursement there were 265 catastrophic households.

Source: 2004 Screen-positive Household Survey and 2004 Screen-negative Household Rapid Appraisal Test

reimbursement, the CMP headcount was 8.55%, and the frequency was 265 catastrophic households³ (Figure 3). The impact of the NCMS was a reduction of 24 households.

3.2.2 Sensitivity analysis using other catastrophic thresholds related to capacity to pay

Table 3 presents the results of our sensitivity analysis on the CMP headcount at thresholds of 20%, 30%, 50% and 60% of CTP. The higher the threshold level, the lower the CMP headcount. At 20% of CTP, the CMP headcount was 11.77% before reimbursement and fell

Table 3. Catastrophic headcount (incidence) as % of the sample (3101 households) before and after reimbursement, at selected thresholds of CTP in Linyi County, 2004

% of CTP	CMP headcount before NCMS reimbursement (%) (a)	CMP headcount after NCMS reimbursement (%) (b)	Reduction by the NCMS (%) $(\frac{a-b}{a} \times 100)$
60%	8.09	7.58	6.37
50%	8.64	8.00	7.46
40%	9.32	8.55	8.30
30%	10.32	9.51	7.81
20%	11.77	11.19	4.93

Note:

CTP (capacity to pay) is defined as total household disposal income minus total subsistence expenditure.

Source: 2004 Screen-positive Household Survey and 2004 Screen-negative Household Rapid Appraisal Test

to 11.19% after reimbursement. At 60% of CTP, the CMP headcount was 8.09% before reimbursement and 7.58% after reimbursement.

³ On the evidence of the data, we calculated that NCMS reimbursements had reduced the 231 screen-positive catastrophic households to 207. However, as catastrophe was not eliminated for any of the 8 false-negative households, we assumed the same for the extrapolated 58 false-negative catastrophic households. Thus 265 (207+58) was the CMP headcount after NCMS reimbursement.

The CMP headcount before and after reimbursement at different thresholds varied between 0.52 and 0.81 percentage points. We note that the impact of NCMS reimbursement was greatest at the threshold of 40% of CTP, reaching the highest reduction in CMP headcount of 8.3% (Table 3).

3.3 Measuring the impact of the NCMS using the mean CMP gap

The CMP gap captures by how much a household’s catastrophic medical payment (CMP) exceeds the 40% threshold of its CTP. The impact of the NCMS was measured by the

Table 4. Mean CMP gap of the 265 catastrophic households at the 40% of CTP threshold in Linyi County, 2004

	Mean CMP gap
Before reimbursement (a) (number of times household CTP)	8.06
After reimbursement (b) (number of times household CTP)	6.34
Reduction by the NCMS (a-b)	1.72
Reduction in original payment	21.3%

Notes:

CMP is catastrophic medical payment. The 265 households analyzed are those that remained in catastrophe after reimbursement.

CTP is capacity to pay, defined as total household disposal income minus total subsistence expenditure.

Source: 2004 Screen-positive Household Survey and 2004 Screen-negative Household Rapid Appraisal Test

reduction in the mean CMP gap before and after NCMS reimbursement for households remaining in catastrophe after reimbursement.⁴

⁴ Using data collected from interviews, we calculated the CMP gap of each of the 207 households remaining in catastrophe after reimbursement, and of each of the 8 false-negative households. Results for the 8 households were then extrapolated to the estimated 58 false-negative households. Thus we obtained the mean CMP gap for 265 (207+58) households in catastrophe.

There were 265 households remaining in catastrophe after reimbursement. For them the mean CMP gap declined from 8.06 times their CTP before reimbursement to 6.34 times their CTP after reimbursement, a reduction of 21.3% of the original (before reimbursement) mean CMP gap (Table 4).

3.4 Modelling projected impact of the NCMS on CMP headcount using selected reimbursement rates (at 40% of CTP)

In practice, the NCMS in various locations throughout Linyi County offered a variety of reimbursement rates for different circumstances; the 17.8% reimbursement rate was the

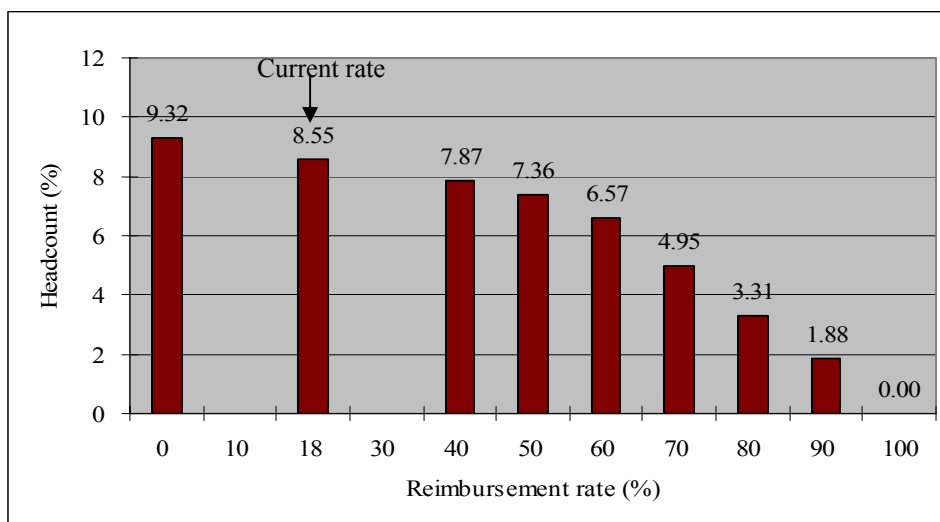


Figure 4. CMP headcount (as % of a sample of 3,101 households) at selected reimbursement rates, Linyi County, 2004

Note: calculation of CMP (catastrophic medical payment) headcount has been adjusted according to results of the Screen-negative Household Rapid Appraisal Test (see Methods)

Source: 2004 Screen-positive Household Survey and 2004 Screen-negative Household Rapid Appraisal Test

average observed in this study. This section explores what the NCMS could achieve at different reimbursement rates, other factors assumed constant (including the 40% of CTP catastrophic threshold). For the sake of simplicity, we modelled reimbursement rates at 40%,

50%, 60%, 70%, 80% and 90% to calculate the impact of the NCMS on financial protection. Our focus here is the reduction achieved in the CMP headcount.

Figure 4 shows how the CMP headcount would change with various reimbursement rates. Without the NCMS, at zero reimbursement, the CMP headcount was 9.32% of the sample (3,101 households); at full (100%) reimbursement the CMP headcount would be 0% (no catastrophes). Of course, the CMP headcount falls as the reimbursement rate rises. For example, if the reimbursement rate was 80% then catastrophe would occur in only 3.31% of the households in the sample.

Impact of the NCMS

The current NCMS reimbursement rate, averaging 17.8%, had reduced CMP headcount by from 289 to 265 catastrophic households, a reduction of 8.3% (24/289). Our modelling yielded the following results: a reimbursement rate of 50% could reduce the catastrophic headcount by 21.1%, 60% by 29.5%, 70% by 46.9%, 80% by 64.5% and 90% by 79.8%.

4. Discussion

After 25 years of economic reforms, Chinese farmers now pay out-of-pocket for treatment of illness and injury, and many are at risk of facing a catastrophic medical payment. This study is one of the few empirical studies on China to quantify the incidence and severity of catastrophic medical payments among rural households. Also it is probably the first to attempt to measure the impact of the NCMS, China's most recent implementation of health insurance for rural families.

4.1 Catastrophic incidence and severity in relation to medical expenditure for rural households

In our study we measured both the incidence and severity of catastrophic medical payments and provide strong evidence to show that medical expenditure is a financial burden for many rural households. In our sample 9.32% of rural households in 2004 fell into a catastrophe because of out-of-pocket medical payments, and NCMS reimbursements only reduced this incidence to 8.55%, which was still relatively high. Yet Linyi County ranks economically in the middle among all counties of Shandong Province, and Shandong is above average

economically among the provinces of China. This implies that the harsh economic effects of illness and injury in the less well-off parts of China would be even worse. Moreover, many households could incur catastrophic payments several years in a row, especially those with chronic illnesses.

The CMP headcount in our Shandong study appears to be relatively high when compared to the results of a WHO multi-country (non-China) study of household catastrophic health expenditures (Xu *et al.* 2003), also based on the threshold of 40% of capacity-to-pay (CTP). Although lower than Vietnam at 10.45% and Brazil at 10.27%, our Shandong CMP headcount was higher than those for all the other countries in this WHO study; for example, Azerbaijan at 7.15%, Colombia at 6.26%, Argentina at 5.77% and Cambodia at 5.02%.

There was a study on China in 2000 by (van Doorslaer *et al.* 2005), also based on the 40% of capacity-to-pay threshold. The catastrophic incidence of 4.81% in a sample covering 10 provinces was lower than that in our Shandong study. However, their study covered both rural and urban areas, and urban residents are normally protected by some kind of health insurance, unlike their rural counterparts. Indeed out-of-pocket payment averaged 60.4% of the household's total health expenditure in their sampled population, compared to 82% in our study, which concentrated on only the rural residents.

The severity of catastrophic payments in rural households is noteworthy. Our study found that for the 289 households, out-of-pocket payments before NCMS reimbursement averaged 7.39 times the household's capacity-to-pay. After reimbursement it was 5.81 times, which was still too harsh for the rural households and a disaster in the context of their meagre lives.

4.2 Impact of NCMS on financial protection

It is evident from this study that the NCMS has a role in protecting households from the financial burden of illness. Both indicators of catastrophe - CMP headcount and CMP gap - were reduced after households received NCMS reimbursements; but the relief was modest at best. The reimbursement rate, averaging 17.8 % (Table 2, last column), had cut the catastrophic headcount (incidence) by just 8.3% and the mean CMP gap by 21.3%. So a large number of households remained catastrophic despite the reimbursements; for many only the severity was alleviated slightly.

Two main factors may explain the modest impact of the NCMS. The first is the low premiums of the scheme. The ability of the NCMS to reduce the financial burden of illness depends on how much funds can be raised and pooled. Raising the funding level is fundamental to improving NCMS capacity to shield more households from catastrophic medical payments and to reduce the severity of catastrophes. The relationship between the reimbursement rate and NCMS impact on CMPs has been illustrated by our simulation analysis. The funding levels of the NCMS were too low in Shandong's pilot counties, as farmers still paid relatively large sums out-of-pocket.

The second factor relates to the benefit package of the scheme, which was determined by the funding level and premiums of the NCMS. In Linyi County the NCMS insured for both outpatient and inpatient care, and was meant to protect households from CMP by increasing reimbursement rates in proportion to medical expenditure. In practice, the reimbursement rates did not vary significantly between low-paying and high-paying households (Figure 5). Households with $\geq 3,000$ yuan in total medical payments received reimbursement of 18.7%,

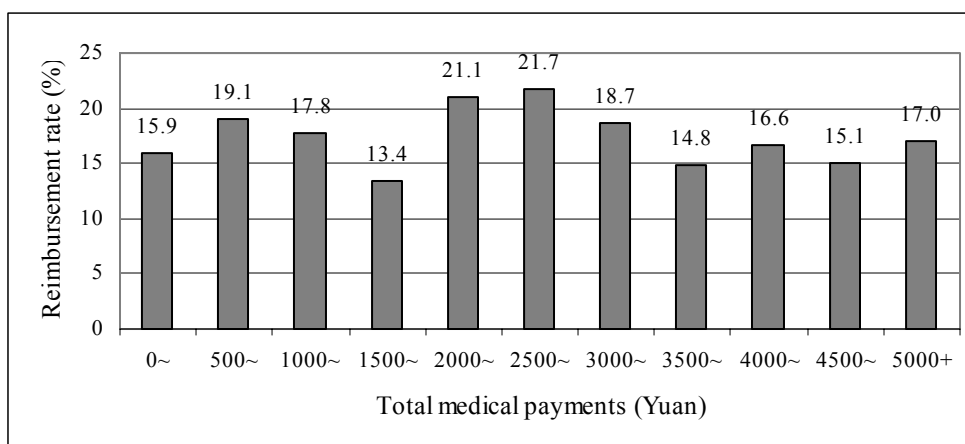


Figure 5. NCMS reimbursement as a proportion of total medical payments among 239 catastrophic households in Linyi County, 2004

Source: 2004 Screen-positive Household Survey and 2004 Screen-negative Household Rapid Appraisal Test. Analysis was based on data collected from the 231 true positive households and 8 false negative households (see Methods)

compared to 16.9% for households with total payments of $< 3,000$ yuan. The average was 17.8% of households' total health payments; co-payments were still high, so that the out-of-

pocket payments of many still exceeded 40% of their capacity to pay. Thus, the scheme design in Linyi County could not adequately alter the predicaments of many households.

4.3 Problems of measuring the impact of the NCMS on financial protection

This study quantified the impact of the NCMS on financial protection by measuring the reduction in the level of catastrophic medical payments among rural households. The strength of our methodology is that we have two indicators of catastrophe – CMP headcount and CMP gap – to inform on whether NCMS reimbursements have achieved their goal to provide financial protection. The indicators, however, are subject to several factors that could influence the results. Two important ones – (1) the definitions of CMP and thresholds and (2) the types of costs used in the study - are discussed below

4.3.1 Definition of CMP and threshold levels

Definitions of CMP

There are two main definitions of CMP used in contemporary studies. The first is CMP related to CTP, which was adopted in this study. The second is CMP in relation to absolute income level or absolute fixed amount of medical expenses (deemed to be catastrophic if “too high”). Some studies have adopted the income-related CMP definition (Wyszewianski 1986a; 1986b; Waters *et al.* 2004; Su *et al.* 2006); for example, Russell (2004) considers total health payment to be catastrophic if it is $\geq 10\%$ of household income. The definition of CMP based on CTP has been adopted in many WHO studies (Murray *et al.* 2003; Xu, Evans *et al.* 2003; Xu, Klavus *et al.* 2003).

Different catastrophic thresholds

The catastrophic thresholds used in different studies are not uniform. Comparison of results between different studies is difficult when the threshold levels are not the same. However, some studies have adopted a range of cut-off points to generate a corresponding range of catastrophic incidence and catastrophic severity measures under different thresholds. We have undertaken a sensitivity analysis to show how the impact of the NCMS varied according to different thresholds relative to capacity to pay.

Specifically, it is necessary in China to compare the performance and impact of the different existing versions of NCMS, so that the one with the best ability to reduce CMP could be chosen by policymakers for nationwide implementation. To evaluate the impact of NCMS, it is essential to be consistent in the use of a threshold to define catastrophic payments. How do we know which threshold to use? The rationale is that the catastrophic threshold should represent an approximate point at which the household is forced to sacrifice other basic needs. But the appropriate threshold is still somewhat arbitrary, as the share of household resources can vary in different social and cultural situations.

4.4 Limitation of medical costs in measurement of CMP incidence and CMP severity

Generally, the cost of illness and injury comprises direct and indirect costs. Direct costs arise from treatment-seeking (including medical expenses and non-medical expenses such as transport and food) and indirect costs result from loss of the productive labour of patients and caregivers (Jackson *et al* 2002; Russell 2004; Jackson *et al* 2005; Jackson *et al* 2006a&b; McIntyre *et al.* 2006). McIntyre *et al.* (2006) reviewed the literature on the economic effects of direct and indirect costs of illness in low and middle income countries and noted that in a majority of studies indirect costs exceeded direct costs, by 2 to 3.6 times.

In our study, only medical costs (part of the direct costs) were used to measure catastrophes, which would be bigger if non-medical costs and indirect costs were also taken into account. We are aware that only considering medical costs underestimates the CMP headcount (incidence) and CMP gap (severity), but our main interest is the role of the NCMS. We took this approach because only out-of-pocket medical expenses can be ameliorated directly by the NCMS, and only changes in medical expenses before and after reimbursement reflect the impact of the NCMS on financial protection.

5. Conclusions

Financial protection against the cost of illness for rural residents in China is an urgent issue, as catastrophic payments are affecting nearly 10% of the population each year. The NCMS is a viable risk-sharing mechanism for rural residents who have long been excluded from financial protection in respect of illness and injury. Implementation of the NCMS is a great leap forward towards fairer health financing and could prevent catastrophes for many

households. However, at the current NCMS funding level, financial protection is limited because premiums are relatively low and benefits ungenerous.

The scheme design could certainly be improved. One possibility is to reduce co-payments (that is, provide higher NCMS reimbursements), which necessitates more financial inputs into the scheme either by increasing government subsidies or by increasing the premiums of individual participants, or both. A less costly option is to target specifically those impoverished households with high risks of incurring catastrophic medical payments, perhaps exempting them totally from medical costs. This requires a better understanding of what kind of households are at high risk of catastrophic or impoverishing payments, and further research is necessary to this end. If all vulnerable households could be effectively helped, the scheme then could achieve its fundamental goal of financial protection for the needy.

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