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The Impact of the New Rural Cooperative Medical Scheme on Activities and Financing of Township Hospitals in Weifang, China

Xiaoxian HUANG, Aurore PELISSIER, Martine AUDIBERT, Jacky MATHONNAT[1]
With Ningshan CHEN and Anning MA[2]

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[1] CERDI-CNRS, Corresponding author: A. Pélissier, *Phone:* (33) 4 73 17 75 07; *Fax:* (33) 4 73 17 74 28. *E-mail:* pelissier.aurore@gmail.com

[2] N. Chen is Division Chief, Division of Policy Research, Department of Health Policy and Legislation, MoH, Beijing and A. Ma is Vice-President of Weifang Medical University. He was Director of Weifang Health Bureau during the period of the study.

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This Working Paper is the companion of two others: on (i) the determinants of inpatients and outpatients activities and (ii) of efficiency of preventive and curative activities of township hospitals.

A general report regarding the whole research describes more extensively the activities and financing of township hospitals, their individual situation, and includes a set of policy oriented recommendations with numerous statistical data. It is available in English and in Chinese language.

The methodology and the results of this research have been discussed with the Weifang Health Bureau, the Weifang Medical University and the CERDI, and presented in several international forums. But the authors alone are responsible for the content of this paper.

Jacky Mathonnat

Abstract

Since 2003, the New Rural Cooperative Medical Scheme is gradually implemented in China, in order first, to increase access of the poor to health services, reduce out-of-pocket expenditures and avoid catastrophic health expenditures and second to re-oriented patient to township hospitals. The paper estimates the impact of the New Rural Cooperative Medical Scheme on a sample of 24 township hospitals of Weifang prefecture (Shandong province), using a generalized form of differences-in-differences model on longitudinal data over the period 2000-2008. The estimations conclude to the significant and positive impact of the New Rural Cooperative Medical Scheme on inpatient activities and on the bed occupancy rate, and to the significant and negative impact on the average length of stay. As expected, the impact on inpatient activities is higher in poor areas than in non poor ones and the marginal impact is decreasing over time.

JEL Classification: G22, I1, I38, O12.
KEY WORDS: China, New Rural Cooperative Medical Scheme, Impact analysis, Township Hospitals.

1 Introduction

Two important links of the Chinese rural health insurance system are at the origin of this paper: the **New Rural Cooperative Medical System** (NRCMS) and the **township hospitals** (THs).

Since the beginning of the 21st century, China is committed into vast social reforms, particularly addressed to the rural population. In 2003, this surge is expressed by the beginning of the implementation of a new health insurance system for the rural population: the NRCMS. During the Tenth National People's Congress on March 2007, the Prime Minister Wen Jiabao confirmed the strong commitment of the Government to develop quickly health insurance in rural areas. Taking into account the evolution of health insurance system since 1950s as well as the specific role accorded to THs[3], two objectives were assigned to the reform. On the one hand, the reform of the insurance system targets to improve rural people's access to health care and to reduce financial burden caused by the cost of health services On the other hand, the reform also aims to enforce the performance of THs, by re-orientating patients to THs rather than to county hospitals (Weifang Health Bureau).

The choice of TH as the object of this study is relevant for three reasons. First, they are a target of the NRCMS. Second, they serve mainly rural residents who are also a target of NRCMS reform. This constructs a straight linkage between the insurer (NRCMS) and the service provider (THs). Finally, NRCMS aims at increasing the rural population's access to basic medical services, and the THs play an important role in delivering this kind of services beside village health stations. THs are also the first referral facilities above village health stations and the first one to deliver general surgical services, before county level. By studying the impact of the implementation of NRCMS on the activities, efficiency and financial structure of THs, it permits to measure the distance between political expectation and practical results and thus gives inspiration for future health and social policy orientation.

In order to asses this objective, the paper is organized in 6 sections. Section 2 describes the context in which the NRCMS was implemented in Weifang prefecture. Based on a longitudinal survey, sections 3 and 4 respectively present the data and the methodology. Results are listed in Section 5 and discussions and conclusion end the paper in section 6.

[3] For more details about the evolution of the health care system in China, please see: Eggleston *et al.* (2008), Hillier and Shen (1996), Hsiao (1984, 1995), Liu *et al.* (1996), Liu *et al.* (2003), World Bank (1997, 2009) and Yip and Hsiao (2008).

2 Background of the NRCMS reform in Weifang

Weifang is a city-prefecture of Shandong province located in the northeast of China. It is composed of 16 county-level administrative divisions[4]. These counties have jurisdiction over 148 townships (or districts) and 9285 villages. The total population is 8.5 million, in which 6.22 million are rural population, accounting for 73% of total. In terms of health infrastructures, there are 6384 health facilities, including 61 county-or-above-level hospitals and 194 THs (Weifang Health Bureau).

The reform proceeds in a gradual way in rural areas since 2003. At the initial stage, the Weifang government has chosen some pilots counties, each of them selecting a number of townships for applying the reform. New counties and townships were involved into the reform in the following years. Until 2006, all the municipalities and counties in Weifang are eligible to the insurance reform. In 2010, 99% of the rural households are involved into the NRCMS (Weifang Health Bureau).

As each county can modulate the NRCMS, the insurance system in Weifang possesses its own characteristics.

First, contribution was 10 Yuans per person in 2003 and gradually rose to 25 Yuans by 2009. Correspondingly, local and central governments' subsidies increased from 20 Yuans to 40 Yuans per person respectively. The total contribution reached 105 Yuans per person by 2009. Once individual's contributions collected, the subsidies from local and central governments are allocated in accordance with the number of participates. At the initial stage, funds are divided into two accounts: a personal medical saving account (MSA) for outpatient spending and a mutual assistant fund for expenditures on more complicated treatments (such as the treatment for chronic diseases or hospitalization). However, since 2009, the accounts are pooled at county level and then split into outpatient fund and hospitalization fund. The first one accounts for about 30% of the total funds while the second one represents 67%. The rest 3% is set as a risk fund.

Second, the reimbursement process is quite complex. Deductibles, caps and co-insurance ratios are specified for expenditures at different health facilities level. As treatment costs at lower level hospitals are cheaper than at higher level ones, the insurance is much more generous for the use of health service at lower-level hospitals. Precisely, the deductible is set at 100 to 300 Yuans for the consultation at first-level hospital (corresponding to TH), 400 to 600 Yuans at second-level hospitals, and 1500 Yuans at third-level hospitals. The cap is 40,000 Yuans per person per year whatever health facilities. The co-insurance for hospitalization is 60 to 70% at first-level hospital. For higher level hospitals, co-insurance rate changes according to total expenditure and is generally less than 60% if expenditures are lower than 5000 Yuans. The reimbursement for outpatient is confined to the consultation at first-level hospitals or health stations and reimbursement ratio is set around 20%

[4] They are composed of four districts, six cities, two counties, three development zones and one economic zone.

(Weifang Health Bureau). In 2009, the share of reimbursement in total health expenditure in Weifang was around 35%.

Third, several measures are adopted as incentives to join the insurance scheme. For example, an annual free health exam is organized for the insured whose have not used the insurance during the covered year. An office of NRCMS is set inside of the TH to perform the reimbursement on the spot. Before 2008, the insured need to seek the medical consultation at designated hospitals. However, great discrepancy in the quality of services offered by designated and non designated hospitals in some townships makes households bypass the former at the expense of giving up insurance reimbursement. In return, they are reluctant to continue the adherence due to the lack of benefits obtained from the insurance. Since 2008, the rule of designated hospitals is released. The patient can choose any hospital inside of the county and get the reimbursement, leading to some kind of competition among hospitals.

3 Data

3.1 The dataset

This study uses an original dataset, built from a survey conducted in collaboration with the Studies and Researches Center in International Development (CERDI) of Auvergne University, the Weifang Health Bureau, and the Medical University of Weifang. It is a longitudinal survey covering the period from 2000 to 2008 for Weifang prefecture and containing 24 THs randomly selected and belonging to 6 counties. The NRCMS is implemented gradually among the sample, from 2003 to 2006 (Fig.1).

County	Township	2000	2001	2002	2003	2004	2005	2006	2007	2008
Anqui (2003)	Jin Zhongzi								X	X
	Guan Gong Zhen							X	X	X
	Jingshi							X	X	X
	Lin Wu							X	X	X
	Wu Shan Zhen							X	X	X
	Xin An							X	X	X
	Zhe Shan Zhen							X	X	X
Changyi (2004)	Liu Tan								X	X
	Xia Dian Zhen							X	X	X
Gaomi (2005)	Cai Gou Zhen							X	X	X
	Da Mou Jia Zhen						X	X	X	X
	Jing Gou Zhen						X	X	X	X
	Kan Jia Zhen						X	X	X	X
Qinzhou (2003)	Dong Xia Zhen				X	X	X	X	X	X
	Gao Liu Zhen							X	X	X
	He Guan Zhen							X	X	X
	Shao Zhuang Zhen						X	X	X	X
	Tan Fang Zhen						X	X	X	X
	Wang Fen Zhen						X	X	X	X
Shouguang (2004)	Dao Tian Zhen					X	X	X	X	X
	Hou Zhen					X	X	X	X	X
	Tian Liu Zhen							X	X	X
Zhucheng (2004)	Bai Chi He						X	X	X	X
	Ma Zhuang Zhen							X	X	X

Note: the entry date of county into the reform is in the parentheses. In our sample, not all townships entered the reform at the same date that the county which they belong to. Before 2003, none counties or townships were involved into the NRCMS. No NRCMS. Township is covered by NRCMS.
X: 90% or more of NRCMS participant in the township.
Source: Authors' database.

Fig.1 Phasing-in of the rural health insurance reform in the selected townships

3.2 Descriptive statistics

The main descriptive statistics are presented in table 1. On average, townships contain 13,603 households with 92% of rural population and the rural net income per capita amounts 4581 Yuans[5] over the sample period. The number of households and the farmer's net income per capita increased over the period; the share of rural population remained quite stable.

Regarding the size of THs, on average, a TH holds about 40 beds and 50 health care professionals. This size increased over the sample period, especially after 2003. From 2003 to 2008, the average numbers of beds and health professionals increased by 64% and 37% separately. This rise is mainly due to the augmentation of intermediate and junior professionals[6], from 7 to 13 staff members for the

[5] All the monetary terms are in 2000 constant prices.
[6] Junior and intermediate health workers have generally a medical formation less than university degree.

former and 40 to 52 for the latter. In contrast, the number of senior professionals remains low and stable, about 1 person per TH.

Hospital activities consist of outpatient, inpatient[7] and preventive[8] activities. Outpatient visits turn out to be the main activities of THs. It accounts for 74% of all the three activities. Globally, THs activities increased significantly since 2003. All the three indicators have doubled between 2003 and 2008, whereas they stayed quite stable during the three years preceding the reform.

In terms of the performance of hospitals, the average bed occupancy ratio has almost doubled between 2003 and 2008 (from 38% to 61%), while it has slightly declined (from 42% to 38%) in the pre-reform period (2000-2003). As far as ALOS is concerned, patients stay on average five days at THs. It remains quite stable over the period.

Business income[9] of hospitals has tripled between 2003 and 2008, while it stagnated during the pre-reform period (2000-2003). A great part of this increase comes from the selling of drugs, which was multiplied by four. Subsidies increased also strongly, more than doubling between 2003 and 2008. Nevertheless, the business income remains the most important financial resource, about 92% of total.

The average of reimbursement is much higher in 2008 comparing to that in 2003: reimbursement for outpatient and inpatient increased respectively by 10 and 5 times, from 113200 Yuan in 2000 to 120180 Yuan in 2008 for outpatient reimbursement and from 159100 Yuan in 2003 to 692200 Yuan in 2008, for inpatient reimbursement.

[7] Inpatient activities are measured by the number of discharged patient.
[8] Preventive activities are measured by the number of vaccinations.
[9] Business income is computed from medical treatment income and drug income.

Table 1 - Descriptive Statistics

	Total sample (2000 – 2008)		YEAR 2000		YEAR 2003		YEAR 2008	
Variables[10]	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Township characteristics'								
# of households[11]	1.36	0.68	1.09	0.54	1.26	0.61	1.79	0.83
Share of rural (%)	92.80	4.38	93.46	3.98	93.56	4.17	92.57	4.46
Rural net income per capita	0.45	0.12	0.33	0.05	0.38	0.06	0.63	0.09
Township hospitals characteristics'								
# of beds	40.62	19.17	34.78	13.02	35.92	13.43	59.08	32.35
# of professionals	51.64	31.49	46.00	25.83	49.13	29.61	66.96	42.32
# of seniors	1.15	1.29	1.09	1.19	1.17	1.53	1.17	1.11
# of intermediate	8.30	8.19	5.96	7.16	7.25	7.36	12.79	9.90
# of juniors	41.16	23.60	37.7	19.12	39.67	22.33	52.17	33.97
# of outpatient visits	30196.21	24882.01	25395.26	21332.54	25350.04	21182.67	48244.58	32582.50
# of discharged patients	1271.42	892.17	958.87	642.79	912.29	712.21	2184.00	1077.56
# of actual vaccination	9122.75	9523.00	6795.26	4991.84	7362.79	5329.86	14860.88	18529.26
ALOS (in days)	5.03	1.42	5.29	2.43	5.21	1.52	5.12	0.92
Bed occupancy ratio (in days)	0.47	0.24	0.44	1.25	0.38	0.24	0.61	0.19
Total subsidies	16.55	22.07	15.54	14.78	14.26	14.62	37.17	47.60
Business income	202.48	195.4	133.28	99.72	129.34	99.81	418.69	311.31
Medical treatment income	78.99	88.29	50.42	47.24	48.4	47.31	152.8	138.06
Drug income	123.49	112.18	82.85	56.77	80.94	56.28	265.88	181.39
NRCMS reimbursement	86.22	114.74	-	-	26.93	32.03	190.96	182.17
for inpatient	32.84	48.91	-	-	15.91	20.24	69.22	71.50
for outpatient	53.11	71.57	-	-	11.32	15.05	120.18	119.63

4 Objective and Methodology

The objective of the study is to estimate the impact of the NRCMS on activities, efficiency and financing structure of THs. Five outcome variables are selected. Medical activities are measured by the number of outpatient visits and the number of discharged patients[12] whereas efficiency is measured by proxies as the ALOS and the bed occupancy ratio. Changes in financial structure are measured by the share of drugs selling in business income.

4.1 Econometric Model

In order to estimate the NRCMS impact, the generalization of the double-difference method is used. This quasi-experimental approach allows exploiting the panel dataset and the gradual implementation of the health insurance reform over time. THs not yet covered by the reform are used as a comparison group for THs covered by the NRCMS. Typically, the within estimator is used. Let

[10] All monetary variables are in 10000 Yuan and normalized to 2000 constant prices.
[11] Unit: 10000 households.
[12] It is a conventional indicator to measure the volume of inpatient.

Y_{it} be the outcomes variables for TH i at time t. As there is only one TH per township in our sample, we use "i" to represent either TH or township. Let P_{it} be a dummy variable equals to one if in year t the township i is covered by the NRCMS, and 0 otherwise. The coefficient of P_{it}, δ, is the estimator of interest. It represents the estimated average effect of the NRCMS implementation on hospital outcomes. The basic model to be estimated is the following:

$$[\ln(Y)_{it}] = (P_{it} + u_i + v_t + \varepsilon_{it} \quad (1)$$

Where u_i and v_t are the THs fixed-effects and the year fixed-effects respectively. The former controls for time-invariant individual characteristics whereas the latter captures THs common characteristics varying over years. ε_{it} is the error term, assumed to be *iid*.

As positive serial correlation is detected in our data[13], the model 1 is estimated via first-differences rather than fixed-effect estimator. The first differences estimator is more efficient than the within one in the presence of serial correlation (Wooldridge 2002, Aker 2008). The estimated model is the following:

$$[\Delta\ln(Y)_{it}] = (\Delta P_{it} + [\Delta v]_t + [\Delta\varepsilon]_{it} \quad (2)$$

Data for t=2000 are dropped and the panel contains now 8 years (2001-2008). Standard errors are corrected for heteroskedasticity and clustered at township level.

4.2 Identification

In order to obtain an unbiased and consistent estimator of the program impact based on equation (2), several assumptions need to be verified: i) the parallel trend assumption (PTA), ii) the exogeneity of the order in which the reform was implemented, and iii) the absence of migration.

4.2.1 The parallel trend hypothesis

The validity of the double-differenced estimator requires that the difference between before and after in the comparison group is a good counterfactual for the treatment group (Sadoulet and De Janvry 2009). PTA states that the intrinsic evolution of the outcomes of THs should be independent of NRCMS implementation. One conventional way to test the existence of PTA is to compare the pre-intervention trends of hospital outcomes between the regions which enter into the program at different time (Aker 2008, Wagstaff and Moreno-Serra 2009, Barham 2010). The hypothesis is that the pre-intervention trends of TH outcomes would be the same in the post-intervention period if the program were not introduced. This will be the case if, other things equal; the pre-intervention trends are not

[13] The Wooldridge test (2002), the Baltagi–Wu LBI statistic and the Bhargava *et al.* (1982) Durbin–Watson statistic were performed. All conclude that error terms are positively serially correlated. Results of tests are available upon request.

significantly different among the regions with different entry dates to the NRCMS. Inspired by Barham (2010), the test of PTA is conducted with the following specification:

$$\ln(Y_{it}) = \gamma_0 + \sum_{t=2001}^{t=2002} \gamma_t dyear_t + \sum_{t=2001}^{t=2002} \sum_{k=2004}^{k=2006} \theta_{tk} dyear_t \times NRCMS_k + u_{kt} \quad (3)$$

Where t=2001-2002 (pre-intervention period, 2000 is drop because it is the reference period), k=2004-2006 (period after the first intervention in 2003) and $NRCMS_k$ equals to one if the TH enters in the reform during year k, 0 otherwise. $dyear_t$ are year dummies which captures the period specific effect of 2001 and 2002. θ_{tk} represents, at year t, the additional period effect hold by the regions which enter into NRCMS program in year k. If θ_{tk} are not significantly different from zero, PTA is assumed and pre-intervention trends can be considered similar between THs that applied the reform at various years. Groups of THs are comparable and so a group of comparison which is composed by THs not yet treated are relevant counterfactual for groups of THs treated. Results are summarized in Table 2. In all cases, the test supports the assumption that pre-intervention trends of outcomes are similar across groups which entered at different time in the reform.

Table 2 – Test of the PTA

Pre-intervention years	Ln (outpatient)	Ln (discharged patient)	Ln (ALOS)	Ln(Bed occupancy rate)	Ln(Share of drug income)
	Township hospitals which implemented NRCMS in 2003				
2001	0.0445	0.0951	0.00567	0.00961	-3.594
	(0.0595)	(0.0658)	(0.152)	(0.0274)	(3.385)
2002	-0.0310	0.0743	-0.00677	0.0510	-0.501
	(0.0593)	(0.414)	(0.158)	(0.140)	(4.114)
	Township hospitals which implemented NRCMS in 2004				
2001	0.0668	0.0555	-0.0674	0.0474	6.965
	(0.120)	(0.145)	(0.166)	(0.0618)	(4.130)
2002	0.194	-0.170	0.0221	-0.0540	2.429
	(0.132)	(0.469)	(0.169)	(0.155)	(4.979)
	Township hospitals which implemented NRCMS in 2005				
2001	-0.0945	-0.0512	-0.0396	0.0449	4.635
	(0.0859)	(0.116)	(0.153)	(0.0388)	(5.025)
2002	-0.0783	-0.101	-0.0566	0.00544	-0.808
	(0.118)	(0.424)	(0.162)	(0.143)	(4.786)
	Township hospitals which implemented NRCMS in 2006				
2001	-0.0205	-0.0683	0.105	-0.0893	4.345
	(0.119)	(0.197)	(0.172)	(0.0546)	(3.453)
2002	-0.0278	-0.278	0.0549	-0.148	3.646
	(0.141)	(0.473)	(0.187)	(0.158)	(4.586)

Note: Standard errors (in parentheses) are corrected for heteroskedasticity and clustered at township level. *** indicates significance at 1%; ** at 5%; and, * at 10%. Test is performed on a sample from 2000 to 2003, i.e. the pre-reform period. The model is estimated by OLS with county fixed-effects because TH fixed-effects lead to a huge loss of degree-of-freedom. Moreover, the county level is relevant because: i) the decisional power concerning the NRCMS reform is set at county level, ii) in a county, townships are relatively homogeneous.

4.2.2 The exogeneity of the reform

The model requires that the assignment of the program is exogenous across space and over time. NRCMS is a national policy which is expected to be adapted in all rural areas in China. Therefore the potential endogeneity comes rather from the date in which counties enter into the reform rather than of their eligibility. There are two sources of potential selection bias: the reverse causality and the omitted variables.

Reverse causality refers to the situation where the outcome of THs influence the order that the NRCMS is implemented in corresponding township. Hospitals with more activities, for example, may be better organized and thus have higher efficiency. Therefore at the initial stage of the reform, the authority may prefer to choose the areas where hospitals have better performance. As a consequence, areas where the hospitals have more activities have more chance to be chosen first. It may also be the case that the variation in hospital outcome influences the chance that the township should be chosen into the program. If, for instance, the TH has encountered rapid decrease of the number of patients in the preceding years of the reform, the township may be more motivated to participate to the program, in hoping that it should bring more patients. In these cases, the date of introduction of the reform is not independent from the outcome of the hospital.

Regarding to the problem of omitted variables, the FD model (or FE model) controls for the time-invariant characteristics of THs and so assumes a time-invariant selection bias (Ravallion 2007). But, it is possible that variables which vary across time and THs have effects on both outcomes variables and program implementation. The income of rural household, for example, is a variable varying across townships and years. It can be correlated with TH activities, or financing, because this variable reflects the capacity of household to pay for health care services and also the living standard of the township. But it can also be correlated with the interest variable, P_{it}, because poorer townships can have implemented the reform in first and richer in last, as NRCMS aims to increase healthcare access for the poor. This problem can be solved by adding control variables into the regression, to avoid the artificial relation caused by omitted variables (Aker 2008, Imbens 2004). The model 2 is then augmented:

$$[\Delta \ln(Y]_{\_}it) = (\Delta P_{\_}it + \beta \Delta X_{\_}it + [\Delta v]_{\_}t + [\Delta \varepsilon]_{\_}it \quad (4)$$

The list of control variables can be identified by comparing the means of a comprehensive list of township and TH characteristics between townships hospitals chosen for the first year of implementation of the health insurance reform and townships that entered into the insurance program later on (Aker 2008, 2010). According to the strategy of Aker (2008, 2010) based on Imbens and Wooldridge work (2007), the differences in means of covariates between townships entered into the reform in 2003 and those which entered later are calculated. Then, they are divided by standard deviation of the 2003 group. Covariates with score higher than 0.25 (in absolute value) are considered

to be significantly different, and thus will be entered into the model (Imbens and Wooldridge 2007, Aker 2008). Mean tests are performed on the pre-reform period. According to Table 3, seven covariates are to be included. At township level, the surface, the number of households, the number of village health stations and the rural net income per capita. At TH level, the number of total staff and that of operational beds, and the total amount of subsidies received.

Table 3 – Mean tests

	Year reform 2003		Year reform 2004		Diff/Sd. (2003)	Year reform 2005		Diff/Sd. (2003)	Year reform 2006		Diff/Sd. (2003)
	Mean	Sd.	Mean	Sd.		Mean	Sd.		Mean	Sd.	
Township characteristics											
Surface	110.45	57.78	95.57	28.27	0.26	95.31	10.44	0.26	95.23	42.05	0.26
# of households	1.07	0.24	1.31	0.33	-0.96	1.05	0.21	0.09	1.25	0.82	-0.73
# of health stations	27.72	3.17	34.67	19.02	-2.19	26.73	17.44	0.31	22.79	15.42	1.56
Share of rural population	93.27	2.79	93.83	2.64	-0.2	93.76	4.77	-0.17	93.24	4.89	0.01
Rural net income per capita	0.31	0.05	0.37	0.05	-1.33	0.32	0.01	-0.35	0.35	0.06	-0.89
Township hospital characteristics											
# of beds	29.33	2.51	32.07	12.09	-0.09	35.00	11.34	-2.26	35.96	15.41	-2.64
# of staff	28.50	9.28	43.20	14.31	-0.52	44.67	22.42	-1.74	44.63	48.97	-1.74
Subsidies	5.82	3.66	30.45	22.09	-4.23	14.37	2.91	-2.34	13.90	11.43	-2.21

Note: Diff equals the differences in means of covariates between townships entered in the reform in 2003 and those which entered later. Sd. (2003) refers to the standard deviation of covariates for townships entered in the reform in 2003.

To test the existence of reverse causality, two strategies are adopted. The first one is adapted to test whether the NRCMS implementation decision is correlated with the variation of outcome variables during the preceding years of reform. The test is performed on a pre-reform period sample. For each township, it consists of the data for the three years before the implementation of the NRCMS[14]. The following specification is used to test the assumption (Gruber and Hanratty 1995, De Janvry *et al.* 2009):

$$Y_{it} = w_j + v_c + \sum_{l=a}^{l=a} \kappa_l year_{-l,it} + u_{it} \quad (5)$$

Where: $year_{-l,it}$ takes the value 1 if at year t, the reform will be implemented in l years for township i, and 0 otherwise, l = 1, 2 or 3 ($year_{-3,it}$ is dropped because it is the reference period). County and year

[14] As the dataset begins in 2000 and the reform begins in 2003, for townships that first implemented NRCMS in 2003, the information on the period before the implementation of reform is available for maximum three years. In order to keep the same quantity of information for all the townships whatever their entry dates into the reform, we choose the three years before the implementation to construct pre-reform dataset.

fixed effects are included, noted as w_j and v_t respectively[15]. κ_l are the coefficients of interest. If κ_l are statistically significant, it suggests that the entrance dates of THs are subject to the evolution of outcomes during the three years before the implementation of the NRCMS. The results are presented in Table 4. None of the coefficients are significant, which implies that the date of NRCMS placement is not driven by evolution of outcome trends during the three years before the implementation of the reform.

Table 4 – Test of reverse causality

	Ln (outpatient)	Ln (discharged patient)	Ln (ALOS)	Ln(Bed occupancy rate)	Ln(Share of drug income)
year1_before	0.0280	0.132	-0.0382	0.0315	-0.365
	(0.378)	(0.530)	(0.182)	(0.0819)	(3.596)
year2_before	0.0784	0.108	-0.0101	0.0155	-1.674
	(0.189)	(0.293)	(0.0959)	(0.0511)	(1.910)

Note: Standard errors (in parentheses) are corrected for heteroskedasticity and clustered at township level. *** indicates significance at 1%; ** at 5%; and, * at 10%. The five specifications are estimated on a sample consisted of the three years preceding the entrance date into the reform of each township. The model is estimated by OLS with county and year fixed-effects because TH fixed-effects lead to a huge loss of degree-of-freedom. Moreover, the county level is relevant because: i) the decisional power concerning the NRCMS reform is set at county level, ii) in a county, townships are relatively homogeneous.

Second, the reverse causality is checked with the test proposed by Gruber and Hanratty (1995) and also applied in the study of Wagstaff and Moreno-Serra (2009). The reverse causality is tested by adding to the model a dummy variable reflecting the implementation of the reform in the next year (P_{it+1}):

$$Y_{it} = \alpha + [\delta P]_{it} + (P_{it+1}) + \beta X_{it} + u_i + v_t + \varepsilon_{it} \quad (6)$$

There is no problem of reverse causality when coefficient on P_{it+1}, noted δ' is not statistically significant. Coefficient on the added variable (participation in the next year) is not significant in any regressions[16].

4.2.3 Migration

The last issue which can potentially biased the result concerns the problem of selective migration (Galiani *et al.* 2008). The change of outcome may issues from the change of characteristic of the target population due to the implementation of the program, rather than the effect of reform itself. In our sample, different townships enter into the program at different time. Therefore, at a given period, residents in townships which are not yet covered by insurance may want to go to townships that are

[15] County fixed effects rather than township ones are included into the model due to the small sample size of the sample.
[16] P_value on tested variable is not listed here, results are available upon request.

covered, to benefit from the system. It will bias results if the immigrates are significantly different from the local population. If, for instance, they are sicker than local people and therefore have more important needs for medical services, the increase of medical activities in the insured TH will not be due to the reform but rather to the characteristic of the immigrated patient. This is not the case in this sample, because the beneficiary status depends on the resident place of the population. People in the township which is not covered by NRMCS will not be able to benefit from the insurance, even if they seek medical consultation at covered hospitals. Another possibility is that people move into the covered region. However, in China, the residence status is generally linked with the birth place. It is costly to change the living place, even if possible.

5 Results

5.1 The impact of the NRCMS

Table 5 lists the results. Column 1 presents the results of equation 2. In others columns, townships' and THs' characteristics are included (equation 4). In columns 4 and 5, the introduction of the insurance system is measured by two others indicators. First, it is replaced by the share of the population covered by the NRCMS in the township (column 4) in order to capture the intensity of the reform (Wagstaff and Moreno-Serra 2009). Second, the reimbursement rate at TH level for outpatient activities (outpatient estimation) or for inpatient activities (inpatient, ALOS and the bed occupancy rate estimations) allows measuring the depth of the insurance coverage (column 5). In columns 1, 2, 4 and 5, standard errors are corrected for heteroskedasticity and clustered at township level. In order to check the consistency of the standard errors, column 3 shows results with bootstrap standard errors (reps=1000).

The introduction of the NRCMS has an impact on THs' activities (columns 1, 2 and 3). Although significance and coefficients are *not very stable for outpatient activities and ALOS*, estimations clearly show that the NRCMS has a *positive impact on the inpatient activity and the bed occupancy ratio* (columns 1-3). When the dummy "participation" is replaced (columns 4 and 5), significance and sign are similar to those obtained from the basic model, *except for outpatient* estimation.

For THs covered by the NRCMS, the number of discharged patients increases by 58%[17] and that of the bed occupancy ratio by 25%. Significance of coefficients increases with bootstrap standard errors (column3). So, inpatient activities and the bed occupancy ratio increase when the coverage or the reimbursement rate of the NRCMS increased. For *outpatient activities, the positive coefficient on the participation dummy is significant only in column 3 and only at 10% level.* Nevertheless, the coefficient on the share of coverage is significant and positive (at 10% level). Moreover, the impact of

[17] Participation is a dummy variable so the elasticity is calculated by the following formula: $[e^{(coefficient)}-1]*100$.

insurance coverage is smaller for outpatient visits than for inpatient visits. By contrast, the coefficient on ALOS, which is not significant in the column 1, becomes significant when covariates are added to the model (columns 2 and 3). As covariates are added to ensure that participation is exogenous, the significant and negative coefficient allows confirming that the NRCMS leads to a decrease of the ALOS for THs by 9%. Similarly, coefficients on the two others insurance indicators are significant and negative: the ALOS decreases when the coverage or the depth of insurance increased, suggesting a positive effect of insurance on efficiency of TH[18]. To conclude, the coefficient on the share of the business income generated by the sale of drug is not significant, suggesting that this outcome was not impacted by the reform, what is interesting to notice as the health bureau took measures to reduce the growth of drug expenditures, for patients.

[18] The issue of efficiency is addressed in another paper written by the authors: *Efficiency Analysis of Township Hospitals in Weifang, China*, available at Cerdi website as a working paper.

Table 5 – Impact of the NRCMS

	(1)	(2)	(3)	(4)	(5)
Ln(outpatient)					
Participation	0.151	0.149	0.149*		
	(0.0899)	(0.0925)	(0.0782)		
NRCMS coverage				0.00201*	
				(0.00116)	
OP reimbursement rate					0.00739
					(0.00479)
Observations	192	192	192	192	192
R-squared	0.192	0.232	0.232	0.239	0.233
X(it)	N	Y	Y	Y	Y
Ln(inpatient)					
Participation	0.478**	0.456**	0.456***		
	(0.172)	(0.170)	(0.159)		
NRCMS coverage				0.00523**	
				(0.00208)	
IP reimbursement rate					0.0107**
					(0.00400)
Observations	192	192	192	192	192
R-squared	0.191	0.221	0.221	0.215	0.213
X(it)	N	Y	Y	Y	Y
Ln(bed occupancy rate)					
Participation	0.244**	0.224**	0.224**		
	(0.0899)	(0.0988)	(0.104)		
NRCMS coverage				0.00211*	
				(0.00110)	
IP reimbursement rate					0.00545**
					(0.00232)
Observations	192	192	192	192	192
R-squared	0.171	0.199	0.199	0.190	0.198
X(it)	N	Y	Y	Y	Y
Ln(ALOS)					
Participation	-0.0697	-0.0826*	-0.0826**		
	(0.0455)	(0.0441)	(0.0417)		
NRCMS coverage				-0.00101*	
				(0.000494)	
IP reimbursement rate					-0.00211*
					(0.00120)
Observations	192	192	192	192	192
R-squared	0.067	0.137	0.137	0.138	0.138
X(it)	N	Y	Y	Y	Y
Ln(share of drug income)					
Participation	0.0165	0.0176	0.0176		
	(0.0248)	(0.0250)	(0.0242)		
NRCMS coverage				0.000256	
				(0.000314)	
Observations	192	192	192	192	
R-squared	0.109	0.144	0.144	0.146	
X(it)	N	Y	Y	Y	

Note: Standard errors (in parentheses) are corrected for heteroskedasticity and clustered at township level. *** indicates significance at 1%; ** at 5%; and, * at 10%. The model is estimated by OLS with year fixed-effects.

5.2 Heterogeneity of the impact

The previous analysis supposes that the impact of NRCMS is homogenous. This section investigates the potential heterogeneous impacts of reform across space and over time. Results are listed in Table 6.

First, the incentive brought by the new insurance system is different for the population with different socio-economic characteristics. It can be expected that the price effect of insurance to increase healthcare demand and then, TH activities, is less important for people in rich townships than those in poor townships. In order to check these differentiated impacts across space and socio-economic conditions, a dummy variable "poor"[19] is interacted with P_{ijt}. Poor is calculated from the rural net income per capita. The "poor" dummy alone has not to be included into the model since it is captured by the income variable. *According to table 6, the reform shows higher impacts on discharged patient in poor townships than in non-poor ones.* For the bed occupancy ratio, the interactive variable is significant and positive whereas the participation dummy is not. It indicates that the reform has a *positive impact on the bed occupancy ratio only for THs located in poor townships*. In contrast, impact is not significantly different for the ALOS of THs in poor and non-poor zone, suggesting a homogenous pattern of disease for poor and rich. The NRCMS has neither average impact nor heterogeneous impact on the outpatient activities and on the share of drug income of THs in poor and non-poor zone.

Second, there are two types of THs: general and central. Theoretically, their missions and responsibilities are complementary. Central THs are better equipped to treat discharged patients than general hospitals. The former also brings technical support to the latter. In practice, our Chinese partners reveal that this distinction is not as clear. Central and general THs compete for patients. By interacting the participation variable with a dummy reflecting the hospital level (1 for central THs, and 0 otherwise, i.e. for general THs), it is possible to check if there is a differentiated impact of the NRCMS as regard to the type of the TH. The result of our estimation shows no evidence of the heterogeneous impacts of insurance between general and central hospitals.

Third, the effect of the NRCMS can be different over the time. The experience under the scheme can influence the impact of the NRCMS. It is therefore expected that the insurance has more influence on local agents' behaviors in places which have more experience with reform. Inspired by Gruber and Hanratty (1995) and Galiani *et al.* (2008), this paper investigates experience effect in two ways. On the one hand, cumulative effects of the reform are captured by the introduction of two dummies: 1 year

[19] Poor is calculated from the rural net income per capita of the township. A township is considered as poor when it belongs to the quintile 1 (townships belonging to the 20% of the poorest townships).

after the reform", "2 years or more after the reform"[20]. On the other hand, a discrete variable from 0 to 5, reflects the number of years of coverage by the insurance system: 0 for the year in which the NRCMS is implemented, 1 when NRCMS is implemented since one year, 2 when the NRCMS is implemented since two years, etc. It assumes that there is a linear trend in the impact of the NRCMS. Results show that the impact of the NRCMS on outpatient visits, on the number of discharged patient and on the bed occupancy ratio decrease over time. The volume of outpatient and inpatient activities and the bed occupancy ratio continue to increase over time but at a lower rate of growth: the marginal impact of the NRCMS is decreasing. For ALOS estimation, the impact of the NRCMS seems to remain stable over time.

Table 6 – Heterogeneous impact of the NRCMS

Ln(outpatient)		Ln(inpatient)	Ln(ALOS)	Ln(occupancy bed rate)	Ln(share drug income)
Participation	0.150	0.395**	-0.0807*	0.156	0.0161
	(0.0971)	(0.170)	(0.0446)	(0.0970)	(0.0244)
P*Poor	-0.00721	0.297*	-0.00932	0.328***	0.00751
(1=poor, 0=non poor)	(0.142)	(0.172)	(0.0582)	(0.106)	(0.0397)
Participation	0.209	0.386**	-0.0951*	0.296**	-0.00370
	(0.123)	(0.164)	(0.0522)	(0.132)	(0.0302)
P*hospital level	-0.160	0.187	0.0332	-0.191	0.0566
(1=central, 0=general)	(0.142)	(0.381)	(0.0783)	(0.162)	(0.0400)
1 year after NRCMS	-0.0357	-0.145**	-0.00627	-0.0216	0.0320
	(0.0615)	(0.0566)	(0.0454)	(0.0729)	(0.0313)
2 years or more after NRCMS	-0.170*	-0.529***	0.0504	-0.309**	0.0783**
	(0.0968)	(0.103)	(0.0711)	(0.111)	(0.0358)
# of years after NRCMS	-0.129**	-0.287***	0.0289	-0.215***	-0.00290
	(0.0527)	(0.0969)	(0.0520)	(0.0659)	(0.0213)

Note: Standard errors (in parentheses) are corrected for heteroskedasticity and clustered at township level. *** indicates significance at 1%; ** at 5%; and, * at 10%. The model is estimated by OLS with year fixed-effects.

6 Discussion and conclusion

Chinese government began in 2003 the gradual implementation of the NRCMS, a medical insurance system for rural population. This analysis aims to assess the impact of the introduction of NRCMS on THs in Weifang prefecture. Based on a sample of randomly selected 24 THs over a nine years period, the impact of NRCMS on THs outcomes is estimated with first difference method, after having checked all the assumptions for the model with staggered entry.

Estimations confirm that insurance reform increases THs activities. These results are particularly interesting from a policy point of view and are consistent with those presented in the literature about the impact of the health insurance introduction (Wagstaff and Moreno-Serra 2009, Wagstaff *et al*.

[20] "1 year after the reform" equals to 1 if the township has been in the program since one year, 0 otherwise; "2 years or more after the reform" equals to 1 if reform as implemented in the township since two years or more, 0 otherwise.

2009). First, insurance impact is significant for hospitalization (discharged patients) but there are no clear effects for outpatient visits. It fits with expectation, because the design of the reform is merely focused on alleviating hospitalization costs borne by patients, these cost being much more expensive in average than outpatient visits. As the volume of hospitalization rises, the bed occupancy ratio increases as well. Second, results show the ALOS significantly decreased with the introduction of the reform. In order to control cost, the insurance scheme set reimbursement ceiling and Health Bureau took great effort to control drugs and service prices. These measures incite THs to reduce ALOS. Nevertheless, complementary information is needed to assess whether the reduction of ALOS is accompanied with a lower quality of health care.

The share of the business income generated by the drug sales reflects the financial structure of THs. The modification of THs' income structure is not a primary target of the reform, but it can be indirectly affected by the evolution of medical activities. In fact, medical activities bring two kinds of income: the sale of services and drugs. In China, the sale of drugs is more profitable for hospitals than the sales of services, especially those which are not associated with high-tech diagnosis. Therefore, hospitals tend to over-prescribe drugs (Liu and Mills 1999). Insurance is expected to encourage the sale of services because it incites people to seek medical consultation. However, as long as the profit margin of the sale of drugs is higher than that of the sale of services, the increase of the sale of services would proportionally increase the sale of drugs. The results of our estimation confirmed that insurance does not change the structure of TH's business income. The sale of drug continues to be the main source of business income.

Finally, *estimations show that the impact can be heterogeneous across space and time, especially for hospitalization*. On the one hand, discharged patients increase more in poor townships after the implementation of insurance than that in non-poor townships. Such results are not surprising because income is often the main obstacle to hospitalization, and the price elasticity of demand is higher for poor households. As insurance scheme gives similar financial support to all the insured, it represents a more important proportion of capacity to pay for the poor than for non-poor. Nevertheless, we can't infer from this point that catastrophic health care expenditures have been drastically reduced. Wagstaff *et al.* (2009) found that in Gansu province medical insurance had lead households to search for more specialized and costly care. As a result, they detected an increase in catastrophic expenditure. On the other hand, the influence of the NRCMS also changes over time because of the extension of the coverage rates and accumulated experience, the marginal effect being decreasing. However a longer period is necessary to assess the long term impact of the reform. An "∩" curve for activities could be observed in the coming years, although unlikely, if the quality of care deteriorates.

Two precautions needed to be highlighted. First, obviously the demand for healthcare at THs has increased thanks to the reform. But we don't know to what extend it implies a *net* increase of demand, or if a share of this demand is stemming from a transfer of demand from the upper level hospitals, as

NCMS increase the gap between the cost of care at township and county hospitals. Second, this study is based on a relatively small sample of 24 THs. Although this shortcoming is partly "compensated" by randomized process of selection of the hospitals and by the nine years of the survey period, it would be desirable to check the results with a larger sample. Lastly, as all the selected THs are from Weifang prefecture, the results cannot be directly generalized for other regions in China.

References

Aker Jenny C., (2008), "Information from Markets Near and Far: The Impact of Mobile Phones on Grain Markets in Niger", Bureau for Research and Economic Analysis of Development (BREAD), Working Paper 177.

Aker Jenny C., (2010), "Information from Markets Near and Far: The Impact of Mobile Phones on Grain Markets in Niger", *American Economic Journal: Applied Economics*, 2(3), pp. 46-59.

Barham T., (2010), "A healthier start: The effect of conditional cash transfers on neonatal and infant mortality in rural Mexico", *Journal of Development Economics*.

Bhargava A., Franzini L., and Narendranathan W., (1982), "Serial correlation and the fixed effects model", *Review of Economic Studies*, 49(4), pp. 533-549.

De Janvry A., McIntosh C. and Sadoulet E., (2010), "The Supply- and Demand-Side Impacts of Credit Market Information", *Journal of Development Economics,* 93(2), pp. 173-188.

Eggleston K., Ling L., Qingyue M., Lindelow M. and Wagstaff A., (2008), "Health Service delivery in China: a literature review", *Health Economics*, 17, pp. 149-165.

Galiani S., Gertler P., and Schargrodsky E., (2008), "School decentralization: helping the good get better, but leaving the poor behind", *Journal of Public Economics*, 92(10-11), pp. 2106-2120.

Gruber J. and Hanratty M., (1995), "The Labor-Market Effects of Introduction National Health Insurance: Evidence from Canada", *Journal of Business & Economic Statistics*, 13(2), pp. 163-173.

Hillier S. and Shen J., (1996), "Health care systems in transition: People's Republic of China. Part I: An overview of China's health care system", *Journal of Public Medicines*, 18(3), pp. 258-265.

Hsiao William C., (1984), "Transformation of health care in China", *The New England Journal of Medicine*, 310(14), pp. 932-936.

Hsiao William C., (1995), "The Chinese Health Care system: lessons for other nations." *Social Sciences & Medicine*, 41(8), pp. 1047-1055.

Imbens Guido W., (2004), "Nonparametric estimations of average treatment effects under exogeneity: a review", *Review of Economics and Statistics*, 86(1), pp. 4-29.

Imbens Guido W. and Wooldridge Jeffrey M., (2007), "What's New in Econometrics." Lecture Notes, NBER Summer Institute.

Liu Y., Rao K. and Hu S., (2003), "People's Republic of China. Toward Establishing A Rural Health Protection System", Beijing: Asian Development Bank.

Liu X., Xu L., and Wang S., (1996), "Reforming China's 50,000 Township Hospitals: Effectiveness, Challenges, and Opportunities." *Health Policy*, 38 (1), pp. 13-29.

Liu X. and Mills A. (1999) "Evaluating Payment Mechanisms: How Can We Measure Unnecessary Care?" *Health Policy and Planning*, 14 (4), pp. 409–13

Ravaillon M., (2007), *Chapter 59 Evaluating Anti-Poverty Programs*, Handbook of Development Economics, pp. 3787-3846.

Sadoulet E., De Janvry A., (2009), Impact handout #5, Part 1.

Wagstaff A., Lindelow M., Jun G., Ling X., and Juncheng Q., (2009), "Extending health insurance to the rural population: An impact evaluation of China's new cooperative medical scheme", *Journal of Health Economics*, 28, pp. 1-19.

Wagstaff A. and Moreno-Serra R., (2009), "Europe and central Asia's great post-communist social health insurance experiment: Aggregate impacts on health sector outcomes", *Journal of Health Economics*, 28, pp. 322-340.

Wooldridge Jeffrey M., (2002), *Econometric analysis of cross section and panel data*. Cambridge, MIT Press.

World Bank. 1997. Financing Health Care: issues and options for China. China 2020 series. Washington D.C.: World Bank.

World Bank. 2009. Reforming China's Rural Health System. Direction in development Human development. Washington D.C.: World Bank.

Yip W. and Hsiao William C., (2008), "The Chinese health system at a crossroads", *Health Affairs*, 27(2), pp.460-468.