

Efficiency Evaluation of China's New Rural Cooperative Medical System (NRCMS) Using DEA method

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1. Introduction

- Old vs. New Rural Cooperative Medical System (NRCMS) in China
- Purpose of the study

Old vs. New

- **Old Rural Cooperative Medical System**
 - 1950s: established
 - 1970s: covered more than 90% of rural population
 - 1980s: lost its economic foundation
 - 1998: shrank to 9.5%
- **New Rural Cooperative Medical System (NRCMS)**
 - 2003: pilot program started
 - 2008: covered 91.5% of rural population

Old vs. New

- Differences (new vs. old)
 - financed on county level vs. village level
 - focuses on large and inpatient medical expenditure vs. prevention and outpatient expenditure
 - heavily-subsidized vs. very limited government support

Old vs. New

- Financing structure of NRCMS in Xiangtan City (RMB)

Year	Farmer	Local Governments	Central Government	Total
2005	10	10	10	30
2006	10	20	20	50
2007	10	20	20	50
2008	10	30	40	80
2009	20	40	40	100

Purpose of the study

- To evaluate the efficiency of China's NRCMS
 - technical efficiency (TE), or overall technical efficiency
 - achieving better results (outputs) with minimal costs (inputs)
- To provide policy suggestion
 - make the NRCMS more efficient and more sustainable

2. Methods

- DEA (Data Envelopment Analysis)
 - a useful tool to estimate the efficiency of a multi-input and multi-output system
- Basic DEA models
 - $TE = PTE * SE$
 - TE: Technical Efficiency, from CCR model
 - PTE: Pure Technical Efficiency, from BCC model
 - $SE = TE / PTE$
- Super-efficiency DEA model
 - super CCR
 - super BCC
- Use Tobit and OLS regressions to identify the environmental variables that significantly influence the efficiency scores.

3. Data and variables

- Data sources
- Main content of data sets
- Input and output variables
- Environmental variables

Data sources

- Three-year data (2005, 2006, 2007) from 30 provinces
- *National Statistical Yearbook on NRCMS, Health Statistical Yearbook, etc.*, Ministry of Health, China

Main content of data sets

Data set	Content
Participation data	The number of covered counties, villages, families, farmers, etc.
Financing data	The amount of fund and the structure of the fund.
Reimbursement data	The inpatient/outpatient reimbursements, physical examination expenditures, number of beneficiaries, etc.
Administration data	The number of county-level personnel and the structure of income/expenditures of the administration institution.

Input and output variables

Inputs (4)	
PCPIN	per capita premiums paid by individual (RMB) =Overall premiums paid by individuals / number of enrollees
PCGOV	per capita premiums paid by government subsidies (RMB) =(Overall subsidies from central government + overall subsidies from all levels of local governments + other subsidies) / number of enrollees
PCADCOST	per capita administration cost (RMB) =Overall administration cost / number of enrollees
PCADPSN	number of administration personnel (county level) for every 10,000 enrollees =Overall number of administration personnel (county level) / number of enrollees (measured by 10,000)

Input and output variables

Outputs (3)	
ERLRATE	Enrollment Rate (%)
PCNREIM	per capita number of beneficiaries from reimbursement (person-times) =overall number of beneficiaries from reimbursement / number of enrollees
LEVREIM	level of reimbursement per person-time (RMB/person-time) =overall amount of reimbursement / overall number of beneficiaries from reimbursement

Environmental variables

- GDP
- percentage of rural population (PCTPOP)
- GDP per capita (GDPPC)
- per capita annual net income of rural households (Income)
- per capita consumption expenditure on health care and medical services of rural household (HealthExp)
- health care institution per thousand residents (PTHINST)
- number of employed persons in health institutions per thousand residents (PTHEP)
- government revenue (GREV)
- dummy “Region” (East=0, Central=1, West=2)

4. Result and discussion

(1) Efficiency scores

(2) Regional comparison

(3) Environmental variable analysis

(1) Efficiency scores

Region	DMU	2005			2006			2007		
		TE	PTE	SE	TE	PTE	SE	TE	PTE	SE
East China (9)	Beijing	0.522	0.531	0.983	0.372	0.372	1.000	0.427	0.427	1.000
	Tianjin	1.000	1.000	1.000	0.408	0.408	1.000	0.577	0.577	1.000
	Liaoning	0.818	1.000	0.818	1.000	1.000	1.000	0.944	0.945	0.999
	Shanghai	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	Jiangsu	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	Zhejiang	0.583	0.583	1.000	0.817	0.817	1.000	0.736	0.736	1.000
	Fujian	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	Shandong	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	Guangdong	1.000	1.000	1.000	0.852	1.000	0.852	1.000	1.000	1.000

(1) Efficiency scores

Region	DMU	2005			2006			2007		
		TE	PTE	SE	TE	PTE	SE	TE	PTE	SE
Central China (10)	Hebei	0.801	0.801	1.000	0.82	0.820	1.000	0.880	0.88	1.000
	Shanxi	0.973	1.000	0.973	0.933	0.968	0.964	0.893	0.893	1.000
	Jilin	0.754	0.823	0.916	0.902	0.961	0.939	0.878	0.878	1.000
	Heilongjiang	0.648	0.648	1.000	0.936	0.936	1.000	1.000	1.000	1.000
	Anhui	0.988	0.988	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	Jiangxi	0.827	0.827	1.000	0.898	0.898	1.000	0.989	0.989	1.000
	Henan	1.000	1.000	1.000	0.947	0.947	1.000	1.000	1.000	1.000
	Hubei	1.000	1.000	1.000	1.000	1.000	1.000	0.845	0.845	1.000
	Hunan	0.763	0.763	1.000	0.881	0.881	1.000	0.886	0.886	1.000
	Hainan	0.764	0.764	1.000	0.916	0.997	0.919	1.000	1.000	1.000

(1) Efficiency scores

Region	DMU	2005			2006			2007		
		TE	PTE	SE	TE	PTE	SE	TE	PTE	SE
West China (11)	Neimenggu	0.913	0.913	1.000	0.873	0.873	1.000	0.845	0.845	1.000
	Guangxi	0.730	1.000	0.730	0.853	1.000	0.853	0.944	1.000	0.944
	Chongqing	0.924	0.946	0.977	1.000	1.000	1.000	0.936	1.000	0.936
	Sichuan	0.727	0.863	0.842	0.985	1.000	0.985	0.986	1.000	0.986
	Guizhou	0.760	1.000	0.760	0.892	1.000	0.892	0.986	1.000	0.986
	Yunnan	1	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	Shaanxi	0.919	0.919	1.000	0.958	1.000	0.958	1.000	1.000	1.000
	Gansu	0.930	1.000	0.930	1.000	1.000	1.000	0.962	0.962	1.000
	Qinghai	1.000	1.000	1.000	0.951	0.951	1.000	0.957	1.000	0.957
	Ningxia	0.798	0.819	0.974	0.881	0.881	1.000	0.879	0.879	1.000
	Xinjiang	0.684	0.685	0.999	0.804	0.804	1.000	0.737	0.737	1.000
Average		0.861	0.896	0.963	0.896	0.917	0.979	0.910	0.916	0.994

(2) Regional comparison

- 30 provinces
 - East region: 9
 - Central region: 10
 - West region: 11
- Central government subsidy policies are different in three regions.
 - East region: no or low
 - Central region: middle
 - West region: high

Region	Year	TE				PTE			
		2005	2006	2007	2005-2007	2005	2006	2007	2005-2007
East China	Average 1	0.880	0.828	0.854	0.854	0.902	0.844	0.854	0.867
	Average 2	1.377	1.308	1.318	1.335	1.564	1.491	1.541	1.532
	# of E. DMUs	6	5	5	16	7	6	5	18
	Proportion 1	20.00%	16.67%	16.67%	17.78%	23.33%	20.00%	16.67%	20.00%
	Proportion 2	66.67%	55.56%	55.56%	59.26%	77.78%	66.67%	55.56%	66.67%
Central China	Average 1	0.852	0.923	0.937	0.904	0.861	0.941	0.937	0.913
	Average 2	0.880	0.927	1.017	0.941	0.901	0.947	1.020	0.956
	# of E. DMUs	2	2	4	8	3	2	4	9
	Proportion 1	6.67%	6.67%	13.33%	8.89%	10.00%	6.67%	13.33%	10.00%
	Proportion 2	20.00%	20.00%	40.00%	26.67%	30.00%	20.00%	13.33%	30.00%
West China	Average 1	0.853	0.927	0.930	0.903	0.922	0.955	0.948	0.942
	Average 2	0.904	0.952	0.944	0.933	0.979	0.992	0.986	0.986
	# of E. DMUs	2	3	2	7	5	7	7	20
	Proportion 1	6.67%	10.00%	6.67%	7.78%	16.67%	23.33%	23.33%	22.22%
	Proportion 2	18.18%	27.27%	18.18%	21.21%	45.45%	63.64%	63.64%	60.61%

- Note: **Average 1** is the average of standard DEA models, and **Average 2** is the average of super-efficiency models. **Proportion 1** is the proportion of efficient DMUs in all regions, and **Proportion 2** is the proportion of efficient DMUs in the region. 20

Region	Year	SE			
		2005	2006	2007	2005-2007
East China	Average 1	0.978	0.984	1.000	0.987
	Average 2				
	# of E. DMUs	7	8	8	23
	Proportion 1	23.33%	26.67%	26.67%	25.56%
	Proportion 2	77.78%	88.89%	88.89%	85.19%
Central China	Average 1	0.989	0.982	1.000	0.990
	Average 2				
	# of E. DMUs	8	7	10	25
	Proportion 1	26.67%	23.33%	33.33%	27.78%
	Proportion 2	80.00%	70.00%	100.00%	83.33%
West China	Average 1	0.928	0.972	0.983	0.961
	Average 2				
	# of E. DMUs	4	7	6	17
	Proportion 1	13.33%	23.33%	20.00%	18.89%
	Proportion 2	36.36%	63.64%	54.55%	51.52%

- Note: **Average 1** is the average of standard DEA models, and **Average 2** is the average of super-efficiency models. **Proportion 1** is the proportion of efficient DMUs in all regions, and **Proportion 2** is the proportion of efficient DMUs in the region.

(3) Environmental variable analysis

- To examine the relationship between environmental factors and the efficiency.
- Tobit model
 - to regress the standard TE on the environmental variables
- OLS model
 - to regress the super TE on the environmental variables

(3) Environmental variable analysis

- Significant variables
 - GDP per capita
 - per capita annual net income of rural households
 - number of employed persons in health institutions per thousand residents
 - region (east, middle, west)
- Not so significant
 - GDP
 - government revenue
- Insignificant variables
 - percentage of rural population
 - per capita consumption expenditure on health care and medical services of rural household
 - health care institution per thousand residents

5. Summary of the efficiency evaluation

- In this paper, we studied the NRCMS efficiency of 30 province-level units in China from 2005 to 2007 using standard DEA models and super-efficiency DEA models.
- One good sign from our research is that the efficiency is increasing, although not significantly, from 2005 to 2007.

5. Summary of the efficiency evaluation

- By region
 - NRCMS in **east China** is generally more efficient than in middle and west regions.
 - This implies that the financing ability of **local government** (lower or no subsidy from central government for east) and rural residents' ability to pay premiums are playing important roles in the implementations of NRCMS.

5. Summary of the efficiency evaluation

- Structure of outputs matters
 - For example, Beijing and Shanghai both received no central government subsidy, but Beijing has very low efficiency while Shanghai shows very high (super) efficiency.
 - This implies that although the inputs are critical to the NRCMS, the structure of outputs is also an important issue.
 - Hence it is a practical question for the DMU to find a balance between the number of reimbursements and level of reimbursements.

5. Summary of the efficiency evaluation

- Decomposition of TE: PTE, SE
 - The decomposition of the relative technical efficiency suggests that the pure technical inefficiency is the main source of overall inefficiency, and the structure of the inputs and outputs needs to be adjusted in the east region.
 - Analysis of the returns to scale of inefficient DMUs further indicates that the scale of NRCMS in the west region is too small to attain high efficiency.

5. Summary of the efficiency evaluation

- Regression analysis
 - The analysis of efficiency based on regression on the environmental variables confirms our conclusion about the distribution of efficiency in different regions of China.

6. Some thoughts about Microinsurance

- Current situation of China's microinsurance
- Why develop the microinsurance market?
- What is the relationship between the government and the market?
- What is the potential risks?
- How big is the growth potential of China's insurance market?

Current situation of China's microinsurance

- Microinsurance (by narrow definition)
 - Officially launched in mid 2008
 - Term life, accident insurance
 - Sold by insurance companies (mainly China Life)
 - Regulated by CIRC (China Insurance Regulatory Commission)
- 2008
 - Number of Insureds: 2.39 million
 - Premium: RMB 42.12 m, roughly Euro 4.2 m
- 2009 (goal)
 - Number of Insureds: > 6 million
 - Premium: RMB 100 m, or Euro 10 m

Why develop the (micro)insurance market?

- Role of insurance
 - fire escape of a big building
- Key purpose
 - not to develop the insurance market itself
 - but to contribute to the economic and social development, via invisible hand
- Insurance education
 - to public
 - to government officials
 - an indispensable part of the “market economy”
 - a criteria: compensation after catastrophe, public finance vs. private insurance, planned economy vs. market economy

What is the relationship between government and market?

- PPP
- Role of government
 - social security protection to rural residents
 - government subsidy to attract participants (important in China)
 - tax reduction to microinsurance providers
- Two types of “government”
 - market-*replacing* government vs. market-*regulating* government
 - If market can do, let it do, so mostly we need market-regulating government.

What is the relationship between government and market?

- Role of insurance companies
 - Insurance is often excluded from social protection due to profit motive
 - but it might be more costly if government operates itself
 - expand budget, recruit people whom you cannot easily fire
 - Insurance companies are gradually accepted, participating as a TPA.

What are the potential risks?

- Two possible roles of insurance
 - risk manager
 - risk maker, if not operate properly or fail (extreme case)
 - regulation is always important
- Microinsurance is a two-edged sword
 - good or bad
 - it determines the consumer's initial and long-lasting feeling about “insurance”

What are the potential risks?

- So, efficiency evaluation, very important!
 - not from the insurer's perspective
 - but from the society's perspective
 - the claims ratio should not be too low
 - DEA is a useful tool
- A lot of things for insurance companies to do
 - improve the reputation of insurance
 - no sales misleading
 - let people understand the product
 - distinguish the insurance from savings and investment
 - keep the administrative costs low, and increase the value of insurance products
 - let people trust you,

How big is the growth potential of China's insurance market?

- premium, insurance density, insurance penetration?
- market share in the world?
- microinsurance market?

China's Insurance: premium, density and penetration (2005~2020)

		Conservative (GDP Growth Rate 6%)			Median (GDP Growth Rate 7.5%)			Optimistic (GDP Growth Rate 9%)		
		Life	Non-Life	Total	Life	Non-Life	Total	Life	Non-Life	Total
Average Annual Growth Rate		10.3%	8.8%	9.8%	13.0%	10.9%	12.3%	15.6%	12.9%	14.8%
2005	Premium	3,244	1,683	4,927	3,244	1,683	4,927	3,244	1,683	4,927
	Density	248	129	377	248	129	377	248	129	377
	Penetration	1.8%	0.9%	2.7%	1.8%	0.9%	2.7%	1.8%	0.9%	2.7%
2010	Premium	5,304	2,569	7,873	5,975	2,825	8,800	6,698	3,091	9,789
	Density	387	188	575	436	206	642	489	226	714
	Penetration	2.3%	1.1%	3.4%	2.4%	1.1%	3.6%	2.5%	1.2%	3.7%
2015	Premium	8,670	3,923	12,593	11,005	4,742	15,747	13,826	5,677	19,504
	Density	613	277	890	778	335	1,113	978	401	1,379
	Penetration	2.8%	1.3%	4.1%	3.1%	1.3%	4.4%	3.4%	1.4%	4.8%
2020	Premium	14,174	5,989	20,162	20,269	7,960	28,229	28,544	10,427	38,970
	Density	971	410	1,381	1,388	545	1,933	1,955	714	2,669
	Penetration	3.4%	1.5%	4.9%	4.0%	1.6%	5.6%	4.6%	1.7%	6.3%

Market share in the world (2005~2020)

		Conservative (GDP Growth Rate 6%)			Median (GDP Growth Rate 7.5%)			Optimistic (GDP Growth Rate 9%)		
		Life	Non-Life	Total	Life	Non-Life	Total	Life	Non-Life	Total
Average Annual Growth Rate		10.3%	8.8%	9.8%	13.0%	10.9%	12.3%	15.6%	12.9%	14.8%
2005	China Premium	40	21	60	40	21	60	40	21	60
	World Premium	2,004	1,442	3,446	2,004	1,442	3,446	2,004	1,442	3,446
	China's Share	2.0%	1.4%	1.7%	2.0%	1.4%	1.7%	2.0%	1.4%	1.7%
2010	China Premium	65	31	96	73	34	108	142	38	120
	World Premium	2,847	1,799	4,646	2,847	1,799	4,646	2,847	1,799	4,646
	China's Share	2.3%	1.7%	2.1%	2.6%	1.9%	2.3%	5.0%	2.1%	2.6%
2015	China Premium	106	48	154	134	58	193	169	69	239
	World Premium	4,046	2,244	6,289	4,046	2,244	6,289	4,046	2,244	6,289
	China's Share	2.6%	2.1%	2.4%	3.3%	2.6%	3.1%	4.2%	3.1%	3.8%
2020	China Premium	173	73	246	247	97	345	348	127	476
	World Premium	5,749	2,798	8,548	5,749	2,798	8,548	5,749	2,798	8,548
	China's Share	3.0%	2.6%	2.9%	4.3%	3.5%	4.0%	6.1%	4.5%	5.6%

How big for microinsurance market?

- No answer yet
- Need future research
 - more data
 - more field investigations and surveys
 - more international communications
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- Thank you for your attention!
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