

Impact of lack of sufficient incentives on the healthcare provision of township healthcare centers in rural China

Zhongliang Zhou

Xi'an Jiaotong University

Chi Shen (✉ shenchi@outlook.com)

Xi'an Jiaotong University

Sha Lai

Xi'an Jiaotong University

Wanyue Dong

Nanjing University of Chinese Medicine

Yaxin Zhao

Xi'an Jiaotong University

Dan Cao

Xi'an Jiaotong University

Dantong Zhao

Xi'an Jiaotong University

Yangling Ren

Xi'an Jiaotong University

Xiaoqing Fan

Xi'an Jiaotong University

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1 **Impact of lack of sufficient incentives on the healthcare provision of township**
2 **healthcare centers in rural China**

3 Zhongliang Zhou^{a, §}, Chi Shen^{a, §, *}, Sha Lai^a, Wanyue Dong^b,

4 Yaxin Zhao^c, Dan Cao^a, Dantong Zhao^a, Yangling Ren^a, Xiaojing Fan^a

5 ^aSchool of Public Policy and Administration, Xi'an Jiaotong University, Xi'an, China, 710049

6 ^bSchool of Health Economics and Management, Nanjing University of Chinese Medicine, Nan
7 Jing, China, 210023

8 ^cSchool of Public Health, Health Science Center, Xi'an Jiaotong University, Xi'an, China,
9 710061

10

11 § Zhongliang Zhou and Chi Shen contributed equally to this work.

12 ***Corresponding author:** Chi Shen, PhD, School of Public Policy and Administration, Xi'an
13 Jiaotong University, No.28 Xianning West Road, Xi'an, 710049, China. Email:
14 shenchi@outlook.com.

15 Zhongliang Zhou, zzliang1981@163.com

16 Chi Shen, shenchi@outlook.com

17 Sha Lai, shayanglala0217@163.com

18 Wangyue Dong, wanyuedong@foxmail.com

19 Yaxin Zhao, zyaxin1996@163.com

20 Dan Cao, cdan1996@163.com

21 Dantong Zhao, zhaodt1224@163.com

22 Yangling Ren, ryling0317@163.com

23 Xiaojing Fan, emirada@163.com

24 **Abstract**

25 **Background**

26 China's government launched a large-scale healthcare reform from 2009. One of the main targets
27 of this round reform was to improve the primary health care system. Major reforms for primary
28 healthcare institutions include increasing government investment. However, it is lack of an
29 empirical study based on large sample to catch long-term effect of increased government subsidy
30 and lack of sufficient incentives on township healthcare centers (THCs), therefore, this study aims
31 to fill this gap by conducting an empirical analysis of THCs in Shaanxi province in China.

32 **Methods**

33 We collected nine years (2009 to 2017) data of THCs from the Health Finance Annual Report
34 System (HFARS) that was acquired from the Health Commission of Shaanxi Province. We applied
35 two-way fixed effect model and continue difference-in-difference (DID) model to estimate the
36 effect of percentage of government subsidy on medical provision.

37 **Results**

38 A clear jump of the average percentage of government subsidy to total revenue of THCs can be
39 found in Shaanxi province in 2011, and the average percentage has been more than 60% after 2011.
40 Continue DID models indicate every 1% percentage of government subsidy to total revenue
41 increase after 2011 resulted in a decrease of 1.1% to 3.5% in THCs healthcare provision (1.9% in
42 medical revenue, 1.2% in outpatient visit, 3.5% in total occupy beds of inpatient, 1.1% in surgery
43 revenue, 2.1% in sickbed utilization rate). The results show that the THCs with high government
44 subsidy reduce the number of medical services after 2011.

45 **Conclusions**

46 We think that it is no doubt that the government should take more responsibility for the financing

47 of primary healthcare institutions, the problem is when government plays a central role in the
48 financing and delivery of primary health care services, more effective incentives should be
49 developed.

50 **Keyword:** Incentives, Township healthcare centers, Healthcare reform, China

51

52 **Background**

53 In order to deal with the problem of the healthcare system and achieve the goal of establishing a
54 universal coverage healthcare system for all citizens by 2020, the Chinese government launched a
55 large-scale healthcare reform in 2009 [1, 2]. Policies in this round reform can be summarized into
56 five parts: Social health security, Essential medicines, Primary healthcare, Essential public health
57 services program, Public hospitals [3, 4]. To improve the performance of the primary healthcare
58 system is one of the main targets of this round reform. Major reforms for primary healthcare
59 institutions (PHIs) include increasing government investment, eliminating drug mark-ups, and
60 general practitioners contract service [4–6].

61 Increasing government investment means the government provides financial subsidies to
62 cover all the costs of PHIs, such as construction and equipment expenditure, personnel salary, and
63 operational expenses for public health services [7]. Before the reform, the PHIs' cost was financed
64 by the government and revenue of PHIs (including drug sales) [8]. According to increasing
65 government investment and eliminating 15% drug mark-ups, China government hopes the PHIs
66 can provide convenient and low-cost essential health services for residents rather than profit-
67 oriented [1].

68 Along with the change of compensation strategy, the incentives of primary healthcare staff are
69 also changed. After the reform, the total salary of staff in township healthcare centers (THCs) is

70 approved based on the number of staff and service workload, referring to the average salary of the
71 local government staff [7]. The salary consists of basic salary and performance-based bonus. The
72 basic salary shares 60% to 70% of the total salary, performance-based bonus accounts for 30% to
73 40% of total salary [8]. However, every staff can get 70% of the bonus, only 30% of the bonus is
74 really based on performance [9]. Therefore, the low bonus based on performance leads to a
75 problem - a lack of sufficient incentives.

76 Due to professional ethics, practice norms, and financial incentives affect the performance of
77 staff in THCs, a lack of sufficient incentives would lead to inefficiencies and poor quality of
78 healthcare services [10]. From 2009 to 2017, the percentage of outpatient services provided by
79 THCs decreased from 16.0% to 13.6%, and inpatients services decreased from 28.7% to 16.6%
80 [11]. One study shows that the compensation and incentive strategy is the key point in the reform
81 of THCs [12]. Another study conducted in Anhui province in China shows that healthcare services
82 provided by THCs with high government subsidy and performance-based salary system have
83 reduced to varying degrees between 2009 and 2010 [9]. In Hubei province in China, the technical
84 efficiency of THCs decreased from 2012, and THCs experienced a decline in productivity [13].
85 However, existed research have some limitations: small sample (6 and 48 THCs) [9, 13],
86 descriptive analysis, or theoretical analysis [9, 12].

87 It is lack of an empirical study based on a large sample to catch the long-term effect of
88 increased government subsidies and lack of sufficient incentives on THCs. This study aims to
89 estimate the effect of the percentage of government subsidy on total revenue on the medical service
90 of THCs. We conducted an empirical analysis by using a balanced panel data that includes 1199
91 THCs from 2009 to 2017 in Shaanxi province, China. We find that higher percentage of
92 government subsidy to total revenue of THCs, less provision of medical services, lack of sufficient

93 incentives made THC's shrink in terms of medical service.

94

Box 1 The entire history of China's township healthcare centers

The main component of PHIs in rural China is township health centers (THCs). The entire history of China's THCs is about how to balance the relationship between government and market in terms of financing (Figure.1). At the stage of the People's Republic of China funded (1958 - 1980), the government strongly supported and financed the THCs, and people's health status intensely promoted during this period [14]. At the stage of Economic Reform and Open Up (1981 - 2001), the government changed the financing policy and made the THCs into the market, which caused a massive loss of technical staff from THCs and resident's healthcare utilization in THCs decreased [14–16]. After aware of the shrinking of THCs, the government began to increase the subsidy to THCs from 2002 and continue to increase it from 2009 [7].

[Insert Figure 1 about here]

95

96 Methods

97 Study site and data collection

98 Shaanxi province is located in northwest China and has an area of 205,800 square kilometers, the
99 total population in 2017 is over 38.35 million [17]. There are 11 prefecture-level cities, 77 counties
100 [18]. The economic and development level of Shaanxi province is the average level of China.

101 We collected nine years (2009 to 2017) data of THCs from the Health Finance Annual Report
102 System (HFARS) that was acquired from the Health Commission of Shaanxi Province. The
103 HFARS includes resource, service, and finance information of each health institutions hosted by
104 the government. The data include number of medical personnel, number of beds, number of visits

105 in hospitals, and day of in-hospital patient bed occupancy, revenue, medical revenue, and more
106 other provision indicators. Due to changes in administrative divisions and the elimination of
107 missing values, finally, this study included 1199 THCs from total 1552 THCs and constructed a
108 balanced panel dataset [19].

109 **Indicators and models**

110 We chose the percentage of government subsidy to total revenue of THCs as the explanatory
111 indicator that can identify the degree of compensation of THCs from the government.
112 Considering the lack of efficient incentives would firstly affect the medical services provided by
113 THCs, we selected the indicators that can reflect the amount of inpatient and outpatient services
114 as the explained variable. Moreover, some confounders will affect the THCs' provision, such as
115 number of physicians and sickbeds, we chose these confounders as control variables. The detail
116 about variables including in this study can be found in Table.1.

117 [Insert Table.1 about here]

118 A two-way fixed-effect model was used to estimate the average treatment effect of the percentage
119 of government subsidy, estimating equation (1) is written as:

$$120 \quad y_{it} = \beta \cdot Subsidy_{it} + z_i \delta + \lambda t + \mu_i + \epsilon_{it} \quad (1)$$

121 Where,

- 122 • where i indexes THCs and t indexes years.
- 123 • y_{it} is the indicator that can reflect the amount of inpatient and outpatient services of THCs.
- 124 • $Subsidy_{it}$ is the government subsidy as % of total revenue of i THCs at t time.
- 125 • z_i is the control variable.
- 126 • λt is the year fixed effect.
- 127 • μ_i is the THCs fixed effect.

128 • ϵ_{it} is the residual error.

129 According to the official document [20], released on July 6, 2011, government subsidy of
130 THCs increased from 2011 in Shaanxi province. Since there is a clear policy cut-point, we also
131 applied a difference-in-difference (DID) model to compare the average effect of subsidy
132 percentage on the provision of medical services of THCs before and after 2011. However, the DID
133 model used in this study is different from standard DID model [21], the difference is that the
134 intensity of treatment is a continuous measure (i.e., government subsidy as % of total revenue).
135 The detail about the continuous DID model can be found here [22]. Estimating equation (2) is
136 written as:

$$137 \quad y_{it} = \beta \cdot Subsidy_{it} * Year^{2011} + z_i \delta + \lambda t + \mu_i + \epsilon_{it} \quad (2)$$

138 Where,

- 139 • where i indexes THCs and t indexes years.
- 140 • y_{it} is the indicator that can reflect the amount of inpatient and outpatient services of THCs.
- 141 • $Subsidy_{it}$ is the government subsidy as % of total revenue of i THCs at t time.
- 142 • z_i is the control variable.
- 143 • λt is the year fixed effect.
- 144 • μ_i is the THCs fixed effect.
- 145 • ϵ_{it} is the residual error.
- 146 • $Year^{2011}$ is a dummy variable (2009 and 2010 = 0, after 2011 = 1)

147 As we found, the distribution of explained variables is over discrete in the process of
148 descriptive analysis, and we made a logarithmic conversion of explained variables in models. All
149 analysis in this study was performed by R 3.5.3 [23].

150

151 **Results**

152 **Basic information of explained and explanatory variables**

153 We can find a clear jump of the average percentage of government subsidy to total revenue of
154 THC_s in Shaanxi province in 2011 from Figure.2, and the average percentage has been more than
155 60% after 2011. In terms of medical services, medical revenue, and inpatient and outpatient
156 services increased from 2010 to 2017, and there was a decrease in surgical income and no increase
157 in sickbed utilization rate (Table.2). Furthermore, Figure.3 presents the scatter plots of THC_s
158 between government subsidy to total revenue and total occupy beds of inpatient yearly from 2009
159 to 2017, the locally estimated scatterplot smoothing (LOESS) curves show that the relationship
160 between government subsidy and total occupy beds of inpatient are negative. Other indicators have
161 the same relationship, please see Figure.A1 to Figure.A4 in Additional file).

162 [Insert Figure.2, 3 and Table.2 about here]

163 **Two-way fixed effect model result**

164 Based on the results from scatter plots, we used two-way fixed effect models to estimate the
165 average effect of the percentage of government subsidy to total revenue on number of medical
166 services. We performed a Hausman Test to compare fixed effect model with random effect model,
167 the result indicates that fixed effect model is better. Table.3 shows that all the coefficients of the
168 percentage of government subsidy are negative and significant in model 1 to model 5, which
169 indicates that every 1% percentage of government subsidy to total revenue increase resulted in a
170 decrease of 1.3% to 2.6% in THC_s healthcare provision (2.4% in medical revenue, 1.3% in
171 outpatient visit, 2.6% in total occupy beds of inpatient, 1.4% in surgery revenue, 1.8% in sickbed
172 utilization rate).

173 [Insert Table.3 about here]

174 **Continue difference-in-difference model result**

175 In order to evaluate the average effect of the percentage of government subsidy to total revenue on
176 number of medical services before and after 2011, we applied continue DID model. Table.4 shows
177 that coefficients of interaction between the year dummy variable and the percentage of government
178 subsidy to total revenue are also negative, the coefficients indicate every 1% percentage of
179 government subsidy to total revenue increase after 2011 resulted in a decrease of 1.1% to 3.5% in
180 THC's healthcare provision (1.9% in medical revenue, 1.2% in outpatient visit, 3.5% in total
181 occupy beds of inpatient, 1.1% in surgery revenue, 2.1% in sickbed utilization rate). The results
182 show that the THCs with high government subsidy reduce the number of medical services after
183 2011.

184 [Insert Table.4 about here]

185 **Discussion**

186 Our study indicates that, from 2009 to 2017, medical services provided by THCs in Shaanxi
187 province slightly increased, and the government subsidy to THCs experienced substantial growth
188 from 2011. However, the increase of government subsidy did not make the THCs provide more
189 necessary medical services after completing the tasks set by the government. THCs did not meet
190 the health needs of rural residents stimulated by New Rural Cooperative Medical [24, 25].

191 The findings in our study are similar to the previous studies conducted in Anhui and Hubei
192 province [9, 13], the new contribution of our research is that we confirm the effect of compensation
193 policy changes on the medical services provided by THCs from the perspective of large samples
194 and long-term effects. So, is the incentive method important for primary healthcare institutions?
195 Several review papers indicate that the financing policies for primary health care in China in this
196 round reform might lead to low productivity in primary health-care institutions, and incentive

197 policy is one of the key elements in building an integrated primary health-care system for China
198 [5, 26]. However, it is difficult to make an appropriate incentive strategy. An insurance intervention
199 study conducted in Ningxia province in China revealed that changes in payment method on supply
200 side failed to change residents' healthcare seeking behavior [27].

201 The original intention of increasing government subsidy for THC's is to compensate for the
202 shortage of income and expenditure of THC's when eliminating 15% drug mark-ups [7]. Along
203 with the government subsidy increase, the incentive strategy shifts from profit-driven (e.g.,
204 prescribing diagnostic tests and drugs) [10] to "approved task, approved revenue and expenditure,
205 performance-based bonus", which means each THC's will be set an annual task. How to set task
206 goals plays a key role in maintaining the quality and efficiency of health services in THC's.
207 However, factually, the task is simply approved by reference to service population and average
208 health service provision of the THC's over the past three years [20]. Under the situation that high
209 government subsidy, unscientific task setting method, and lack of incentive in salary system, it is
210 common sense that staffs in THC's have no incentives to do extra work after completing the task.
211 Therefore, THC's firstly reduced high-risk medical services, such as hospitalization and surgery,
212 we have reason to believe that THC's with higher government subsidy will reduce medical services
213 compared to THC's with lower government subsidies.

214 There is a long-standing debate in China that the financing and provision of healthcare services
215 should depend on the market or government. In the past ten years of reform, the Chinese
216 government has invested a large number of funds in the primary healthcare system, but it has not
217 achieved the expected outcomes. It is no doubt that the government should take more responsibility
218 for the financing of primary healthcare institutions. The problem is that when the government plays
219 a central role in the financing and delivery of primary health care services, more effective

220 incentives should be developed. Supply-side incentives can promote to build an integrated
221 healthcare delivery system based on primary healthcare system in China [28]. Fortunately, however,
222 the Chinese government has begun to promote the reform of the salary system of public hospitals,
223 which proposes “two permits”, namely, allowing health institutions to break the limitation of the
224 current level of salary and allowing health institutions to use the revenue balance as personnel
225 reward [29].

226 There are two limitations in this study. Firstly, as it is difficult to collect the population of
227 towns, we have to use the number of authorized beds of THCs as a proxy variable to control the
228 influence of the population. Secondly, as we mentioned before, services provided by THCs include
229 public health and medical service, however, only indicators of medical service were included in
230 our study because of no suitable indicators about the provision of public health in HFARS.

231 **Conclusion**

232 Because of the changes in the compensation policy of township health centers and the lack of
233 incentives, the increase of government subsidy did not make the township health centers to provide
234 more necessary medical services, which indirectly leads to a decline in medical service quality and
235 aggravates the problem of “KAN BING NAN”. It is no doubt that the government should take
236 more responsibility for the financing of primary healthcare institutions. The problem is that when
237 the government plays a central role in the financing and delivery of primary health care services,
238 more effective incentives should be developed.

239

240 **Abbreviations**

241 DID: Difference-in-Difference;

242 HFARS: Health Finance Annual Report System;

243 LOESS: Locally Estimated Scatterplot Smoothing;

244 PHIs: Primary Healthcare Institutions;

245 THCs: Township Healthcare Centers.

246

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249 Province for providing fund and data support. We also thank China Scholarship Council for
250 providing financial support to Chi Shen to visit Yale University.

251

252 **Authors' contributions**

253 ZL Z and CS proposed the study framework and analysis strategy. ZL Z wrote first draft of the
254 manuscript. YL R, YX Z and WY D carried out all aspects of data collection and data analysis. DC
255 and DT Z provided the analysis assistance. SL and XJ F gave many suggestions about the study
256 design. CS and ZL Z gave the revised suggestions and approved the final version.

257

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264

265 **Availability of data and materials**

266 The datasets used in this study are available from the corresponding author on reasonable request.

267

268 **Declarations**

269 **Ethics approval and consent to participate**

270 Health Finance Annual Report System (HFARS) only includes statistical information of healthcare

271 institutions, there is no human ethical parameter in our data of THCs.

272

273 **Consent for publication**

274 Not applicable.

275

276 **Competing interests**

277 Zhongliang Zhou is a member of the editorial board of BMC Health Services Research journal.

278 The authors declare no other conflicts of interest.

279

280 **Author details**

281 ^aSchool of Public Policy and Administration, Xi'an Jiaotong University, Xi'an, China, 710049

282 ^bSchool of Health Economics and Management, Nanjing University of Chinese Medicine, Nan

283 Jing, China, 210023

284 ^cSchool of Public Health, Health Science Center, Xi'an Jiaotong University, Xi'an, China,

285 710061

286

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Table.1 Detail about indicators in this study

Dependent variables	Control variables	Explanatory variable
Medical revenue	Number of physician	Government subsidy as % of total revenue
Total occupy beds of inpatient	Type of THCs (Center or General)	
Total outpatient visits	Number of authorized bed	
Surgery revenue	Separation between revenue and expenditure	
Sickbed utilization rate		

Table.2 Summary of dependent variables

Year	Observation	Medical revenue (RMB)		Outpatient visit		Total occupy beds of inpatient		Surgery revenue (RMB)		Sickbed utilization rate (%)	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
2009	1199	234326.1	317225.4	11735.5	11280.2	2413.9	2673.1	27241.7	64269.9	47.0	30.2
2010	1199	260552.9	354245.0	11959.4	11725.2	2381.2	2759.5	24353.7	67400.3	44.3	31.3
2011	1199	746156.5	790213.3	12356.4	12128.8	2549.2	2984.1	26435.9	69750.1	45.9	33.0
2012	1199	971877.6	1006631.0	13097.8	12697.1	3253.2	3777.8	27527.2	75973.9	49.4	33.5
2013	1199	1088195.9	1073457.4	13260.8	12647.3	3356.3	3767.9	27798.9	82212.7	51.0	33.6
2014	1199	1172641.7	1141956.2	13598.3	12306.6	3277.1	3637.1	29039.5	84107.3	45.2	32.5
2015	1199	1258281.4	1218177.7	14016.6	13175.1	3342.5	3894.4	26119.3	78710.0	44.9	33.0
2016	1199	1356923.4	1312443.4	14023.1	12760.6	3408.1	4196.3	21359.4	66077.3	42.2	32.0
2017	1199	1617121.6	1601525.4	14498.5	12989.5	3886.7	4615.6	20687.7	61555.1	45.0	33.0

Table.3 Result of fixed effect model

	log(medical revenue)	log(outpatient visit)	log(total occupy beds of inpatient)	log(surgery revenue)	log(sickbed utilization rate)
	(1)	(2)	(3)	(4)	(5)
Subsidy percentage	-0.024***	-0.013***	-0.026***	-0.014***	-0.018***
	(<0.001)	(<0.001)	(0.001)	(0.003)	(0.001)
Type of THCs [C220]	-0.022	-0.002	0.074	0.071	-0.038
	(0.036)	(0.038)	(0.109)	(0.226)	(0.068)
Number of Physician	0.005***	0.005***	0.005**	0.011**	0.002
	(0.001)	(0.001)	(0.002)	(0.005)	(0.002)
Number of authorized bed	0.006***	0.005***	0.034***	0.018***	-0.000
	(0.001)	(0.001)	(0.003)	(0.006)	(0.002)
Separation revenue policy	-0.054***	-0.085***	-0.228***	-0.290**	-0.108***
	(0.020)	(0.022)	(0.061)	(0.128)	(0.039)
Individual effect	YES	YES	YES	YES	YES
Time effect	YES	YES	YES	YES	YES
Observations	10,791	10,791	10,791	10,791	10,791
R^2	0.264	0.097	0.063	0.006	0.052
Adjusted R^2	0.171	-0.018	-0.055	-0.120	-0.068
F Statistic (df = 5; 9579)	688.720***	204.784***	129.574***	10.739***	105.410***

Note: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

p value of Hausman Test is < 0.05 , which indicates that fixed effect model is better

Table.4 Result of continuous measure difference-in-difference model

	log(medical revenue)	log(outpatient visit)	log(total occupy beds of inpatient)	log(surgery revenue)	log(sickbed utilization rate)
	(1)	(2)	(3)	(4)	(5)
Subsidy percentage*Year²⁰¹¹	-0.019***	-0.012***	-0.035***	-0.011***	-0.021***
	(<0.001)	(<0.001)	(0.001)	(0.003)	(0.001)
Type of THCs [C220]	0.020	0.018	0.093	0.096	-0.020
	(0.039)	(0.039)	(0.107)	(0.227)	(0.068)
Number of Physician	0.005***	0.005***	0.005*	0.011**	0.002
	(0.001)	(0.001)	(0.002)	(0.005)	(0.002)
Number of authorized bed	0.005***	0.004***	0.029***	0.017***	-0.003*
	(0.001)	(0.001)	(0.003)	(0.006)	(0.002)
Separation revenue policy	-0.066***	-0.090***	-0.227***	-0.297**	-0.110***
	(0.022)	(0.022)	(0.061)	(0.128)	(0.038)
Individual effect	YES	YES	YES	YES	YES
Time effect	YES	YES	YES	YES	YES
Observations	10,791	10,791	10,791	10,791	10,791
R ²	0.151	0.075	0.088	0.004	0.066
Adjusted R ²	0.044	-0.042	-0.027	-0.122	-0.052
F Statistic (df = 5; 9579)	341.503***	154.581***	184.786***	8.180***	135.773***

Note: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

p value of Hausman Test is < 0.05 , which indicates that fixed model is better

Figure Legend

Figure.1 Stages of development of township health centers

Figure.2 Tread of percentage of subsidy of THCs from 2009 to 2017

Figure.3 Relationship between subsidy and in-hospital from 2009 to 2017

Additional file.1

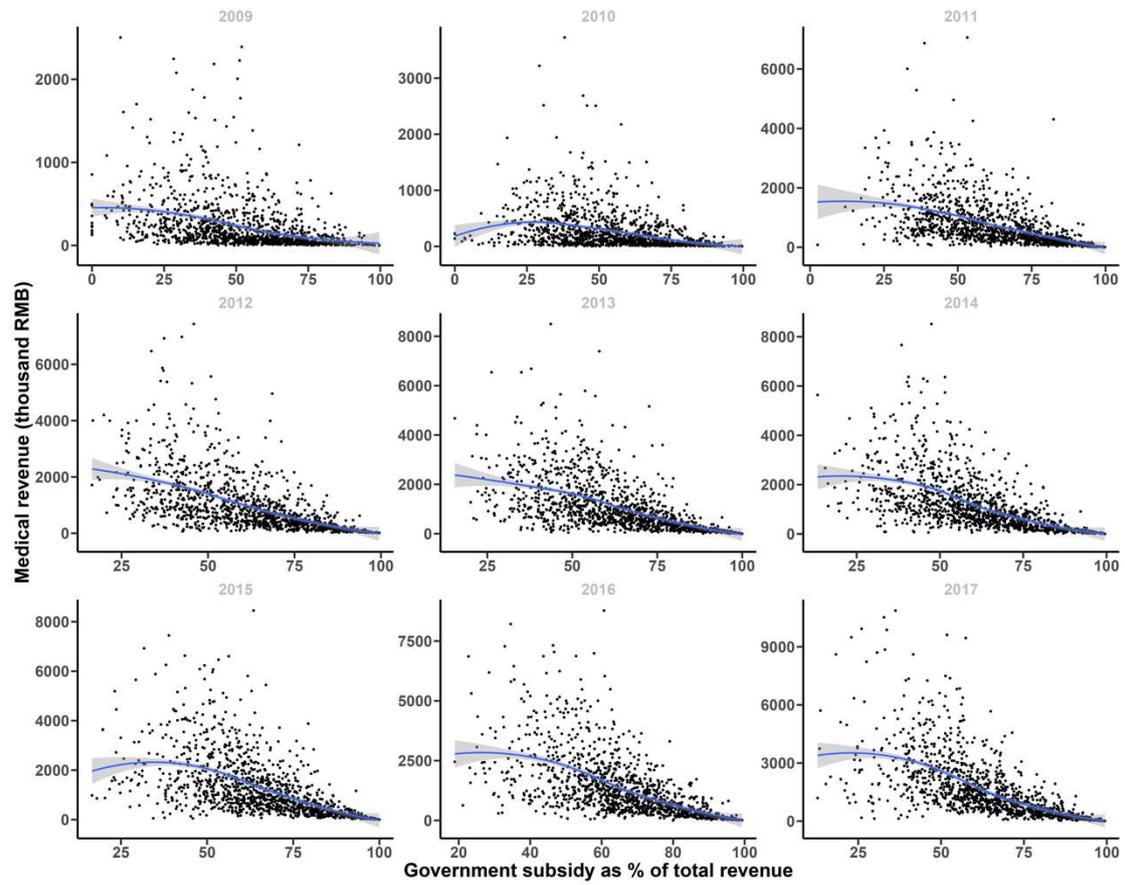


Figure.A1 Relationship between subsidy and medical revenue from 2009 to 2017

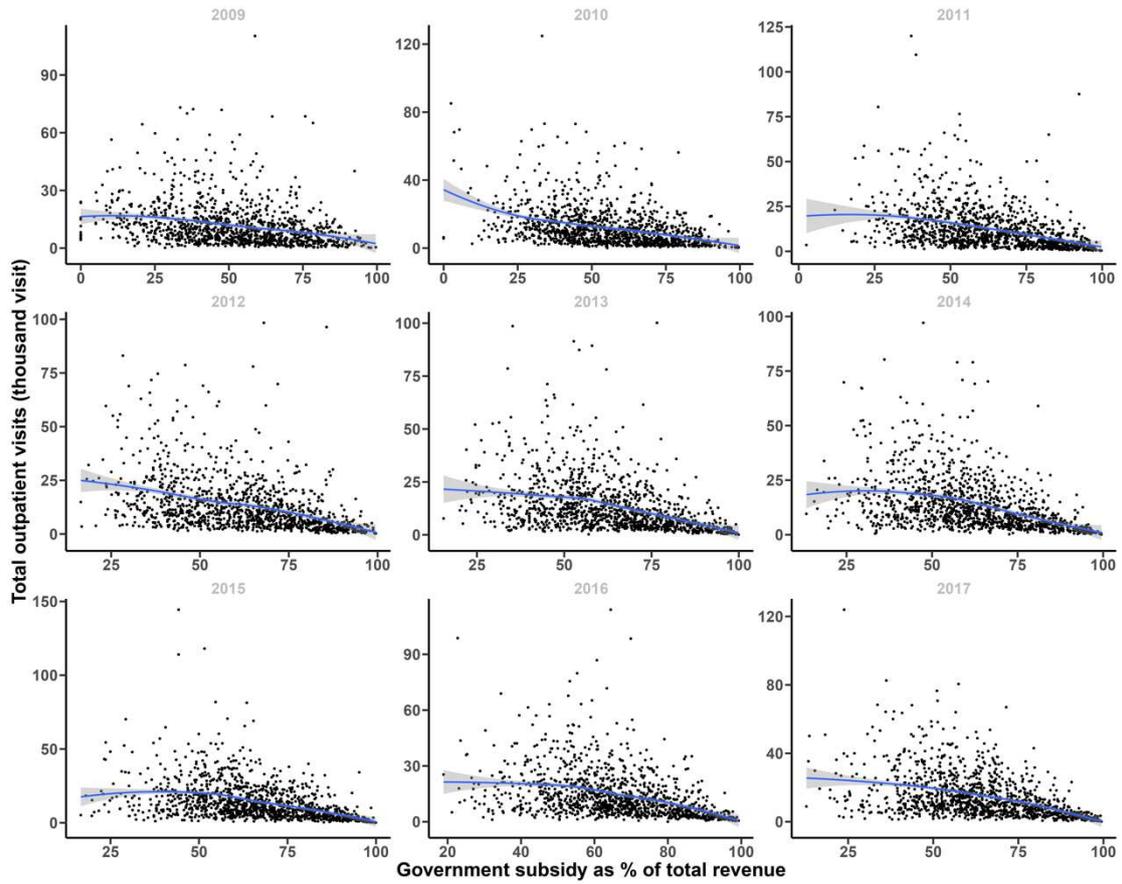


Figure.A2 Relationship between subsidy and outpatient visit from 2009 to 2017

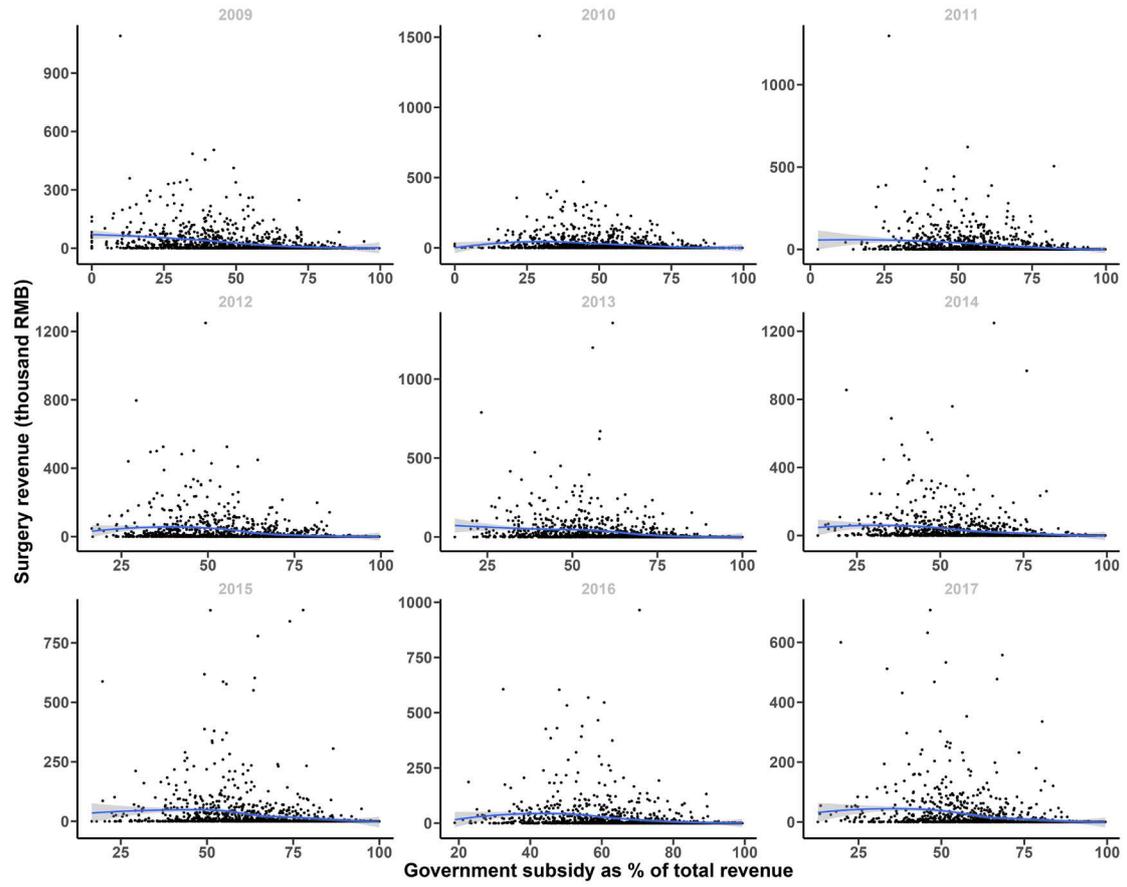


Figure.A3 Relationship between subsidy and surgery revenue from 2009 to 2017

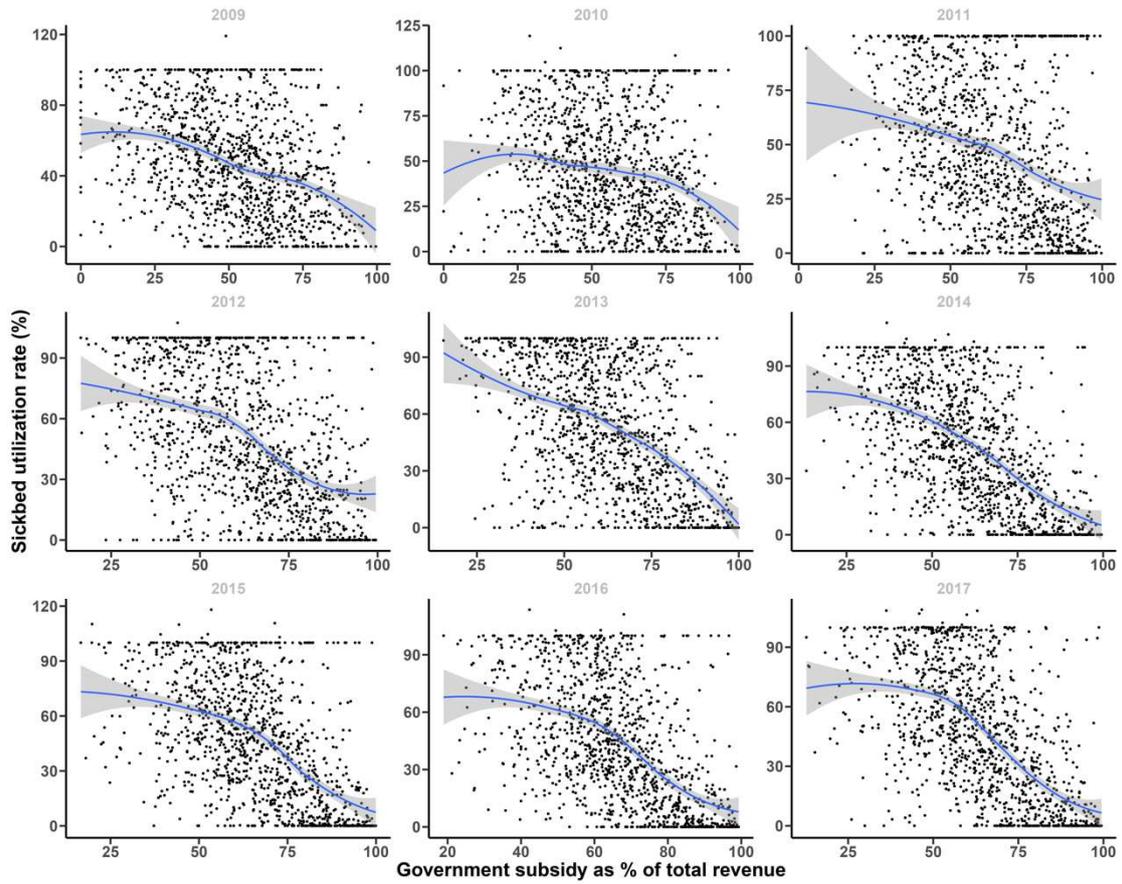


Figure.A4 Relationship between subsidy and sickbed utilization rate from 2009 to

2017

Figures

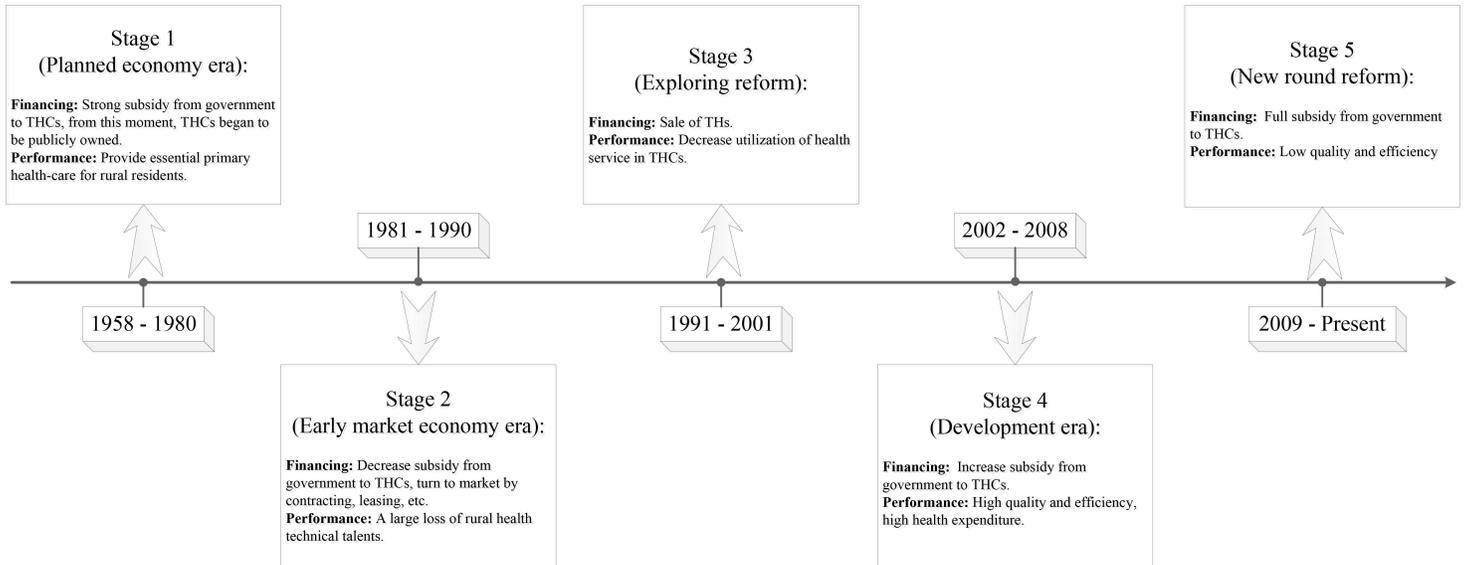


Figure 1

Stages of development of township health centers

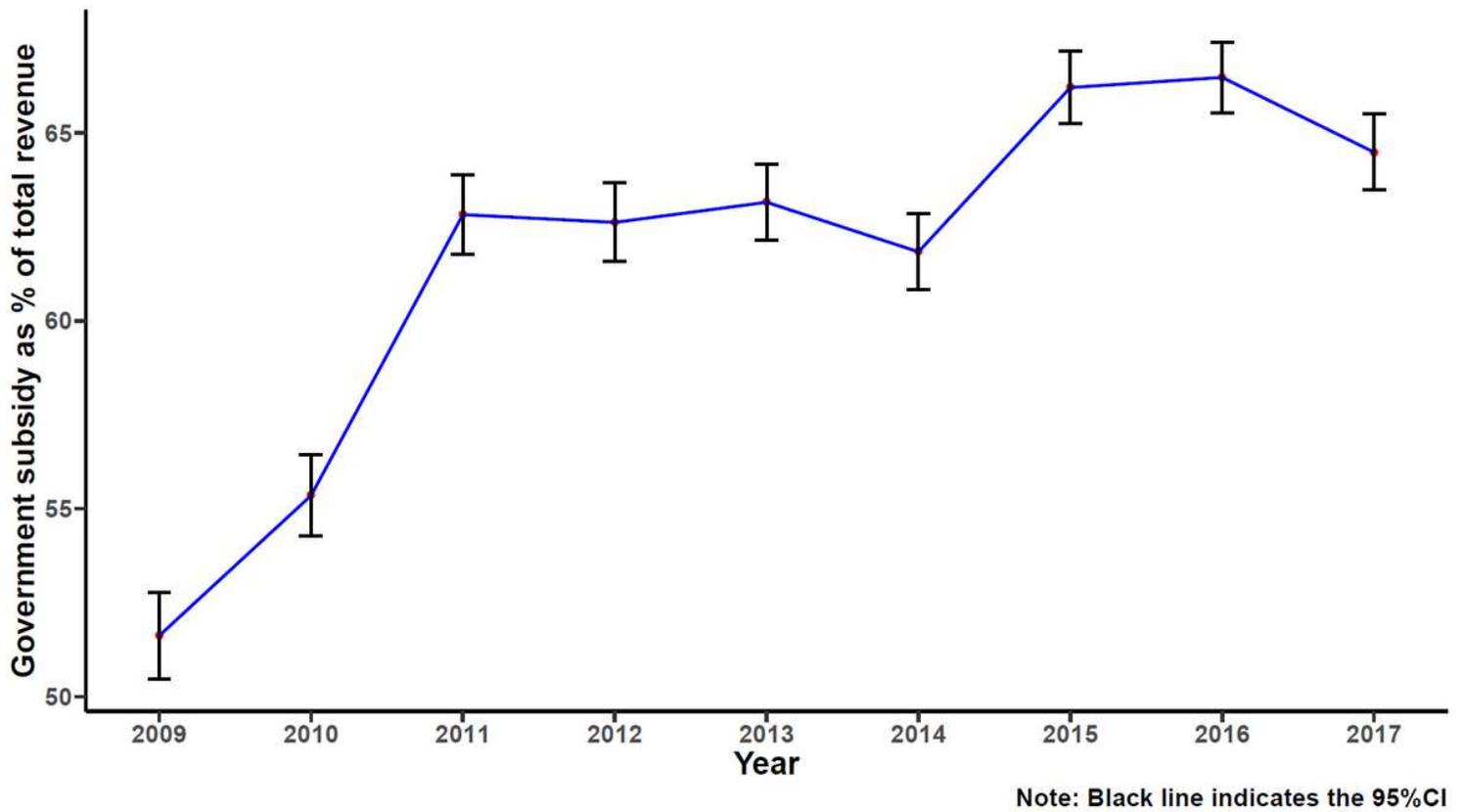


Figure 2

Trend of percentage of subsidy of THCs from 2009 to 2017

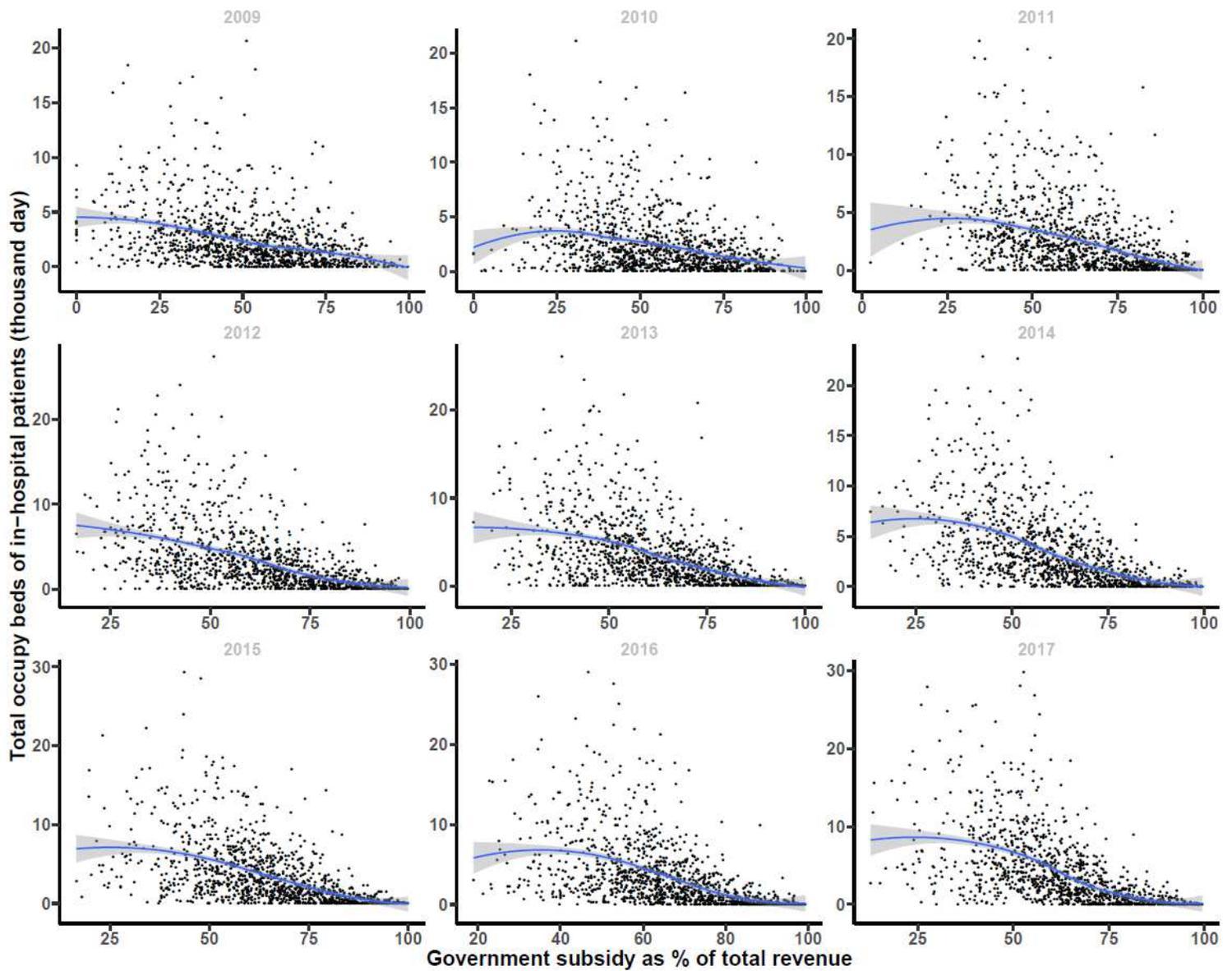


Figure 3

Relationship between subsidy and in-hospital from 2009 to 2017

Supplementary Files

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- [Additionalfile.docx](#)