

Geographical Variance and Convergence of Medical Cost in Japan

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(Presentation Summary)

Presented at the 5-th World Congress of the International Health Economics Association

論文口頭発表用資料

July 11,2005

Anegawa Tomfoumi ,

1. Motivation

a. Literature

Cutler David and Louise Sheiner (1999) "The Geography and Medicare" *Federal Reserve Board Working paper*.

Wennberg, John E. Elliott S. Fisher, and Jonathan S. Skinner (2002) "Geography and the Debate Over Medicare Reform," *Health Affairs, Web Exclusive* reappeared in *Health Affairs* "Variations Revisited" in 2004.

Tokita Tadahiko, Tetsuro Chino, and Hedeaki Kitaki (2000), "Health Care Expenditure and the Major Determinants in Japan," *Hitotsubashi Journal of Economics*, 41(1), 1-16.

b. Why do we study Japanese case?

- Wide geographical variations across geographical regions
- Japanese government's agenda
- The government initiative to contain medical expenditure
- The ratio of medical cost to GDP is 8 percent
- National Health Insurance plan (NHI)
- This NHI is no longer sustained without the increase of insurance premiums and co-payment.
- The government focuses on wide variation of medical expenditure Japan across regions.

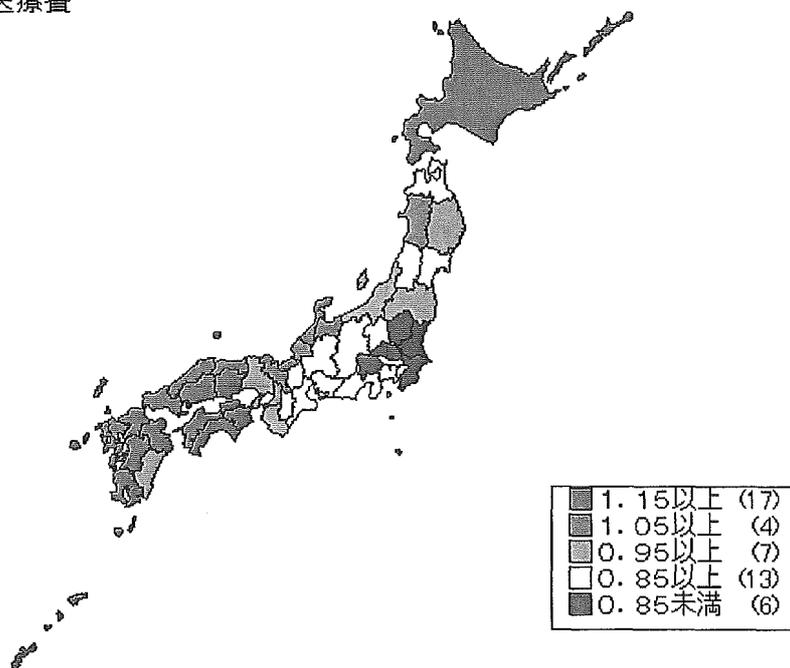
c. Geographical Variation of Medical Cost

Variation of medical expenditure (1998) (actual)

- red ≥ 1.15
- pink ≥ 1.05
- green ≥ 0.95
- yellow ≥ 0.85
- blue < 0.85

平成10年度 国民健康保険医療費マップ

(1) 実績医療費



d. Determinants of Medical Expenditure

Table 1 Determinants of medical expenditure

Supply-side	
Input and its price	hospitals/clinics fixed capital: land, properties, equipments labor: physicians, nurses, technicians human capital: physicians, nurses, technicians drugs, materials, devices
technology	technology level and technology progress
market competition	structure and competition
	medical decisions by physicians
Demand-side	
individual profiles	health status, income, leisure, age, and sex access to medical services
population	population, aging, disease profile, concentration prevention
Health insurance plan	service coverage insurance premium, co-payment

2. Method

a. Measurements

unit of analysis is 47 “prefecture as local areas (PLA)”

medical expenditure C_{htsjk} :

j-th person in h-th PLA insured by s-program receives i-th medical service
at k-th medical institutes t-th fiscal year,

medical expenditure by each PLA

by medical service (outpatients, inpatients, dental)

by types of insured (general, aged)

$$C_{htsi} = \sum_{j \in S} \sum_{k \in K} C_{htsjk} \quad (1)$$

N_{hts} : number of insured (average) for h-PLA, t-th year, s-program

Aged : Aged is subjects which are covered by “Elderly Insurance”

General: Subjects covered by the “Kokuho” insurance excluding “Aged”

$$N_{hts} = \sum_s N_{hts} = N_{htg} + N_{hta}, \quad \text{g: general, a: aged.}$$

E_{htsi} : Number of events as medical services

D_{htsi} : Days of medical services

$$\text{Days per Events } d_{htsi}^E = D_{htsi} / E_{htsi} \quad (2)$$

$$\text{Events per Persons } e_{htsi}^N = E_{htsi} / N_{hts} \quad (3)$$

$$\text{Days per Persons } d_{htsi}^N = D_{htsi} / N_{hts} \quad (4)$$

$$\text{Medical cost per Persons } c_{htsi}^N = C_{htsi} / N_{hts} \quad (5)$$

$$c_{htsi}^N = \frac{C_{htsi}}{N_{hts}} = \frac{C_{htsi}}{D_{htsi}} \cdot \frac{D_{htsi}}{E_{htsi}} \cdot \frac{E_{htsi}}{N_{hts}} = c_{htsi}^D d_{htsi}^E e_{htsi}^N \quad (6)$$

$$c_{htsi}^N = \frac{C_{htsi}}{N_{hts}} = \frac{C_{htsi}}{D_{htsi}} \cdot \frac{D_{htsi}}{N_{hts}} = c_{htsi}^D d_{htsi}^N \quad (7)$$

Medical cost per Events $c_{htsi}^E = C_{htsi} / E_{htsi}$ (8)

Medical Cost per Days $c_{htsi}^D = C_{htsi} / D_{htsi}$ (9)

Medical cost of h-PLA, s-program, t-th year

$$C_{hts} = \sum_s \sum_i C_{htsi} = \sum_s \sum_i (C_{htsi} / N_{hts}) N_{hts} = \sum_s \sum_i c_{htsi}^N N_{hts} \quad (10)$$

$$\Delta C_{hts} = \sum_s \sum_i \Delta C_{htsi} = \sum_s \sum_i \Delta((C_{htsi} / N_{hts}) N_{hts}) = \sum_s \sum_i (\Delta c_{htsi}^N \cdot N_{hts} + c_{htsi}^N \Delta N_{hts}) \quad (11)$$

$$\Delta c_{htsi}^N = \Delta c_{htsi}^D \cdot d_{htsi}^E \cdot e_{htsi}^N + c_{htsi}^D \cdot \Delta d_{htsi}^E \cdot e_{htsi}^N + c_{htsi}^D \cdot d_{htsi}^E \cdot \Delta e_{htsi}^N \quad (12)$$

$$\frac{\Delta C_{ht}}{C_{ht}} = \sum_s \sum_i \left\{ \left(\frac{\Delta c_{htsi}^D}{c_{htsi}^D} + \frac{\Delta d_{htsi}^E}{d_{htsi}^E} + \frac{\Delta e_{htsi}^N}{e_{htsi}^N} + \frac{\Delta N_{hts}}{N_{hts}} \right) \cdot \frac{C_{htsi}}{C_{hts}} \right\} \quad (13)$$

growth of medical cost $g(C_{ht}) = \frac{\Delta C_{ht}}{C_{ht}}$,

growth of medical cost per days $g(c_{htsi}^D) = \frac{\Delta c_{htsi}^D}{c_{htsi}^D}$,

growth of Days per Events $g(d_{htsi}^E) = \frac{\Delta d_{htsi}^E}{d_{htsi}^E}$,

growth of Events per Persons $g(e_{htsi}^N) = \frac{\Delta e_{htsi}^N}{e_{htsi}^N}$,

growth of the number of subjects of s-th program $g(N_{hts}) = \frac{\Delta N_{hts}}{N_{hts}}$,

Weight of i-th medical cost of the total medical cost

$$w_{htsi} = \frac{C_{htsi}}{C_{hts}}$$

$$g(C_{ht}) = \sum_s \sum_i \{g(c_{htsi}^D) + g(d_{htsi}^E) + g(e_{htsi}^N) + g(N_{hts})\} \cdot w_{htsi} \quad (14)$$

$$\frac{\Delta C_{ht}}{C_{ht}} = \sum_s \sum_i \left\{ \left(\frac{\Delta c_{htsi}^D}{c_{htsi}^D} + \frac{\Delta d_{htsi}^N}{d_{htsi}^N} + \frac{\Delta N_{hts}}{N_{hts}} \right) \cdot \frac{C_{htsi}}{C_{hts}} \right\} \quad (15)$$

$$g(C_{ht}) = \sum_s \sum_i \{g(c_{htsi}^D) + g(d_{htsi}^N) + g(N_{hts})\} \cdot w_{htsi} \quad (16)$$

$$g(C_{ht}) = \sum_s \sum_i \{g(c_{htsi}^D)w_{htsi} + g(d_{htsi}^N)w_{htsi} + g(N_{hts})w_{htsi}\} \quad (17)$$

Following fundamental relationship is applied to estimate gross of medical cost.

The growth of medical cost is the weighted sum of the growth of cost per day, days per person, number of insured.

b. Sample Period

“1981” stands for the period 1981-1986

“1986” 1986-1991

“1991” 1991-1996

“1996” 1996-2000

We use compound growth rate over the years in the period.

c. Category of Medical Services

General Inpatient

General Outpatient

General Dental Service

Aged Inpatient

Aged Outpatient

Aged Dental Service

Definition of the category is based on

3. Analysis

Sources of Growth of Medical Expenditure

$$g(C_{ht}) = \sum_s \sum_i \{g(c_{htsi}^D)w_{htsi} + g(d_{htsi}^N)w_{htsi} + g(N_{hts})w_{htsi}\}$$

Decomposition of gross of cost

$$\sum_s \sum_i \{g(c_{htsi}^D)w_{htsi}\} \quad \text{Contribution of cost per day} \quad (18)$$

$$\sum_s \sum_i \{g(d_{htsi}^N)w_{htsi}\} \quad \text{Contribution of days by person} \quad (19)$$

$$\sum_s \sum_i \{g(N_{hts})w_{htsi}\} \quad \text{Contribution of Growth of Insured Population} \quad (20)$$

Contribution of factors than insured population

$$\begin{aligned} &= g(C_{ht}) - \sum_s \sum_i \{g(N_{hts})w_{htsi}\} \\ &= \sum_s \sum_i \{g(c_{htsi}^D) + g(d_{htsi}^N)\}w_{htsi} \\ &= \sum_s \sum_i \{g(c_{htsi}^N)\}w_{htsi} \end{aligned} \quad (21)$$

Table 1. Growth of Medical Cost by Category (in percent)

	General Inpatient	General Outpatient	General Dental	Aged Inpatient	Aged Outpatient	Aged Dental	All Medical Cost
1981	1.6	0.9	0.3	2.0	1.3	0.1	6.7
1986	0.3	0.8	-0.1	0.9	1.2	0.1	3.4
1991	0.4	0.4	0.1	1.5	1.6	0.2	4.4
1996	0.6	0.2	0.1	1.7	1.3	0.2	3.9

Growth of medical cost is mostly driven by category of “Aged Inpatient” and “Aged Outpatient.”

Table 2. Contributions by Population Growth (in percent)

	General Inpatient	General Outpatient	General Dental	Aged Inpatient	Aged Outpatient	Aged Dental	All Medical Cost
1981	-0.2	-0.3	-0.1	1.0	0.8	0.0	
1986	-0.8	-0.8	-0.2	0.8	0.5	0.0	
1991	-0.5	-0.4	-0.1	1.2	1.0	0.1	
1996	0.2	0.2	0.0	1.5	1.4	0.1	

Growth of medical cost is explained by the increase in aged population.

Table 3. Contribution by Components other than Population Growth (in percent)

	General Inpatient	General Outpatient	General Dental	Aged Inpatient	Aged Outpatient	Aged Dental	All Medical Cost
1981	1.8	1.2	0.4	1.0	0.4	0.1	
1986	1.1	1.6	0.1	0.1	0.6	0.0	
1991	0.8	1.0	0.2	0.3	0.6	0.1	
1996	0.4	0.0	0.0	0.2	-0.1	0.1	

Contribution by components other than population is limited.

Table 4. Contribution by Days per Person (in percent)

	General Inpatient	General Outpatient	General Dental	Aged Inpatient	Aged Outpatient	Aged Dental	All Medical Cost
1981	1.5	0.1	0.1	0.7	0.0	0.0	
1986	1.2	0.7	0.1	0.0	0.1	0.0	
1991	0.1	0.2	0.0	-0.5	0.1	0.1	
1996	-0.5	-0.2	0.0	-1.1	-0.3	0.0	

Contribution of the Day per person is negative for most category.

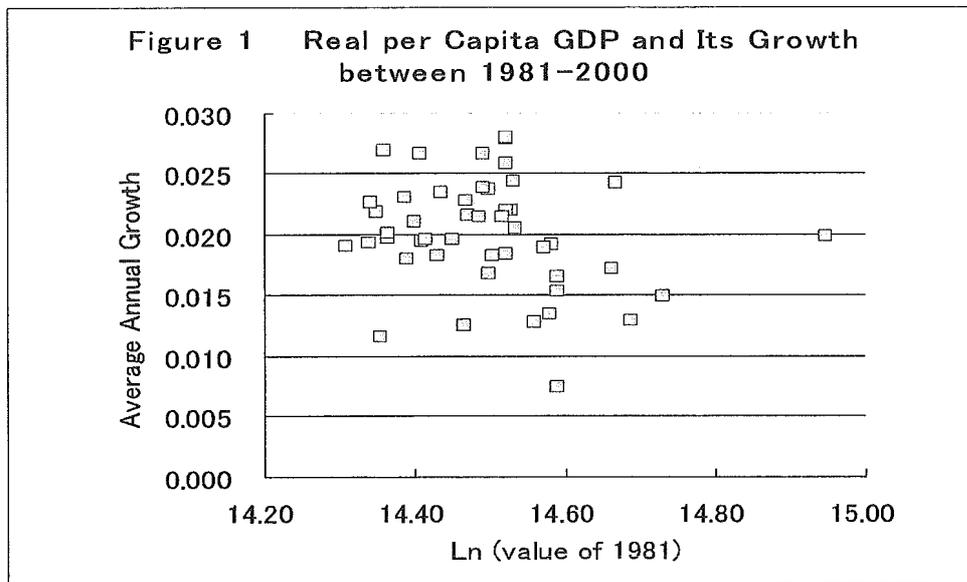
Table 5. Contribution by Cost per Day (in percent)

	General Inpatient	General Outpatient	General Dental	Aged Inpatient	Aged Outpatient	Aged Dental	All Medical Cost
1981	0.3	1.1	0.2	0.3	0.5	0.0	
1986	0.0	1.0	0.0	0.1	0.5	0.0	
1991	0.7	0.8	0.2	0.9	0.5	0.0	
1996	0.9	0.2	0.1	1.2	0.1	0.0	

Contribution of Cost per Day is fairly large for all general inpatient and aged inpatient.

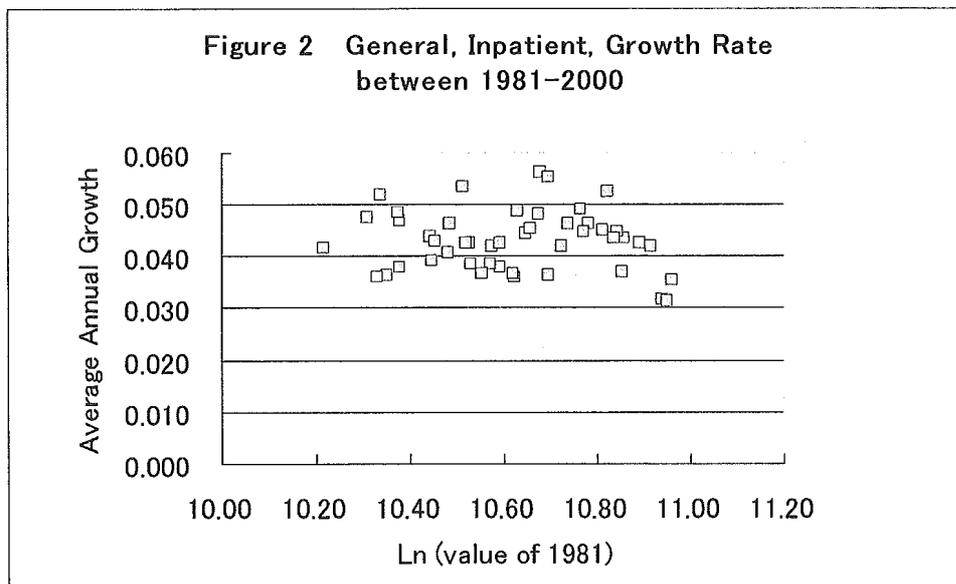
4. Graphical Presentation of Convergence of Medical Expenditure

a. Convergence of Income



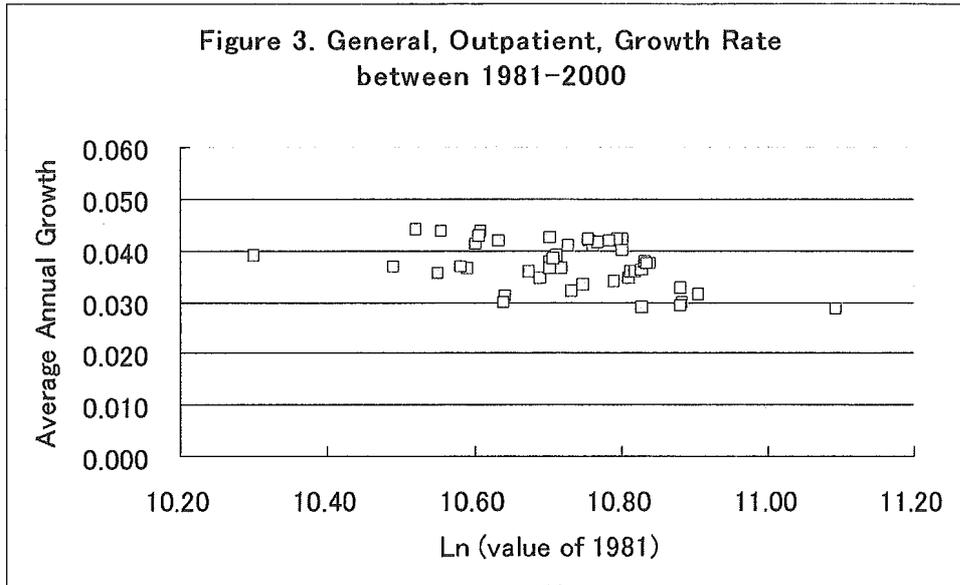
No clear convergence of real per capita GDP

b. Convergence of Medical Cost (General, Inpatient)



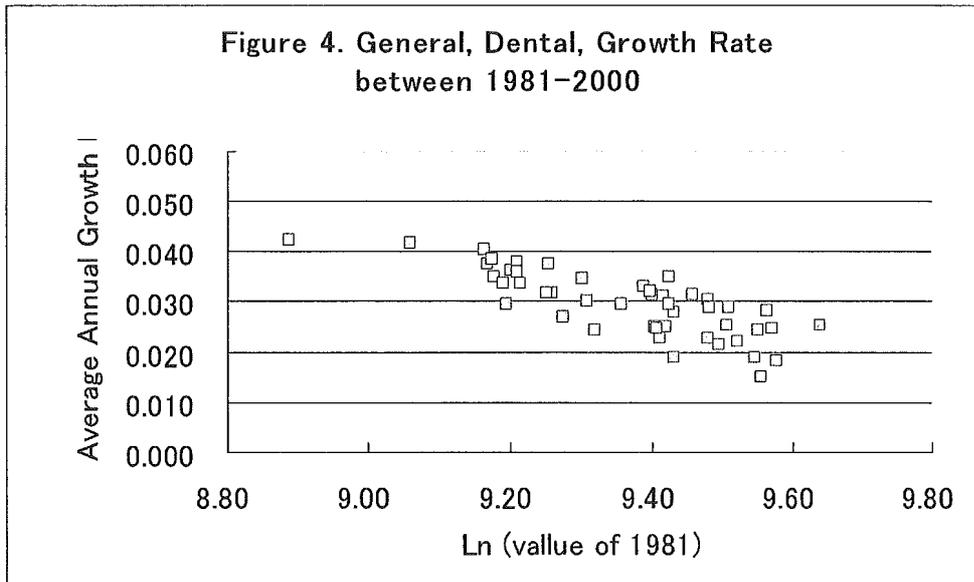
No clear convergence or weak convergence

c. Convergence of Medical Cost (General, Outpatient)



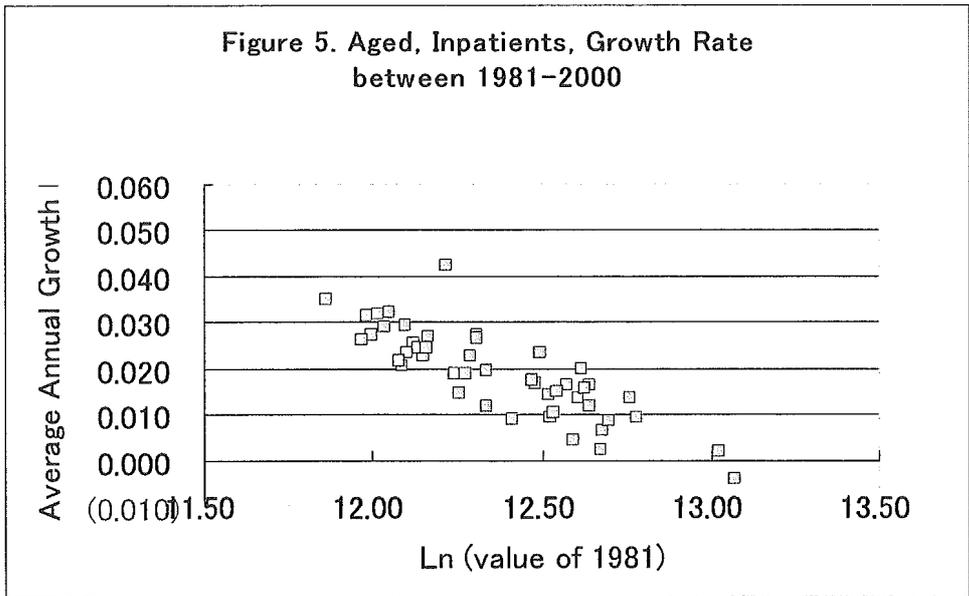
No clear convergence

d. Convergence of Medical Cost (General, Dental)



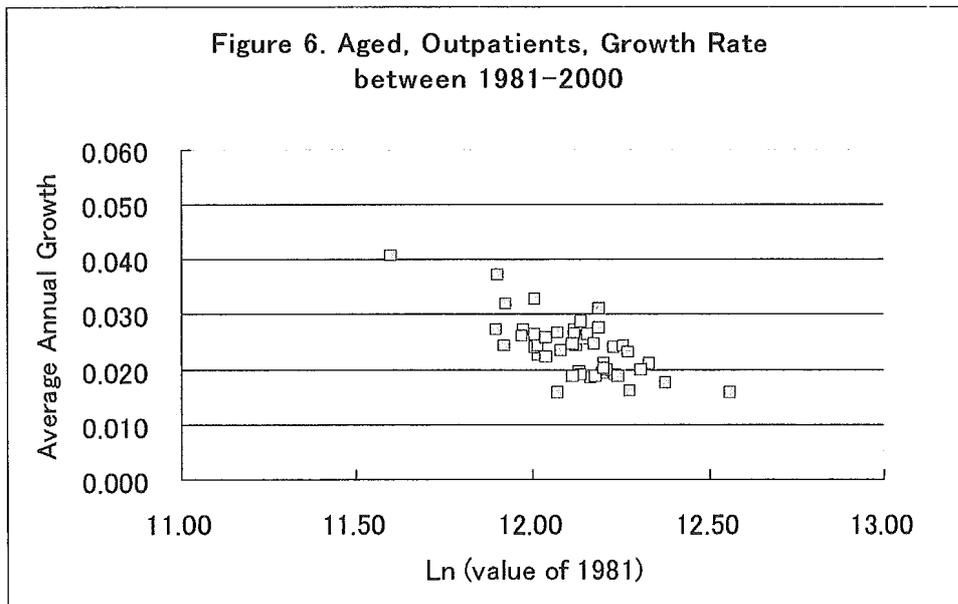
Clear convergence

e. Convergence of Medical Cost (Aged, Inpatient)



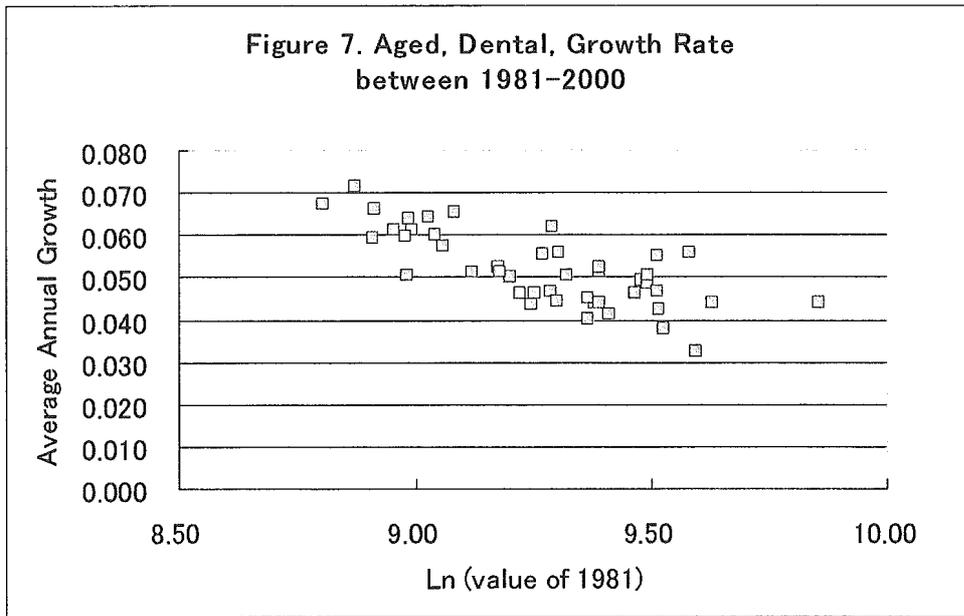
Strong convergence

f. Convergence of Medical Cost (Aged, Outpatient)



Strong convergence

g. Convergence of Medical Cost (Aged, Dental)



Strong convergence

Convergence are found for medical cost for the aged, while it is not found for the general.

4. Estimates of Equation

Table 6. Growth of Medical Cost per Person

Dependent variable is the three year compound average annual growth rate

$$y_{ht} = \alpha + \beta y_{ht-1} + \gamma_1 X_{ht}^1 + \gamma_2 X_{ht}^2 + \gamma_3 X_{ht}^3 + \varepsilon_{ht}$$

	General, Inpatient		General, Outpatient		General, Dental	
	1981-1990	1991-2000	1981-1990	1991-2000	1981-1990	1991-2000
Constant	0.737*** (0.068)	1.822 (1.797)	0.094 (0.063)	- 1.048 (1.528)	0.849*** (0.053)	6.844*** (1.700)
Medical Cost per Person β	-0.067*** (0.006)	-0.161 (0.170)	-0.005 (0.006)	0.106 (0.139)	-0.086*** (0.006)	-0.711*** (0.177)
Physician per Person γ^1	-0.005 (0.004)	-0.048 (0.068)	0.0004 (0.005)	-0.058 (0.070)	0.029*** (0.009)	0.061*** (0.161)
Nurse per Person γ^2	0.012*** (0.002)	-0.137*** (0.03)	0.009*** (0.001)	-0.173*** (0.025)		
Bed per Person γ^3	-0.0001 (0.0005)	0.067*** (0.009)	-0.003*** (0.0006)	0.075*** (0.010)		
Adj.R-Squared	0.186	0.017	0.078	0.016	0.350	0.050
Sample	470	376	470	376	470	376

“General” sample is not explained by the conversion model.

higher “physician per person” has positive effects on medical cost for the “Dental Service.”

“nurse per person” has positive effects on medical cost for the “General Inpatient” and “General Outpatient” in 1981-1990.

“bed per person” has positive effects on medical cost for the “General Inpatient” and “General Outpatient” in 1991-2000.

Table 7. Growth of Medical Cost per Person

Dependent variable is the three year compound average annual growth rate

$$y_{ht} = \alpha + \beta y_{ht-1} + \gamma_1 X_{ht}^1 + \gamma_2 X_{ht}^2 + \gamma_3 X_{ht}^3 + \varepsilon_{ht}$$

	Aged, Inpatient		Aged, Outpatient		Aged, Dental	
	1981-1990	1991-2000	1981-1990	1991-2000	1981-1990	1991-2000
Constant	0.604*** (0.078)	3.416** (1.422)	0.407*** (0.063)	-0.0743 (1.805)	1.245*** (0.079)	4.911*** (0.904)
Medical Cost per Person	-0.046*** (0.006)	-0.276** (0.118)	-0.031*** (0.005)	0.069 (0.147)	-0.133*** (0.008)	-0.509*** (0.095)
Physician per Person	-0.005 (0.005)	-0.013 (0.068)	0.008** (0.003)	-0.056 (0.073)	0.167*** (0.023)	0.160 (0.163)
Nurse per Person	-0.008*** (0.002)	-0.152*** (0.023)	0.004*** (0.001)	-0.167*** (0.023)		
Bed per Person	0.003*** (0.0007)	0.075*** (0.010)	-0.002*** (0.0004)	0.073*** (0.009)		
Adj. R-Squared	0.220	0.017	0.092	0.016	0.320	0.076
Sample	470	376	470	376	470	376

Unlike “General”, “Aged” are well explained by the conversion model.

Nurse per person has negative effects on “medical cost per person.”

5. Conclusion

Geographical variation has been studied by existing literature.

We need to examine convergence of geographical variation.

Japanese data would provide suitable sample for the study.

This preliminary study shows the directions for the future studies.

First, we need to examine “Days per Person”, “Cost per Day” instead of “Cost per Person.”

Second, we need to examine why there is the difference between the “General” and “Aged”

Third, we need to examine the differences across the category of medical services, “inpatient,” “outpatient,” and “dental service.”

Fourth, we need to study the roles of “social capital” represented by “number of physicians per person,” “number of nurses per person,” “number of beds per person.”

II. 研究成果の刊行に関する一覧表

現在刊行準備中である。

書籍

著者氏名	論文タイトル名	書籍全体の 編集者名	書 籍 名	出版社名	出版地	出版年	ページ

雑誌

発表者氏名	論文タイトル名	発表誌名	巻号	ページ	出版年

II. 研究成果の刊行物・別刷

現在刊行準備中である。