d. National Health Insurance Plan

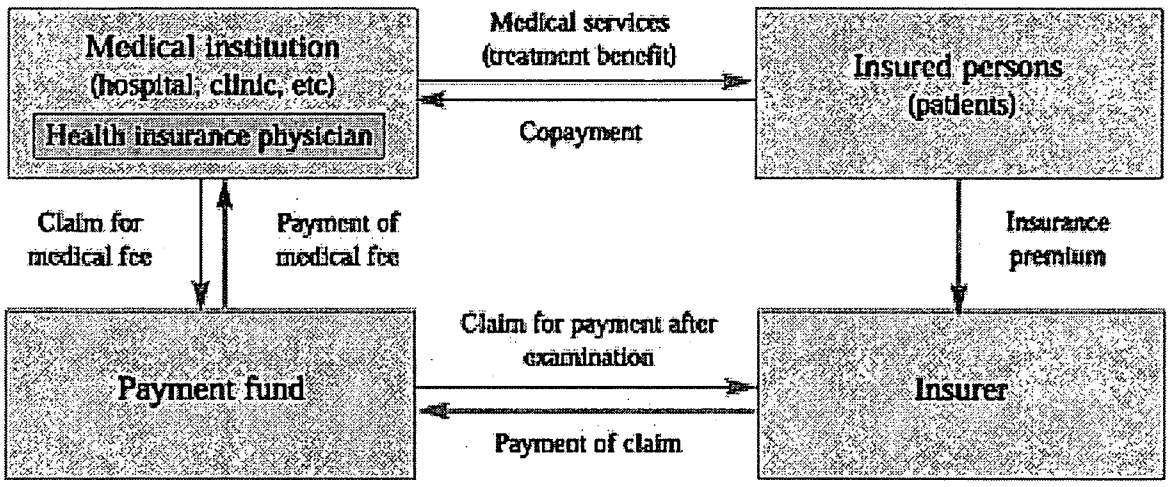


Figure 1. Outline of health insurance payment system.

Source: web of the Japan Pharmaceutical Manufacturers Association(JPMA).

e. Geographical Variation of Medical Cost

Variation of medical expenditure (1998) (actual)

red >= 1.15

pink >= 1.05

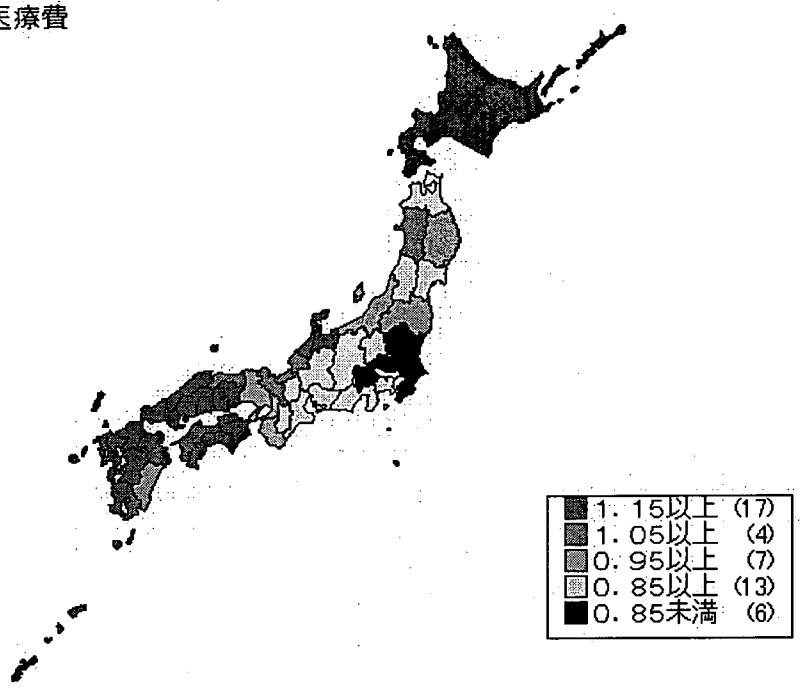
green >=0.95

yellow >=0.85

blue <0.85

平成10年度 国民健康保険医療費マップ

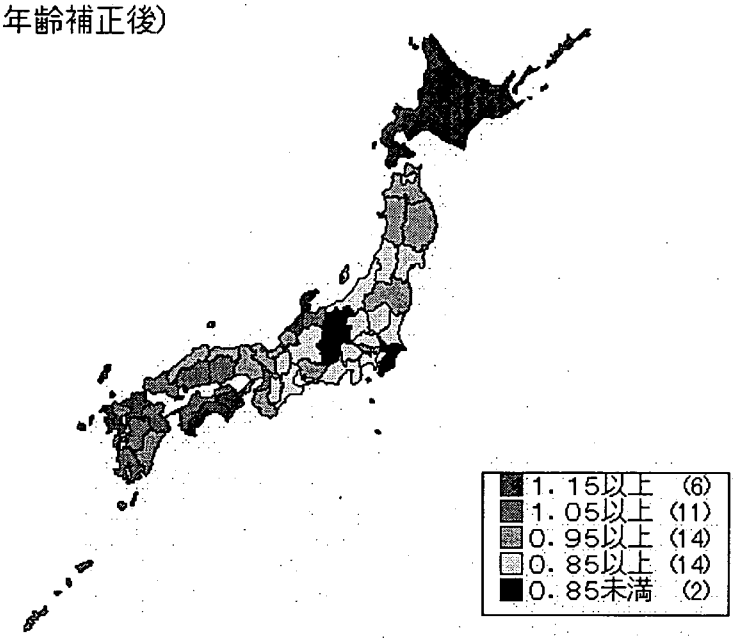
(1) 実績医療費



Variation of medical expenditure (1998) (adjusted for age)

red	**>= 1.15**
pink	**>= 1.05**
green	**>=0.95**
yellow	**>=0.85**
blue	**<0.85**

(2) 地域差指数(年齢補正後)



f. 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 "prefectures" as local areas (PLA)"

medical expenditure C_{htsijk} :

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)

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

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"

$N_{hts} = \sum_{s} N_{hts} = N_{htg} + N_{hta}$, g: general, a: aged.

E_{htsi} : Number of events as medical services

D_{htsi} : Days of medical services

Days per Events $d^{E}_{htsi} = D_{htsi} / E_{htsi}$ (2)

Events per Persons $e^{N}_{htsi} = E_{htsi} / N_{hts}$ (3)

Days per Persons $d^{N}_{htsi} = D_{htsi} / N_{hts}$ (4)

Medical cost per Persons $c^{N}_{htsi} = C_{htsi} / N_{hts}$ (5)

Transformation

$$c^N_{htsi} = \frac{C_{htsi}}{N_{hts}} = \frac{C_{htsi}}{D_{htsi}} \cdot \frac{D_{htsi}}{E_{htsi}} \frac{E_{htsi}}{N_{hts}} = c^D_{htsi} d^E_{htsi} e^N_{htsi} \quad (6)$$

$$c^N_{htsi} = \frac{C_{htsi}}{N_{hts}} = \frac{C_{htsi}}{D_{htsi}} \cdot \frac{D_{htsi}}{N_{hts}} = c^D_{htsi} d^N_{htsi} \quad (7)$$

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

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

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

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

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

$$\Delta c^N_{htsi} = \Delta c^D_{htsi} \cdot d^E_{htsi} \cdot e^N_{htsi} + c^D_{htsi} \cdot \Delta d^E_{htsi} \cdot e^N_{htsi} + c^D_{htsi} \cdot d^E_{htsi} \cdot \Delta e^N_{htsi} \quad (12)$$

$$\frac{\Delta C_{ht}}{C_{ht}} = \sum_s \sum_i \left\{ \left(\frac{\Delta c^D_{htsi}}{c^D_{htsi}} + \frac{\Delta d^E_{htsi}}{d^E_{htsi}} + \frac{\Delta e^N_{htsi}}{e^N_{htsi}} + \frac{\Delta N_{hts}}{N_{hts}} \right) \cdot \frac{C_{htsi}}{C_{hts}} \right\} \quad (13)$$

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

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

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

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

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.

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

$$g(C_{ht}) = \sum_s \sum_i \left\{ \left(g(c^D_{htsi}) + g(d^E_{htsi}) + g(e^N_{htsi}) + g(N_{hts}) \right) \cdot w_{htsi} \right\} \tag{14}$$

$$\frac{\Delta C_{ht}}{C_{ht}} = \sum_s \sum_i \left\{ \left(\frac{\Delta c^D_{htsi}}{c^D_{htsi}} + \frac{\Delta d^N_{htsi}}{d^N_{htsi}} + \frac{\Delta N_{hts}}{N_{hts}} \right) \cdot \frac{C_{htsi}}{C_{hts}} \right\} \tag{15}$$

$$g(C_{ht}) = \sum_s \sum_i \left\{ \left(g(c^D_{htsi}) + g(d^N_{htsi}) + g(N_{hts}) \right) \cdot w_{htsi} \right\} \tag{16}$$

Fundamental relationship

$$g(C_{ht}) = \sum_s \sum_i \left\{ g(c^D_{htsi}) w_{htsi} + g(d^N_{htsi}) w_{htsi} + g(N_{hts}) w_{htsi} \right\} \tag{17}$$

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

3. Sources of Growth of Medical Expenditure

$$g(C_{ht}) = \sum_s \sum_i \left\{ g(c^D_{htsi}) w_{htsi} + g(d^N_{htsi}) w_{htsi} + g(N_{hts}) w_{htsi} \right\} \quad (17)$$

$\sum_s \sum_i \left\{ g(c^D_{htsi}) w_{htsi} \right\}$ Contribution of cost per day (19)

$\sum_s \sum_i \left\{ g(d^N_{htsi}) w_{htsi} \right\}$ Contribution of days by person (20)

$\sum_s \sum_i \left\{ g(N_{hts}) w_{htsi} \right\}$ Contribution of Growth of Insured Population (21)

$$c^N_{htsi} = \frac{C_{htsi}}{N_{hts}} = \frac{C_{htsi}}{D_{htsi}} \cdot \frac{D_{htsi}}{N_{hts}} = c^D_{htsi} d^N_{htsi} \quad (7)$$

Contribution of factors than insured population

$$= g(C_{ht}) - \sum_s \sum_i \left\{ g(N_{hts}) w_{htsi} \right\}$$

$$= \sum_s \sum_i \left\{ (g(c^D_{htsi}) + g(d^N_{htsi})) w_{htsi} \right\}$$

$$= \sum_s \sum_i \left\{ (g(c^N_{htsi})) w_{htsi} \right\}$$

Sample Period

"1981" stands for the period 1981-1986

"1986" 1986-1991

"1991" 1991-1996

"1996" 1996-2001

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

	General Inpatient	General Outpatient	General Dental	Aged Inpatient	Aged Outpatient	Aged Dental	All Medical
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 expenditure are mostly driven by "Aged Impatient", "Aged Outpatient."

Table 2. Contributions by Population Growth (in percent)

	General Inpatient	General Outpatient	General Dental	Aged Inpatient	Aged Outpatient	Aged Dental	All Medical
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 expenditure is explained by the increase in aged population.

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

	General Inpatient	General Outpatient	General Dental	Aged Inpatient	Aged Outpatient	Aged Dental	All Medical
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	

Factors other than population accounts for the growth of medical expenditure

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

	General Inpatient	General Outpatient	General Dental	Aged Inpatient	Aged Outpatient	Aged Dental	All Medical
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	

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

	General Inpatient	General Outpatient	General Dental	Aged Inpatient	Aged Outpatient	Aged Dental	All Medical
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	

Results:

Medical cost 1981-86, 1986-91, 1991-96, 1996-2000, annual growth rate 6.7, 3.4, 4.4, 3.9%

1996-2000 Aged, Inpatient 1.7%, Aged, Outpatients 1.3%

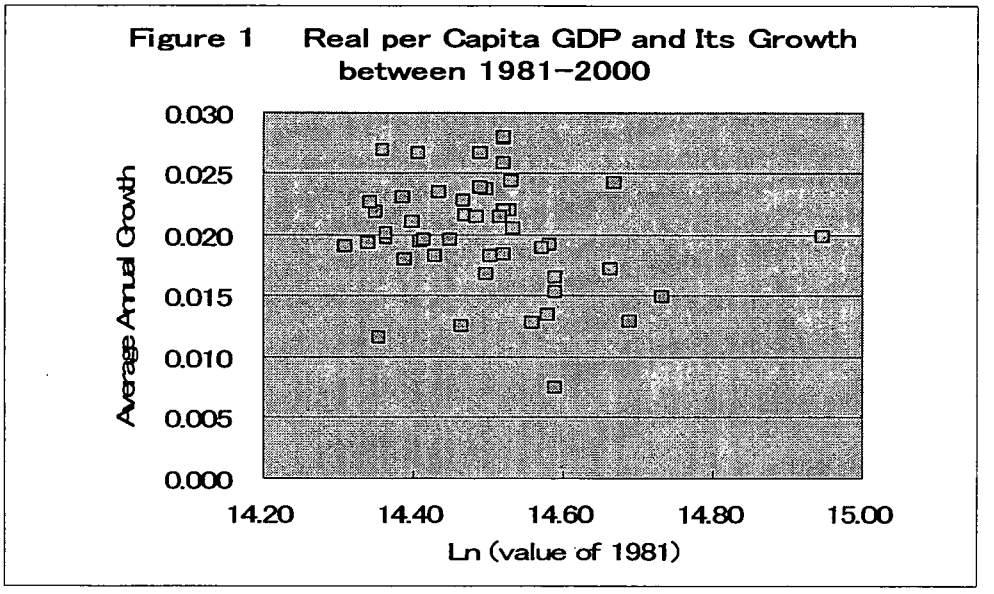
1996-2000 Aged Population contribute 1.5% for Aged, Inpatient, 1.4>%. for Aged, Outpatient

Growth of Insured Population accounts for 3.4% of total growth.

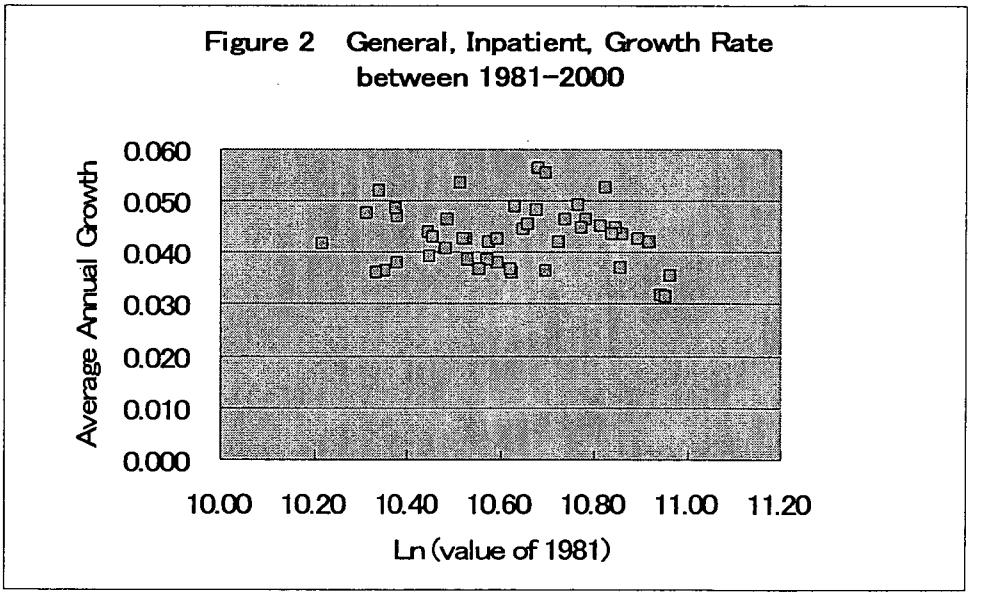
Other factors account only for 0.6%.

4. Graphical Presentation of Convergence of Medical Expenditure

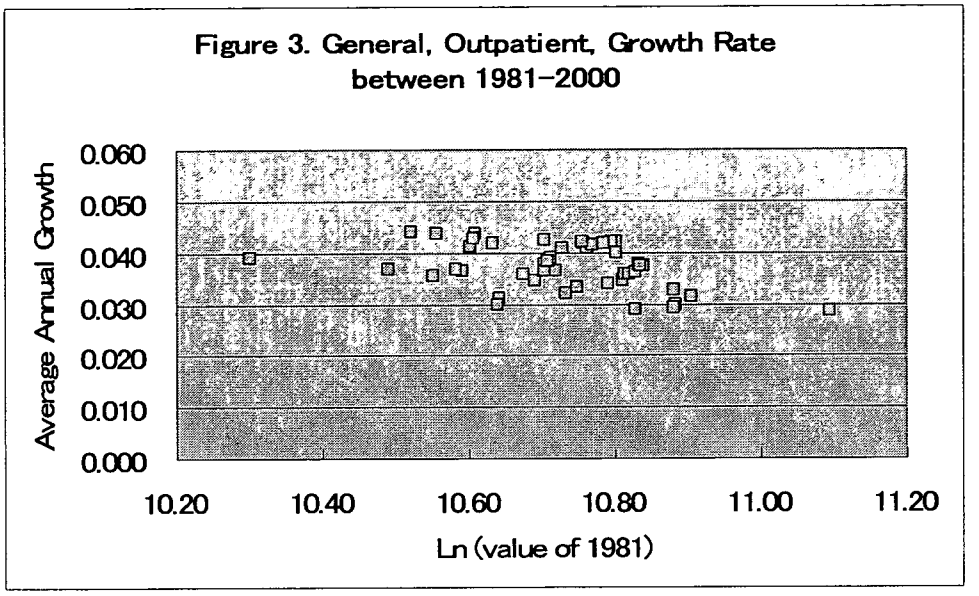
a. Convergence of Income



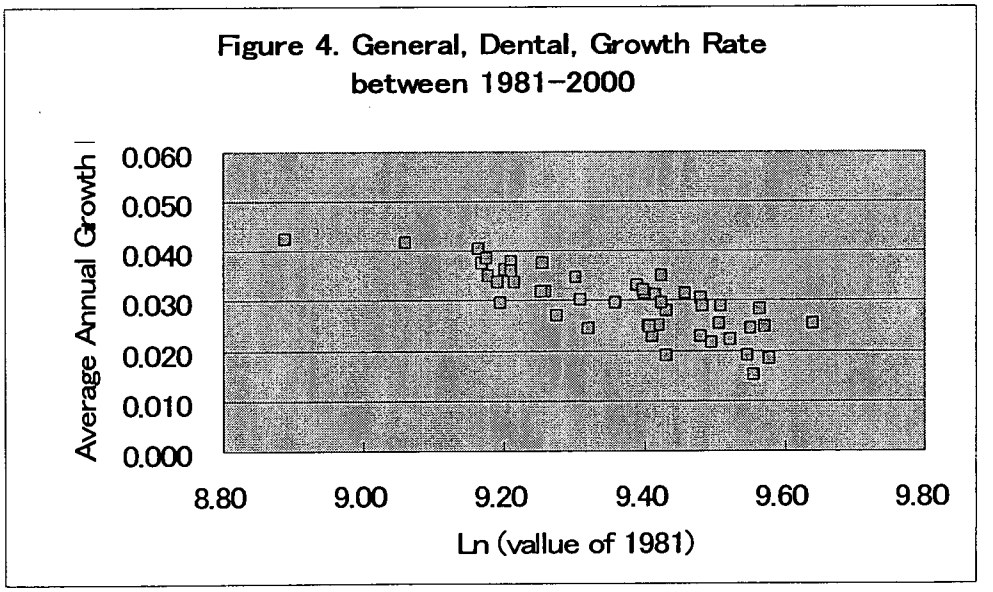
b. Convergence of Medical Cost (General, Inpatient)



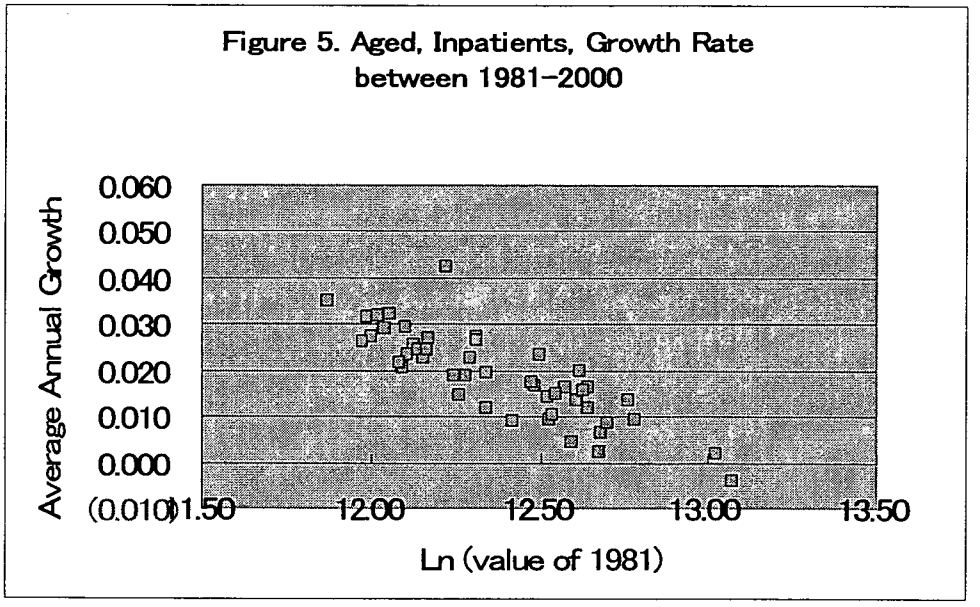
c. Convergence of Medical Cost (General, Outpatient)



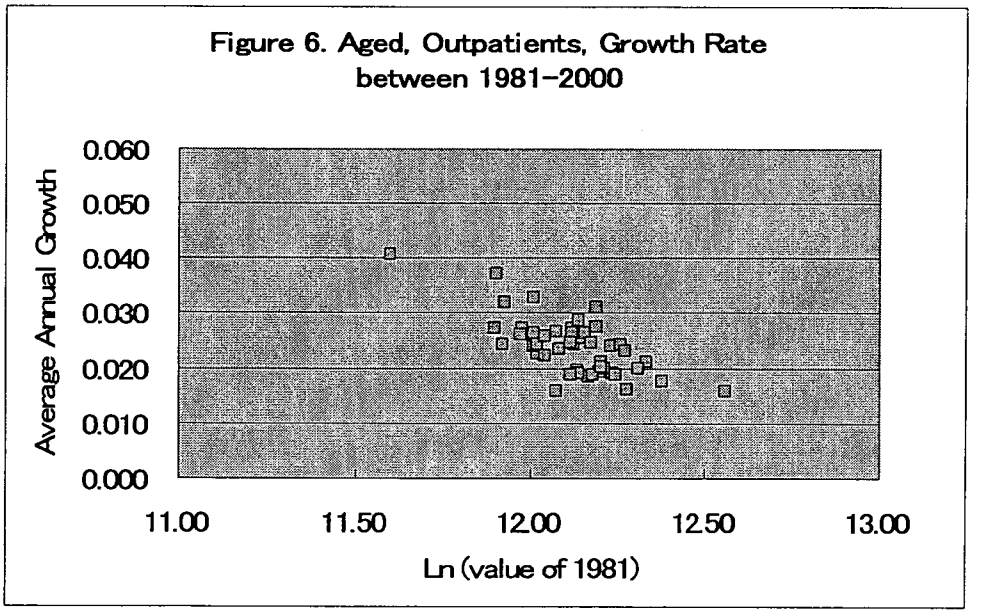
d. Convergence of Medical Cost (General, Dental)



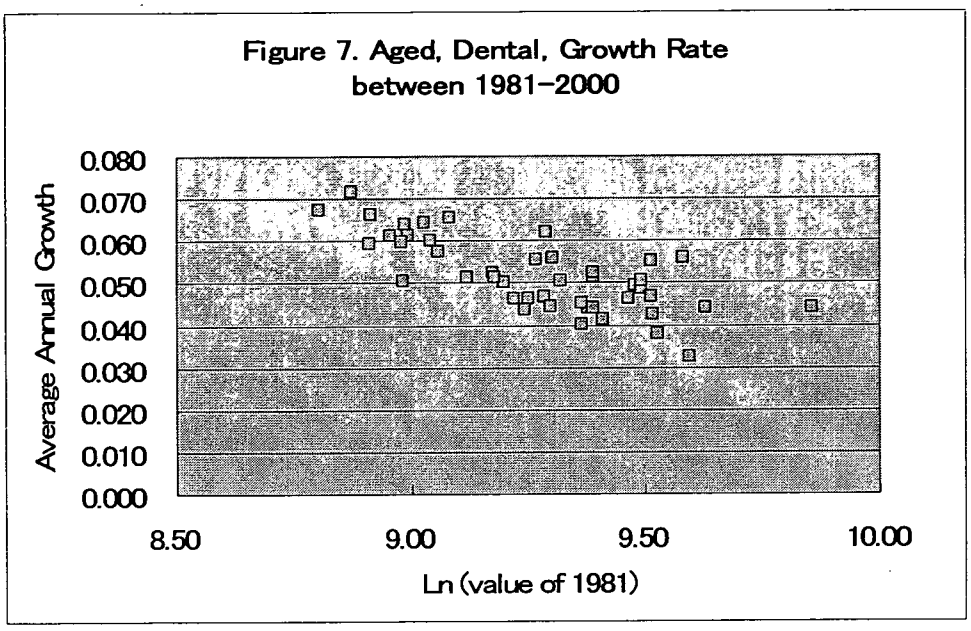
e. Convergence of Medical Cost (Aged, Inpatient)



f. Convergence of Medical Cost (Aged, Outpatient)



g. Convergence of Medical Cost (Aged, Dental)



5. Roles of Social Overhead Capital

a. Correlation Matrix

Table 5. Correlation Matrix of Social Overhead Capital

1981-1990	BED_POP	PHYSICIAN_POP	NURSE_POP	PHYSICIAN_BED	NURSE_BED	PHYSICIAN_NURSE
BED_POP	1.00	0.57	0.90	-0.66	0.19	-0.63
PHYSICIAN_POP	0.57	1.00	0.68	0.20	0.26	0.07
NURSE_POP	0.90	0.68	1.00	-0.49	0.23	-0.66
PHYSICIAN_BED	-0.66	0.20	-0.49	1.00	0.40	0.87
NURSE_BED	-0.19	0.26	0.23	0.40	1.00	-0.09
PHYSICIAN_NURSE	-0.63	0.07	-0.66	0.87	0.09	1.00
1991-2000	BED_POP	PHYSICIAN_POP	NURSE_POP	PHYSICIAN_BED	NURSE_BED	PHYSICIAN_NURSE
BED_POP	1.00	0.61	0.90	-0.71	0.37	-0.60
PHYSICIAN_POP	0.61	1.00	0.70	0.08	0.07	0.05
NURSE_POP	0.90	0.70	1.00	-0.55	0.05	-0.66
PHYSICIAN_BED	-0.71	0.08	-0.55	1.00	0.50	0.85
NURSE_BED	-0.37	0.07	0.05	0.50	1.00	-0.03
PHYSICIAN_NURSE	-0.60	0.05	-0.66	0.85	0.03	1.00

5. Estimates of Equation

Table 7 Growth of Medical Cost per Person (three year average annual growth rate)

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

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

Summary of Findings

"General"sample is well not explained by this model.

"Aged" sample is well explained.

PLA with higher "physician per person" has induced higher medical cost.

Conversion of the medical cost.

Table 8. Growth of Medical Cost per Person (three year average annual growth rate)

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

6. Conclusion

Equation for Cost per Day

$$y_{hti} = C_{htsi} / D_{htsi}$$

$$C_{ht} / D_{ht} = \alpha + \beta (C_{ht-1} / D_{ht-1}) + \gamma_1 X^1_{ht} + \gamma_2 X^2_{ht} + \gamma_3 X^3_{ht} + \varepsilon_{ht}$$

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

X^1_{ht} **Gen. Inpatient Days/Person, Gen. Outpatient Days/Person**
Aged_Inpatient Days/Person, Aged Outpatient Days/Person

X^2_{ht} **Gen Inpatient Cost/Day, Gen Outpatient Cost/Day**
Aged Inpatient Cost/Day, Aged Outpatient Cost/Day

X^3_{ht} **PHYSICIANS/POP, NURSES/POP, BEDS/POP, AGED/POP**
PHYSICIANS/BED, NURSES/BED, PHYSICIANS/NURSE

Estimation of equation using pooled data of 1983-1991 and 1992-2000

Instrumental Variable Estimation

National Health Insurance Plan (NHIP) consist of various insurance plans. National They are which differ in types of insured and are classified into

General Insured

Aged Insured

Retirees and their relatives

(資料3)

Price Regulation of Pharmaceutical Products

- National Health Insurance and Efficiency of R&D-

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2008