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HEALTHCARE EXPENDITURE AND THE MAJOR DETERMINANTS IN JAPAN

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Abstract

This paper estimates healthcare expenditure functions by age groups and in-/outpatient in order to find the determinants of healthcare expenditure in Japan. The result underpins existing studies which point out the significance of income as a determinant, but also suggests that (1) difference of the per capita medical expenditure among the prefectures is mainly due to disparities of the number of beds and doctors per capita, (2) it can be significantly explained by widespread medical high technology.

Key words: Healthcare expenditure; Japanese healthcare system; Categorization of patients; Regional variations; Income elasticity
JEL classification: H51; I11; I18

I. *Introduction*

The purpose of this paper is to improve previous analyses in the field of healthcare expenditure function applying to the Japanese healthcare system with some new elements. In

the literature on this area of study are several critical problems often pointed out in particular concerning international differences in prices of medical services and their heterogeneity across countries. However, the Japanese health care system is favorable to the analysis due to its characteristics: fee-for-service system and uniform fee schedule for individual services across the country. Furthermore, to alleviate the problem on the heterogeneity to some degree, the paper tries to categorize the Japanese domestic data on medical spending into four parts by age group and by type of medical care.

In the context of this field, Newhouse (1977) is the most influential and widely-quoted paper and, therefore, used as the starting point for a critique. Newhouse reached the following results: 1) income can explain the great majority of variance in per capita healthcare expenditure across developed countries and 2) the income elasticity exceeds one (a luxury good). Following this seminal article, most studies using international cross-section data have consequently confirmed its empirical results. For example, Leu (1986) extended Newhouse' analysis to inquire whether other variables than income have any significant impact on healthcare expenditure: the share of the elderly in the population, the share of public financing and delivery, dummies for centralized systems and so on. Leu insisted that non-income variables are significant, but of minor quantitative importance, and income elasticity exceeds one.

Including Leu, some modifications to the initial methodology have been introduced by a number of recent studies through the use of OECD data: inclusion of other explanatory variables, selection of conversion factors, improvement in sample size and renewal of data, theoretical interpretation about macro-data results, and so on. However, there still remain some critical problems to be solved described below.

First, in using international cross-section data, conversion problems emerge as serious particularly in the case of non-tradable goods like health care. Which deflators should be employed, exchange rates, GDP PPP (Purchasing Power Parity), or health PPP? Whether or how would the selection of deflators affect empirical results or not? Parkin, McGuire, and Yule (1987) suggest that income elasticity is sensitive to different conversion factor assumption (exchange rates or PPP) for 1980 OECD data, and in particular that the use of PPP reduces the elasticity below unity.

On the other hand, Gerdtham and Jönsson (1991) indicate that income elasticity is significantly greater than one, no matter which conversion factor (health PPP, GDP PPP or exchange rates) is employed for 1985 OECD data. However, they also point out the following: "We should not forget that greater uncertainty attaches to the calculation of PPPs, especially when it comes to health PPPs. Attempts to develop such health PPP measure are still in their infancy. For this reason, PMYs (Parkin, McGuire, and Yule) results - and indeed our own, too - have to be treated with extreme caution" [Gerdtham and Jönsson(1991, p.234)].[1]

Second, there are some statistical problems about the estimation of healthcare expenditure function by the use of OECD data. Earlier studies are based on relatively small sample sizes, so that the problems emerge in the estimation and analysis. Hitiris and Posnett (1992) use a relatively large data set, i.e., a pooled sample of cross-section and time-series observations, and also introduce a set of shift dummies for grouped countries. The results support previous studies, and show the significance of the shift dummies reflecting country-specific factors

[1] The health PPP Gerdtham and Jönsson (1991) employ is made in 1985. This deflator is also different from one in 1990 [see OECD (1995)].

which cause variations in medical spending. This significance, although several possible explanations are provided in the paper, suggests further investigation into institutional features on healthcare system at each country's level.

Finally, the use of international cross-section data, i.e., OECD health ones, faces serious problems on the definition of health expenditure. Within OECD countries, the coverage of health systems differs (e.g., social services, school health, environmental health, etc.), and there are no universally accepted definitions of various medical institutions: hospitals, clinics, nursing homes, etc. Therefore, the scope of measurement for health expenditure would differ across countries [OECD (1987, 1993, and 1995)]. As pointed out by OECD (1993, p.103), "health-care delivery systems vary genuinely and considerably across the OECD area, and the available data respond to heterogeneous statistical boundaries".

Furthermore, as pointed out by many health economists [Parkin, McGuire, and Yule (1987), Culyer (1989), and so on], there is a diversity and heterogeneity concerning health care. Medical services vary greatly in the mix of services provided, so that analyses of efficiency are hampered by comparing countries which produce essentially different products.

Some of these problems described above are accompanied by the use of international cross-section data.[2] Therefore, to alleviate these to some degree, this paper uses domestic, however aggregate, health data instead of OECD ones to estimate healthcare expenditure function. In order to draw more attention to the heterogeneity in medical services, we try to categorize the Japanese domestic data on medical spending into four parts by age group and by type of medical care.

The plan of this paper is as follows. Next section provides information on the Japanese healthcare system and makes clear key issues related to the differences in medical expenditure. Section 3 presents analytical framework for an econometric approach and introduces common and specific independent variables for estimation. Section 4 shows the empirical results and presents their economic implications.

II. *Background and key issues*

1. Japanese Healthcare System

i. Medical Insurance Schemes

The Japanese healthcare insurance schemes could be categorized into two main groups: (1) Employees' Health Insurance for employees of private firms and public organizations, and their dependents; (2) National Health Insurance (NHI) for the self-employed, retirees, and their dependents.[3] Under these schemes, all people (employees and habitants) are guaranteed to access to health services everywhere across the country.

In 1983, Health and Medical Services Law for the Elderly came into force. Afterwards, as far as the elderly (people aged 70 or over and the bedridden people aged 65 or over) are

[2] Except the problems described in the text, a critical one over theoretical interpretation of empirical results still remains due to the use of aggregate data. In this respect the following studies are useful: Parkin (1991), Parkin et al. (1986, 1987), Newhouse (1987), Parkin, McGuire, and Yule (1987), and McGuire et al. (1993).

[3] The total number of the enrollees covered by the NHI is about 43 million, a third of the population, in 1993.

concerned, they are allowed to participate in the Health Services Scheme for the Aged (HSSA). They participate in not only one of two main insurance schemes described above, but also HSSA. The participants can obtain the benefit of receiving health services at relatively low copayment compared with the non-elderly.[4] This benefit is provided by HSSA through the mandatory contributions from all other insurance schemes as well as subsidy revenues from the national and local governments.

This paper employs the data on NHI at prefectural level which include the elderly and non-elderly people respectively. Especially, the former also have the eligibility for participating in the HSSA, so that they actually differ from the non-elderly in terms of copayment for inpatient and outpatient care. Taking these institutional conditions into consideration, it is necessary to separate their health expenditures into at least two categories, i.e., elderly and non-elderly.

ii. Delivery System and Reimbursement

This section presents some features on the Japanese delivery system of which some are common to OECD countries and others specific to Japan. In particular, in the context of estimating healthcare expenditure, it is worthwhile to point out the following distinct features on the Japanese delivery system of health services and their reimbursements [see Tokita, ed. (1995) in detail].

First, under Japan's universal health insurance system, all medical care providers[5] are reimbursed for the expenses incurred through delivering services according to the fee-for-service payment schedule. The detailed schedule represents officially determined fees for individual services, e.g., consultation, medication, laboratory tests and radiology and so on, and apply to all medical institutions around the country. As a result, differences in medical expenditures, other conditions being equal, would reflect differences in the quantity of individual services. This uniform fee schedule is favorable to the analysis of healthcare expenditure function.

Second, as the reimbursement for medical institutions is mainly based on fee-for-service schedule, it is worthwhile to investigate effects of supply-factors, i.e., the number of beds and doctors, on healthcare expenditures. Because fee-for-service system is supposed to be one of necessary conditions for the supply induced-demand hypothesis [OECD (1996)]. In this respect, the Japanese system is interesting as she still uses fee-for-service system in a wide range of medical services compared with other OECD countries.

Finally, although Japan is expected to be most rapidly approaching the highest aged society among OECD countries, the government does not have accomplished long-term care system enough for the elderly so far. Due to the shortage of the facilities such as nursing homes and/or insufficiency of the delivery system of home care, adult day care, and social support services, some of the elderly patients who need care not cure have been hospitalized in the health sector.[6] The medical institutes in a sense are substitutes for nursing home facilities. This

[4] The total medical expenditure for the elderly covered by HSSA is 7.5 trillion yen in 1993. Their copayments amount to about 30 million yen, i.e., about 4 percent of the total expenditure.

[5] This paper deals with hospitals and general clinics except dental ones.

[6] This phenomenon is called "syakaiteki nyuuin" (hospitalization due to social, not medical, conditions) of which the number is about 270,000 in 1993. They stay in hospitals or clinics in more than 6 month. This long-term hospitalization makes Japan be notorious for many bedridden patients in medical facilities.

TABLE 1. DIFFERENCES IN THE PER CAPITA MEDICAL EXPENDITURE, 1991-93

1991		Mean	STD	CV
Elderly				
inpatient care	M_{11}	313,481	77,333	0.247
outpatient care	M_{12}	249,253	33,312	0.134
Non elderly				
inpatient care	M_{21}	63,584	12,591	0.198
outpatient care	M_{22}	63,870	6,659	0.104
1992		Mean	STD	CV
Elderly				
inpatient care	M_{11}	330,598	79,498	0.240
outpatient care	M_{12}	255,582	33,593	0.131
Non elderly				
inpatient care	M_{21}	71,389	14,298	0.200
outpatient care	M_{22}	67,433	6,924	0.103
1993		Mean	STD	CV
Elderly				
inpatient care	M_{11}	332,529	78,823	0.237
outpatient care	M_{12}	267,120	34,698	0.130
Non elderly				
inpatient care	M_{21}	74,137	15,301	0.206
outpatient care	M_{22}	69,872	7,380	0.106

Notes: M is the per capita medical expenditure at the prefectural level. STD is the standard deviation and CV the coefficient of variation (=STD/Mean).
Source: Ministry of Health and Welfare, "Annual Report on the National Health Insurance Scheme."

institutional situation should be taken into consideration in the estimation of healthcare expenditure function.

2. Differences in Medical Expenditures and Key Issues

Japan is divided into 47 prefectures and 3,235 municipalities, and these municipalities run National Health Insurance (NHI) for their inhabitants' health. As far as the data, aggregate at the prefectural level, on the NHI is concerned, it is often pointed out that the per capita medical expenditure varies across prefectures and is higher in the western areas than in the eastern. This variation across the country might reflect inefficiency in the Japanese delivery system of medical services. Therefore, this investigation is important in the context of health policy as well as theoretical analysis.

First of all, let us turn to the analysis of descriptive statistics on the per capita medical expenditure across prefectures. The per capita medical expenditure in this paper is defined as M_{ij} where i (=1 or 2) represents the elderly or non-elderly, and j (=1 or 2) does in- or outpatient care.[7] From Table 1, the following observations can be made regarding the per capita medical expenditure for the elderly and non-elderly. First, the inpatient expenditure for the elderly (M_{11}) is approximately five times higher than that for the non-elderly (M_{21}), and the outpatient expenditure for the elderly (M_{12}) about four times higher than that for the

[7] Medical expenditures for the retired employees aged up to 69 are excluded from those for the non-elderly (M_{21} and M_{22}). The reason is that the former are covered by the NHI but are different from other non-elderly persons in their copayment due to the Retiree's Medical Insurance System.

TABLE 2. CORRELATION BETWEEN MEDICAL EXPENDITURES BY AGE GROUP AND BY TYPE OF SERVICES, 1991-93

1991			M_{11}	M_{12}	M_{21}	M_{22}
Elderly	inpatient care	M_{11}	1			
	outpatient care	M_{12}	0.278	1		
Non elderly	inpatient care	M_{21}	0.711	0.078	1	
	outpatient care	M_{22}	0.269	0.765	0.479	1
1992			M_{11}	M_{12}	M_{21}	M_{22}
Elderly	inpatient care	M_{11}	1			
	outpatient care	M_{12}	0.260	1		
Non elderly	inpatient care	M_{21}	0.697	0.085	1	
	outpatient care	M_{22}	0.250	0.765	0.496	1
1993			M_{11}	M_{12}	M_{21}	M_{22}
Elderly	inpatient care	M_{11}	1			
	outpatient care	M_{12}	0.249	1		
Non elderly	inpatient care	M_{21}	0.693	0.075	1	
	outpatient care	M_{22}	0.229	0.749	0.491	1

Notes: M is the per capita medical expenditure at the prefectural level.
Source: Ministry of Health and Welfare, "Annual Report on the National Health Insurance Scheme."

non-elderly (M_{22}). Second, the coefficient of variation for inpatient care is higher than that for outpatient care and, what is more important, the coefficients of the elderly expenditures for both in- and outpatient care are much higher than those of the non-elderly.

Next, let us focus on the correlation between medical expenditures by age group and by type of services. Table 2 shows that the positive correlation is comparatively high between M_{11} and M_{21} or between M_{12} and M_{22}, but not so high between M_{11} and M_{12} or between M_{21} and M_{22}. That is, in the prefectures where inpatient spending for the elderly is high, so is inpatient spending for the non-elderly. This feature also holds for outpatient spending. However, in the prefectures where inpatient spending for the elderly (or non-elderly) is high, the outpatient one for the elderly (or non-elderly) is not always so high. Thus, these results suggest that we have to take account of the characteristics of medical services, i.e., inpatient or outpatient care, in analyzing the determinants of healthcare expenditure.

In sum, there is a wide range of differences between the per capita medical expenditures classified by age group and by type of services (also see appendix with regard to their components). Therefore, as we analyze the determinants of medical expenditure at the prefectural level, it is requisite to categorize medical expenditure in terms of age and services in order to clarify the variations across prefectures.

III. *Model*

1. Analytical Framework

What kind of factors would influence medical expenditures at the prefectural level? There is no straightforward theory to rely on in this respect, but most studies on the determinants of

health care expenditure across countries suggest some major explanatory variables [Newhouse (1977), Leu (1986), Gerdtham et al. (1992), Hitiris and Posnett (1992), OECD (1995), and so on]. Among them there are some variables commonly employed by these studies: income, age structure, public provision (or finance) of medical care, the number of doctors and so forth.

Our paper follows this line of research but differs from previous studies in some distinct ways. First, the per capita medical expenditure is categorized by age (the elderly or non-elderly) and by type of medical services (in- or outpatient care) described in section 2. Therefore, the fundamental equations for estimation are of four types. Second, owing to this categorization, some additional variables that are of interest are included in each equation: those representing in- or outpatient care, and those representing institutional characteristics concerning the current health care system.

Our model of health care expenditure can be written in the following way:

$$\ln M_{ij}=\alpha+\alpha_1\ln X_{ij1}+\alpha_2\ln X_{ij2}+\cdots+u_{ij} \qquad (1)$$

where i (=1 or 2) representing the elderly or non-elderly
j (=1 or 2) representing in- or outpatient care

This regression model is composed of four equations (M_{11}, M_{12}, M_{21} and M_{22}): M_{11}, for example, is the equation for inpatient expenditure for the elderly. Therefore, regression analysis is applied independently to each equation. As far as the independent variables (X) are concerned, they can be classified into common and specific variables. The former are per capita income, the number of doctors, the share of public provision and medical technology. The latter are the variables characterized by the age structure and by type of medical services provided.

2. Independent Variables

Let us specify the independent variables and explain why they should be included in the estimation under the current health care system. They are referred to as common and specific independent variables described above. However, this categorization actually is not clear. For example, the public provision variable is included in both in- and outpatient equation, but the data actually employed for the public provision is not the same. The former is measured by public share in total number of beds (PUBBED) and the latter by public share in total medical facilities (PUBMED). In a sense, they might be referred to as specific factors to in- and outpatient care respectively.

i. Common Variables

Let us explain the common independent variables which should be included in all equations irrespective of age group or type of services. These variables are income, the number of doctors, the share of public provision, medical technology and the age structure (table 3).

First, income is measured by the prefectural income per capita and is expected to have a positive effect on medical expenditure. As far as the income elasticity of health care is concerned, according to most of the studies using international cross-section data, their results are greater than unity [Newhouse (1977), Gerdtham et al. (1992), and Hitiris and Posnett

TABLE 3. VARIABLES AND THEIR DEFINITIONS

Variable	Definition
Dependent variables	
1. M_{11}	Medical expenditure of inpatient care for the elderly
2. M_{12}	Medical expenditure of outpatient care for the elderly
3. M_{21}	Medical expenditure of inpatient care for the non-elderly
4. M_{22}	Medical expenditure of outpatient care for the non-elderly
Independent variables (common factors)	
5. NPI	Prefectural income
6. DOC	Number of total doctors per 1.000
7. CT	Number of CT-scanners
8. ICU	Number of Intensive Care Units and Coronary Care Units
9. POP60	Proportion of those aged 60-69 to total of the non-elderly (%)
10. DUM	Dummy variable for Tokyo
(specific factors)	
11. BED	Number of total beds in medical facilities (i.e., hospitals and clinics)
12. BED2	Number of beds except those in Geriatric Hospitals
13. PUBBED	Public share in total beds (%)
14. MED	Number of medical facilities
15. PUBMED	Public share in total medical facilities (%)
16. HSF	Number of admission to Health Services Facilities
17. SNH	Number of admission to Special Nursing Homes
18. SUB	Number of admission to HSF and SNH

Notes: All variables are measured in terms of per capita except ratios.

Source: 1.2.3.4.: Ministry of Health and Welfare, "Annual Report on the National Health Insurance Scheme."
5.: Economic Planning Agency, "Annual Report on Prefectual Accounts."
6.: Ministry of Health and Welfare, "Survey of Doctors, Dentists and Pharmacists."
7.8.11.12.13.14.15.: Ministry of Health and Welfare, "Survey of Medical Care Institutions."
9.: Management and Coordination Agency, "Population Estimates"
16.: Ministry of Health and Welfare, "Annual Report on Health Services Facilities for the elderly."
17.: Ministry of Health and Welfare, "Survey of Social Welfare Institutions."
18.: Ministry of Health and Welfare, "Annual Report on Health Services Facilities for the elderly", and "Survey of Social Welfare Institutions."

(1992)].[8] However, the theoretical interpretations and implications of the estimated elasticities are controversial due to inappropriateness of the data and methods used to calculate them [Parkin (1991), McGuire et al. (1993)].

The number of doctors (DOC) is expected to have a positive effect on medical expenditure although it is very difficult to interpret its economic implications. This variable has often been employed to test the supplier-induced demand or target income hypothesis [Evans (1974)]. Even if empirical relationships between the stock of physicians and the rate of utilization for medical resources are observed,[9] these findings are often not accepted as an

[8] OECD (1995) showed that the income elasticity lie between 0.7 and 0.8. As regard to the studies on national micro data, the results have revealed a low income elasticity for the utilization of health care across households [Wagstaff (1986), Manning et al. (1987)].

[9] The following indicators are usually employed as the rate of utilization: hospitalization rates, the number of surgical operations, average length of stay in hospital or medical spending per patient and so forth.

unambiguous evidence in favor of the hypothesis. The observed relationships may reflect true demand factors, for instance, more doctors may mean improvement in availability to health care, i.e., less distance to travel and less time to wait.[10] Therefore, the empirical results found should be treated with considerable caution.

The ratio of public medical institutions or their beds to the total number (PUBMED or PUBBED) is employed to investigate the impact of public provision on health care expenditure. Leu (1986) argued that public provision increases health care expenditure due to the bureaucratic inefficiency and less intensive competition in public sector. There are some arguments against his view. For example, Culyer (1989) notes that medical costs in the private sector may be larger due to advertising and selling costs, and that market pressures may be less reliable than professional ethics and governmental regulations. Actually, OECD (1987, 1995) report negative signs on healthcare expenditure per capita.

In this respect, when it comes to the Japanese delivery system of medical services, there are some complicated conditions specific to the system. Public institutions should be responsible for ensuring medical services to every citizen anywhere across the country. In consequence, some should be located in remote or sparsely populated areas since private institutions could not deliver medical services there. Considering such complementariness between the public and private sectors, the sign of PUBMED or PUBBED on health expenditure could not be determined a priori.

As an indicator of the development of medical technology, the number of CT-scanners (CT) is employed, which is expected to be one of the major cost-increasing factors. In Japan the purchase of CT-scanners is left to the discretion of individual medical institutions and, moreover, reimbursement fee for this service is also believed to be set at a generous level. Consequently, we have now too many CT-scanners, and even the small clinics have ones. Thus, this variable is expected to contribute to higher medical cost, but we cannot say whether it has significantly positive effect on inpatient, outpatient, or both care costs. The reason is that it could often be applied to not only inpatients but also outpatients as a diagnostic technique. In addition, the total number of Intensive Care Units and Coronary Care Units (ICU) is also employed as a substitute for CT variable particularly in the estimation of inpatient care expenditure.

The age structure of the population is generally considered to be one of the major determinants since the consumption of health care is unevenly distributed over the life-cycle.[11] Furthermore, Japan is expected to be most rapidly approaching the highest aged society among OECD countries. Our previous study [Tokita et al. (1997)], compared with the results of other OECD countries [OECD (1995)], suggests that the ageing factor has significantly positive effect on healthcare expenditure over the next 30 years. In this respect, Japan is a little different from other OECD countries. Ageing factor particularly in Japan should be examined more cautiously and with high priority in the context of research on healthcare expenditure.

In this paper, the elderly and non-elderly equations are estimated separately, so that the age structure is taken into consideration to some extent. Furthermore, since the non-elderly include a wide range of age structure, i.e., those people aged 69 and below, it is necessary to

[10] As for the costs of access to medical services in the Japanese healthcare system, see Chino (1995).

[11] According to the Ministry of Health and Welfare (1995), the per capita medical expenditure during the lifetime for the average Japanese amounts to about 17 million yen in 1992 price. About 62 percent of this amount is spent after the age of 60.

include an indicator reflecting age structure for the non-elderly equation with the ratio of those aged from 60 to 69 in the non-elderly population (POP60) included.

ii. Specific Variables

Let us explain the specific independent variables which could be included in our model. First, the number of total beds (BED) in hospitals and clinics may be specific to inpatient care case and its sign is expected to be positive.[12] This paper also tries to employ the alternative to the variable BED for the non-elderly: the number of beds (BED2) except those equipped by Geriatric Hospitals. These variables are the same as the number of doctors in that it is very difficult to interpret their economic implications. In the outpatient equations, BED or BED2 is included as a substitute for outpatient care, so that, in this case, its sign is expected to be negative.

Next, there are important variables specific to inpatient care for the elderly: the number of admission to Health Services Facilities (HSF), Special Nursing Homes (SNH), or both facilities (SUB). These variables could be employed as a substitute for inpatient services in hospitals. In Japan, among the elderly inpatients staying in hospitals, there are many who do not always need medical cure but need long-term care.[13] This phenomenon could be considered to stem mainly from the paucity of such care-providing facilities as HSF or SNH for the elderly. Therefore, these variables are included in the elderly inpatient equation since they are expected to affect inpatient expenditures.

HSF, SNH, and SUB are expected to have negative signs on inpatient expenditure. An increase in admission number to these facilities will decrease some elderly inpatients who do not always need hospital services described above. As a result, the total expenditure for inpatient care will decline and the inpatient expenditure per capita will also do because it is measured not by per patient but by per elderly person.

IV. *Empirical results*

All of the equations are estimated in both linear and log-linear form based on 1991 through 1993 data. With respect to the selection of regressors, non-significant regressors are fundamentally excluded one by one and the model re-estimated. In tables 4 and 5 are the results of the log-linear equations in 1993.[14]

Let us examine the results of inpatient equations for the elderly and non-elderly. All the regressors except for PUBBED have positive signs as expected. Clearly, NPI, POP60 and BED are the major factors that determine inpatient expenditures. As far as PUBBED is concerned,

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[12] The number of medical facilities (MED), i.e., hospitals and clinics, may also be specific to the outpatient care case since a rise in MED is expected to decrease the costs of access to health services. However, as the estimated results are not significant, this variable is not included.

[13] According to the national Patient Survey in 1993, there are about 270,000 inpatients in hospitals who are 65 years old or over and have been staying for more than six months. Thus, the average length of stay in hospital is so much longer than in other developed countries [OECD (1995)].

[14] In the paper, only the results in 1993 are reported since they are almost the same for the other two years. A dummy variable is introduced for Tokyo since the per capita prefectural income is too high in Tokyo and other variables are also very different compared with those in other prefectures.

TABLE 4. ESTIMATED COEFFICIENTS IN INPATIENT EXPENDITURE EQUATIONS, 1993

	Elderly (M_{1i})				Non-elderly (M_{2i})			
NPI	0.3842	0.2925	0.5547	0.6925	0.3749	0.3996	0.2236	0.2210
	(1.2844)	(1.0969)	(1.9097)	(2.5440)	(2.2153)	(2.4299)	(1.1786)	(1.2629)
DOC	0.2253	0.1939	0.2180	—	0.0769	0.0858	0.1646	0.1661
	(1.2210)	(1.0911)	(1.2884)	(—)	(0.7431)	(0.8408)	(1.4258)	(1.5400)
ICU	0.1091	0.1199	0.1292	0.1363	0.0267	—	0.0473	0.0471
	(1.8495)	(2.1209)	(2.3201)	(2.4390)	(0.7039)	(—)	(1.1051)	(1.1244)
PUBBED	-0.1242	-0.1175	-0.1121	-0.0739	0.0473	0.0446	0.0019	—
	(-1.5874)	(-1.5238)	(-1.5861)	(-1.1424)	(1.0381)	(0.9885)	(0.0382)	(—)
POP60	—	—	—	—	0.4118	0.3711	0.4098	0.4117
	(—)	(—)	(—)	(—)	(3.1074)	(3.1316)	(2.5521)	(2.7358)
BED	0.3952	0.3958	0.3713	0.5222	0.5772	0.6084	—	—
	(2.1039)	(2.1211)	(2.2557)	(4.4800)	(5.4087)	(6.3103)	(—)	(—)
BED2	—	—	—	—	—	—	0.4896	0.4875
	(—)	(—)	(—)	(—)	(—)	(—)	(3.7243)	(4.1375)
SUB	0.1760	0.1609	—	—	—	—	—	—
	(1.5264)	(1.4301)	(—)	(—)	(—)	(—)	(—)	(—)
SNH	—	—	0.3342	0.3139	—	—	—	—
	(—)	(—)	(2.8112)	(2.6422)	(—)	(—)	(—)	(—)
DUM	-0.1239	—	-0.2484	-0.1940	-0.2940	-0.3119	-0.2833	-0.2836
	(-0.6943)	(—)	(-1.4108)	(-1.1258)	(-2.8988)	(-3.1966)	(-2.4574)	(-2.4973)
C	8.4959	9.2895	6.8350	5.3980	5.4751	5.2271	7.1106	7.1367
	(2.9869)	(3.5899)	(2.4706)	(2.1148)	(3.3886)	(3.3359)	(3.9884)	(4.3877)
F-value	14.31	16.84	16.99	19.23	43.60	51.43	32.51	38.90
Adj R^2	0.6695	0.6738	0.7088	0.7040	0.8663	0.8680	0.8275	0.8318

Notes: Figures in parentheses are t-values. All equations are estimated in log-linear form. As for the definitions of the variables, see Appendix Table 2-4.

Source: As in Table 3.

its sign is different between the elderly and non-elderly equations: the former is positive and the latter negative although both equations are not statistically significant. The result is not straightforward to interpret theoretically, so it should be investigated further through gathering new information and data.

Some theoretical and interpretational remarks are in order with regard to inpatient and outpatient equations respectively. In the inpatient equations, first of all, CT and ICU are alternatively employed as a proxy variable for medical technology. ICU is comparatively significant compared to CT in both the elderly and non-elderly equations. Actually, CT is not statistically significant in the case of the non-elderly equation, so that only the results with ICU are reported in the text. In general, rapid development in medical high technology could contribute to an increase in healthcare expenditure. Especially for Japan, the widespread technology in medical equipment stems from the fee schedule favorable to medical institutes which is often pointed out to be at a generous level. Our study shows that medical technology would increase not only inpatient but also outpatient care spending.

Second, as for the elderly equations, HSF, SNH and SUB are alternatively employed as a substitute for inpatient care in hospitals. The results are opposite to the expected signs. HSF

TABLE 5. ESTIMATED COEFFICIENTS IN OUTPATIENT EXPENDITURE EQUATIONS, 1993

	Elderly (M_{12})		Non-elderly (M_{22})	
NPI	0.5541	0.5679	0.4709	0.4860
	(2.5761)	(3.3045)	(2.6253)	(2.6995)
DOC	0.4092	0.4101	0.3140	0.3111
	(3.7220)	(3.7892)	(3.3343)	(3.2678)
CT	0.1445	0.1447	0.1479	0.1398
	(1.5677)	(1.5897)	(1.9254)	(1.8230)
PUBMED	-0.4113	——	0.0135	0.0167
	(-0.1095)	(——)	(0.3602)	(0.4477)
POP60	——	——	0.4554	0.4837
	(——)	(——)	(3.5981)	(3.6465)
BED	-0.1678	-0.1674	-0.1788	——
	(-1.3841)	(-1.3982)	(-1.7379)	(——)
BED2	——	——	——	-0.1873
	(——)	(——)	(——)	(-1.5971)
DUM	-0.4627	-0.4639	-0.3559	-0.3589
	(-3.9239)	(-4.0012)	(-3.6305)	(-3.6414)
C	8.7666	8.6478	7.0344	6.8264
	(4.2579)	(5.0035)	(4.1058)	(4.0117)
F-value	8.86	10.89	9.61	9.44
Adj R^2	0.5062	0.5181	0.5670	0.5621

Notes: Figures in parentheses are t-values. All equations are estimated in log-linear form. As for the definitions of the variables, see Appendix Table 2-4.

Source: As in Table 3.

is not statistically significant at all (although the results are not reported in the text), and the coefficients of SNH and SUB have positive signs with only the SNH significant. These results may partly stem from the following facts: (1) Enough time has not passed since the pilot plan for HSF was carried out in 1987. (2) The fees for inpatient care are decreasing over the certain period of hospitalization. However, as other possible interpretation still remains,[15] further research on this issue will be needed.

Next, let us turn to the results of outpatient equations. All the regressors have the same sign as might be expected with the coefficients for NPI, POP60, DOC and CT (or ICU) positive and one for BED negative. NPI, DOC and CT (or ICU) have a dominant role in explaining outpatient expenditures in contrast with inpatient ones. However, as described in section 3, DOC is very difficult to interpret from the theoretical point of view, since the competing hypotheses cannot be identified in our models. Interestingly, CT as an indicator of medical technology is comparatively significant in the outpatient equations. Under the current fee-for-service payment system CT-scanners may often be applied for outpatients.

In sum, the number of doctors and beds, the age structure, and medical technology are the major factors that determine the medical expenditures at the prefectural level. Particularly

[15] It may be possible that the expected sign on SNH and SUB is not negative but positive. The reason is following. The existence of many inpatients who do not always need cure may prevent or delay the patients in need of cure from hospitalized. Therefore, an increase in SNH and SUB enables them to be hospitalized, and inpatient expenditure increases due to their severity of illness.

under the Japanese healthcare system, it should be worthwhile to draw attention to the ageing and institutional factors in terms of the high explanatory power and to the existence of some distinguished differences of the empirical results between age groups and between type of services.

V. *Conclusion*

This paper argues the degree to which the factors relevant to demand and supply of health services contribute to the increase of healthcare expenditure. As might be expected from previous studies in this field, the per capita prefectural income explains the variations among prefectures to some extent. However, it is also asserted that healthcare expenditures are affected by supply side factors - such as doctors and beds, CT-scanners, and so on. This assertion is rooted in the Japanese healthcare system, particularly fee-for-service system with uniform reimbursement across the country.

Furthermore, the following points could be emphasized in view of health policy:

1. On average the per capita medical expenditure for the elderly patients of the top five prefectures is approximately two times as large as that of the bottom five, irrespective of the fact that broad differences in health status and life expectancy between the two groups are not found. This suggests that Japan's medical expenditure may have room to be reduced without deteriorating residents' health status.

2. Differences of the per capita medical expenditures are mainly due to disparities of the number of beds and doctors per capita. It suggests that the Regional Medical Plan by the Ministry of Health and Welfare in Japan (one of which main purposes is to regulate the number of hospital beds in each medical region) could contribute to the reduction of healthcare expenditure.

3. Widespread medical high technology - the number of ICU beds and CT scanners for example - in Japan can explain significantly the variation in medical expenditures among prefectures. Therefore, medical institutes should be reorganized into at least two classes for primary and secondary or tertiary care to clarify their roles. This will enhance the efficiency in the allocation of medical resources.

APPENDIX: Variations in the Components of Medical Expenditure

Before proceeding to analyze the determinants of medical expenditure, let us focus on the following question: Is there any difference in the components of medical spending per capita between age groups or between medical services? This analysis would suggest what components contribute to variation in healthcare expenditures in Japan.

The per capita medical expenditure, by definition, can be divided into some components as follows:

$$M_{ij}=N_{ij}C_{ij}=N_{ij}T_{ij}D_{ij}$$

N is defined as the number of bills for reimbursement per patient, and C the medical expenses

per bill (or per case). C also comprises of two components: the number of bills per day (T) and medical expenses per day (D). As far as the measurement of C is concerned, it is worthwhile to note. Actually, the amount per bill does not always mean amount per case. The reason is following. Under the current reimbursement system, the bills for patients have to be calculated and put together at the end of each month by each medical institution and, for reimbursement, sent to third-payers (i.e., Review and Payment Organizations). Therefore, whenever a patient is treated during two consecutive months, the reimbursement is divided into two bills. This should be dealt with caution.

Table A.1 shows the descriptive statistics on the components in 1993, and A.2 the trend of the coefficient of variation (CV) in 1991-93. From these tables, some interesting features on the components of medical expenditure emerge from the table. First, as far as the CV for inpatient care is concerned, there is a wide range of CVs within its components. The CV for N is very high not only for the elderly but also for the non-elderly. It suggests that variations in medical expenditure can be attributed to N rather than T or D. Next, with respect to outpatient care, there are also differences in the CVs within its components for both the elderly and non-elderly. The CV for D and T is comparatively high, while that for N is low. Furthermore, there is not so much difference between the CVs of the three components for the non-elderly, while for the elderly the CVs for T and D are clearly more diverse than that for N.

TABLE A.1. COMPONENTS OF THE PER CAPITA MEDICAL EXPENDITURE IN 1993 : DESCRIPTIVE STATISTICS

			Mean	STD	CV
Elderly	inpatient care	(M_{11})	332,529	78,823	0.237
		N_{11}	92.845	24.471	0.264
		T_{11}	21.614	1.443	0.067
		D_{11}	16,836	2,009	0.119
	outpatient care	(M_{12})	267,102	34,698	0.130
		N_{12}	1,311.299	84.104	0.064
		T_{12}	3.208	0.472	0.147
		D_{12}	6,429	783	0.122
Non-elderly	inpatient care	(M_{21})	74,137	15,301	0.206
		N_{21}	23.920	5.435	0.227
		T_{21}	20.391	1.195	0.059
		D_{21}	15.366	1,526	0.099
	outpatient care	(M_{22})	69,872	7,380	0.106
		N_{22}	530.684	42.243	0.080
		T_{22}	2.243	0.192	0.086
		D_{22}	5,897	503	0.085

Notes: N is the number of bills for reimbursement per 1,000 persons, T the number of days per bill, and D medical expenses per day.Therefore, M=NTD. STD is the standard deviation and CV the coefficient of variation (=STD/Mean).

Source: As in Table 3.

TABLE A.2. TRENDS OF CVS OF THREE COMPONENTS, 1991-93

			1991	1992	1993
Elderly	Inpatient care	(M_{11})	0.247	0.240	0.237
		N_{11}	0.277	0.270	0.264
		T_{11}	0.057	0.061	0.067
		D_{11}	0.120	0.120	0.119
	Outpatient care	(M_{12})	0.134	0.131	0.130
		N_{12}	0.069	0.066	0.064
		T_{12}	0.155	0.151	0.147
		D_{12}	0.131	0.122	0.122
Non-elderly	Inpatient care	(M_{21})	0.198	0.200	0.206
		N_{21}	0.219	0.222	0.227
		T_{21}	0.055	0.056	0.059
		D_{21}	0.096	0.099	0.099
	Outpatient care	(M_{22})	0.104	0.103	0.106
		N_{22}	0.077	0.075	0.080
		T_{22}	0.091	0.089	0.086
		D_{22}	0.094	0.086	0.085

Notes: Figures are the coefficients of variation for N, T and D. N is the number of bills for reimbursement per 1,000 persons, T the number of days per bill, and D medical expenses per day. Therefore, M=NTD.
Source: As in Table 3.

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