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Is Health Care a Necessity for the Elderly in Japan?

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Abstract It seems that contributions to social insurance for workers would be raised by the increases in expenditures on health care in Japan. Is health care really a necessity at the country level? The hypothesis that health care is a necessity for the elderly was investigated in this paper. Quarterly data by age group in the 1990s was used. It was found that the characteristics of health care expenditures depend on the effect of changes in out-of-pocket payments. It was concluded that health care expenditures for the elderly is a luxury by vector error correction models when structural changes in payment are taken into consideration.

JEL Classification C32, I10, I18
Key words Cointegration, Elasticity, Out-of-pocket payment, Vector error correction model
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日本の高齢者の医療費は生活必需財か（英文）

要旨　医療費の増加によって日本では勤労者の社会保険料負担が引き上げられるであろうと目されている。一国全体で医療は本当に生活必需財なのか。この論文では，医療の財としての性格が高齢者にとって生活必需財であるかが考察された。1990年代の年齢階層別の四半期データが用いられ，医療の財としての性格は患者自己負担の変化の効果に依存することが見出された。自己負担の支払い方法の構造変化が考慮されたベクトル値誤差修正モデルによって，高齢者にとって医療は奢侈財であるとの結論が得られた。

キーワード　共和分，弾力性，患者の自己負担，ベクトル値誤差修正モデル
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1. Introduction

The current demographic transition includes declining fertility rates and increasing life expectancy has been continued in Japan. The transition will create a severe strain on public finances and raise the economic burden on the working population. According to 2001 OECD projections (Economic Outlook, No. 69), total public expenditures associated with aging are expected to rise by 3 percent of GDP over the next five decades. The main component of these expenses will be the rise in expenditures on health care and long term care. The resulting hikes in taxes and contributions to social insurance by the young generation could give rise to intergenerational inequalities.

From the viewpoint of resource allocation, therefore, it should be discussed whether the characteristics of health care expenditures for the elderly make them a necessity or a luxury. If the magnitude of income elasticity exceeds one, health care is a luxury.

Can health care be both a necessity at the individual and market levels and a luxury at the country level? A pioneering study by Newhouse (1977) revealed that income elasticity of health care is small within-country, and that the cross-national estimate exceeds one since the nation as a whole faces the full costs of health care consumption and health care is largely financed by the state or the country.(1) However, highly aggregated data such as national income or national health care expenditures do not necessarily imply individual behavior (Parkin et al. 1987). Because the individual's response to increases in income differs from the nation's response to increases in income (see Getzen 2000), the level of observation in an empirical analysis is important in this matter.(2)

(1) It is known that in contrast with time-series studies, cross-section analysis commonly produces estimates of income elasticity of less than one. Cross-section estimates may have been misspecified because of omitted variables (McGuire et al. 1993). In the meantime, to avoid complicated calculations, the variance of income elasticity as a function of both a constant and the slope of a regression equation allows an approximation (Parkin et al. 1987).

(2) Getzen (2000) notes that symptoms of illness and pain are often more important reasons for individuals to seek out a doctor, while available health care resources and technologies at the national level often reflect the nation's economic well-being.

On the other hand, most estimates in previous works can be considered short-run in nature since there has been no long-run relationship among variables in the estimation function. In order to provide a more accurate economic interpretation, the estimate should be constructed as a stationary relationship among non-stationary variables (Kumagai 2000, Kumagai and Ginama 2001).(3)

The purpose of this study is to reconsider whether health care is a necessity or a luxury at the macro level in Japan. The paper is organized as follows. The implications of estimating the income elasticity of health care expenditures are presented in Section 2. Section 3 shows a data set by age group of household heads in Japan, and health care functions are estimated using quarterly data of the elderly. In this section, the representative individual's response to increased income with regards to the changes in out-of-pocket payments is discussed. Finally, we make some concluding remarks in Section 4.

2. Income Elasticity of Health Care Expenditures

The relationships between health care expenditures, the representative individual's health status, the provider behavior of the health sector and the extent of income distribution can be analyzed by investigating the characteristics of health care expenditures using aggregated data (Newhouse 1977). If the magnitude of estimated income elasticity exceeds one, health care is interpreted as being a luxury. The fact that the elasticity is greater than one by aggregated data means that increases in total health care expenditures tend to grow faster than income. It is necessary to investigate, on the demand side, the matters of how to find an appropriate out-of-pocket rate, and how to sustain the national health insurance system.(4)

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(3) Recent articles have focused on non-stationarity and cointegration of health care expenditures and GDP using panel data for OECD countries (Hansen and King 1996, Blomqvist and Carter 1997, McCoskey and Selden 1998, Gerdtham and Lothgren 2000, Clemente et al. 2004).

(4) Income differences and health status usually imply better or worse insurance coverage and larger or smaller health care premiums on an individual basis in a private system. On the contrary, this is not usually the case in public health care systems based on the social insurance model.

On the supply side, an excess supply of medicine and increases in charges for medical tests must be examined. It is considered that health care is a necessity when the elasticity is positive but less than one. Matters such as improving the quality of health services and the diffusion of health technologies must be analyzed.(5)

3. Empirical Analyses

In this section, first, the transition in the amount of health care expenditures on the elderly is summarized. Second, a data set arranged by age group of household heads in Japan is presented. Third, we estimate health care functions and discuss changes in the representative individual's response to increased income with regards to out-of-pocket expenses.

3-1. General Medical Care of the Elderly

Descriptive statistics on General Medical Care for persons 65 years and over in Japan are presented in Table 1. It is clear that the amounts of both outpatients and inpatients dramatically increased in the 1990s. It can be considered that the increases were mainly caused by demographic changes and by the existence of a supplier-induced demand in the framework of a fee-for-service system. The latter is conjectured from observed values of per capita variables in Table 1.

The sample period of the regression analysis that follows ends in 1999. The coverage of individuals by national medical care expenditure changed with the introduction of public long term care insurance in 2000. To expand the sample period, we would need to broaden the sense of health care expenditures to include conventional long term care services. This work will be conducted in a future study.

(5) Blomqvist and Carter(1997)find that 11 income elasticities are either less than one or close to one using a large set of countries over time, in which cases the null hypothesis that the income elasticity equaled one could not be ruled out.

Table 1. Comparison of Medical Care Expenditures of the Elderly

FY		Amounts (1000 million yen)	Per Capita (1000 yen)	1999/1990 (%) Amounts, Per Capita
1990	Inpatient	4126.0	276.4	155.3, 109.4
1999		6408.2	302.5	
1990	Outpatient	3332.1	223.2	171.8, 121.1
1999		5726.6	270.3	

Sources : General Medical Care Expenditures of 65 years and over (National Medical Care Expenditures)

3-2. Data by Age Groups and Their Characteristics

Following Masubuchi (2000), the steps in the procedure of arranging the series of income of household heads were as follows. First, the weighted average of disposable income of households with elderly persons per month was derived from data of both worker's households and "no occupation" households. The number of households was used as the weight parameter of the calculation. Second, the series of income per month was transformed appropriately for annual data, adding to the annual income (a) old-age medical care and (b) operating surplus (imputed services of owner-occupied dwellings of households with elderly persons). We could use aggregated income as the disposable income of persons aged 60 years and over. Since the series were linked with 93SNA, we had the series of disposable income of the working generation from the series of total disposable income and the disposable income of persons aged 60 years and over. Finally, using the ratio of the elderly generation to the young generation regarding annual income estimates, a quarterly series of the disposable income of the elderly was calculated. To control for demographic shifts, income per capita was used to estimate the health care function.

The calculation of health care expenditures of the elderly was similar to that of the series of income.[6] First, the series of health care expenditure per month was transformed to annual data. After old-age medical care was added to the annual health care expenditure of senior population, a quarterly series of health care

(6) Medicines, medical fees and medical appliances such a manometer are included in medical care. Health care expenditures of the elderly might be underestimated because the series is based on health care expenditures by the age group 60 to 64 years old.

expenditures was calculated. The relative price of health care is the ratio of medical care costs to the deflator of private consumption. A dummy variable was used to capture changes in the cost-sharing rule of public health insurance in September 1997. The main changes were that the coinsurance rate of employees was raised from 10 percent to 20 percent and the deductible paid by the elderly was successively increased.

The health care expenditures of the senior population are financed in a scheme called Health Services for the Aged (HSA, Rojin-hoken-seido). It is well known that one of the major causes for the financial difficulty for health insurers is their Contribution to the Health Services for the Elderly (CHSE, Rojin-hoken-kyosyutsukin), which is imposed on insurers to finance the health care expenditures of the elderly. The ratio of elderly, therefore, is used as a proxy variable of the extent of financial burden on workers. The definitions and descriptive statistics of variables for this study are presented in Table 2.

As the result of Dickey-Fuller tests for unit roots (Dickey and Fuller 1979), the unit root hypothesis was not rejected at 5 percent significance level for any

Table 2. Definition and Descriptive Statistics of Variables

Sample : 1991 : 1—1999 : 4

Variables	Definition		Mean	Standard Deviation
lnipr	Real income per capita	ln (income per capita of the elderly)	1.64	0.038
lnmepr	Real health care expenditure per capita	ln (medical care per capita of the elderly)	3.67	0.083
rp	Relative price of health care	(the deflator of medical care/ the deflator of private consumption) ×100	99.83	1.811
raged	Ratio of the elderly	the population of the aged 60 and over/ total population	0.20	0.015
dum97Q4	Dummy variable	1997 : 4—1999 : 4=1, the other=0	0.25	0.439

Number of Observations=36.

Base year is CY 1995.

Sources : Income of persons aged 60 years and over and health care expenditures by the age group 60 to 64 years old, Annual Report on the Family Income and Expenditure Survey ; relative price of medical care, System of National Accounts.

variable in Table 2 except the dummy variable. Continuing with the tests, the unit root hypothesis was rejected at the 1 percent significance level for the first difference series of those variables. Therefore, we can consider that all stochastic variables are integrated with an order of one.

3-3. Methodology

The absence of a stationary linear combination implies that there is no long-run relation among the variables, so that these variables may drift away from each other over time. In addition to representing the long-run relationship, it is necessary to represent any short-run interactions among the variables. Thus, we employ a cointegration model as vector autoregressions involving variables in differenced form in the following :

Let z_t be the $n\times 1$ vector of time series in the model and $\beta' z_t$ be the r number of stationary linear combinations. Then the variables in the system are connected by the set of n dynamic equations :

$$\triangle z_t = \mu + \sum_{j=1}^{p-1} \Gamma_j \triangle z_{t-j} + \alpha\beta' z_{t-1} + \mu_t \qquad (1)$$

Γ_j represents $n\times n$ coefficient matrices, μ is a vector of constants, α is an $n\times r$ matrix of adjustment parameters, β is the $n\times r$ matrix and u_t is an $n\times 1$ vector of white noise error processes in equation 1. Once the cointegrating rank has been determined, the corresponding maximum likelihood estimates of the parameters of the r cointegrating equations are contained in the matrix β. If only one cointegrating relation is found, the parameters of this equation are unique up to a factor of proportionality.

Johansen's method (Johansen 1988, 1992, 1995) was adopted to test for the cointegrating relationships among variables. The number of cointegrating relationships and the problem of whether an intercept and/or trend terms should be considered can be simultaneously treated in this method. If the null of no cointegration is rejected for the model tested, then the number of cointegration vectors is also determined. As Engle and Granger (1987) showed, in the case of p variables system, the maximum number of cointegration vectors is $p-1$. If the esti-

mated error correcting term satisfies the stationary condition as a result of the test, statistical interpretation of the long-run equilibrium is given to the term.

The null hypothesis of the cointegration test is $H_0 : r \leq k$; the alternative hypothesis is $H_1 : r > k$, where r and k are the maximum number of cointegration vectors and the number of variables in the system, respectively.

3-4. Empirical Results

As a result of the cointegration test, one cointegrating relationship was found for each combination tested. The variables that constituted combinations were as the following: [1] lnmepr, lnipr, rp, raged [2] lnmepr, lnipr, rp, raged, dum97q4. The results of cointegration tests are shown in Table 3. Since the dummy variable was assumed to be an exogenous constant, the effect of an institutional change in out-of-pocket payments on the cointegrating relationships was not considered in this test.

The results of the estimation of the error-correcting term of the health care function are presented in Table 4. It is noted that it makes a great difference whether changes in out-of-pocket payments are taken into consideration or not. As a result, the estimate of income elasticity is greater than one when there is a dummy variable in the vector error correction model. The dummy variable is statistically significant, and the sign of the variable is negative for changes in relative price and in the ratio of the elderly in the short run.(7) However, the estimate of income elasticity is less than one when there is no dummy variable. Thus, it can be concluded that the characteristics of health care expenditures depend on the effect of changes in out-of-pocket payments in the short run ; however, we cannot declare the representative individual's response to structural changes in payment in the long run.

We can also infer that the difference of lags in the specification slightly affects the relationship among variables in the error-correcting term in Table 4, but

(7) For the dependent variable, the difference in *rp*, the coefficient of *dum97q4*, is around −0.8. This means that a rise in out-of-pocket lessens the increase in relative price of health care.

Table 3. Cointegration Tests

No deterministic trend in the data for Model 1
Linear deterministic trend in the data for Model 2 1991 : 1—1999 : 4

	Eigenvalue	Likelihood ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized Number of CE (s)
Model 1	0.72	74.27	53.12	60.16	None**
Lags=1	0.33	27.45	34.91	41.07	At most 1
Model 1	0.74	80.70	53.12	60.16	None**
Lags=2	0.39	31.65	34.91	41.07	At most 1
Model 2	0.65	55.16	47.21	54.46	None**
Lags=1	0.25	17.20	29.68	35.65	At most 1
Model 2	0.70	67.02	47.21	54.46	None**
Lags=2	0.30	23.21	29.68	35.65	At most 1

Note: Two asterisks denote rejection of the hypothesis at the 1 percent significance level.

there is little difference regarding the value of AIC and SBC for the models.(8) All the coefficients except one variable in the case of Model 1 are statistically significant.

Table 5 shows the adjustment coefficient of the error-correcting term, which represents no error correction if all of the adjustment coefficients are zero. Following Johansen (2002), we checked whether the adjustment coefficients derived from such small samples have a reasonable size by using the correction factor to the test for a linear hypothesis in a cointegrated vector autoregressive model. As a result, we confirmed that the adjustment coefficients in bold type in Table 5 are of adequate size.(9) It can be argued that the relative price in Model 2 plays the role of adjusting short-run interactions among the variables in Table 5. On the contrary, the relative price in Model 1 does not result in adjustments of interactions. It seems that the difference in the estimate is caused by the existence of the dummy variable in the short-run.

It is noteworthy that all the coefficients of the ratio of elderly are positive and statistically significant. A scheme to finance health care expenditures of the elderly should be reconstructed if the result indicates that the determination of

(8) For example, AIC of Model1 are −24.59 and −23.89.
(9) Podivinsky (1998) pointed out the problem that using asymptotic critical values can be misleading for sample sizes of 100 or smaller and that linear restrictions against Johansen's test would seem to result in a strategy most likely to detect true cointegrating relationships in moderately sized samples.

whether such health care expenditure is a luxury or not depends upon the extent of contributions to social insurance by the working generation.(10)

Table 4. Error-Correcting Term

Dependent variable : lnmepr 1991 : 1—1999 : 4

Explanatory variable	Model 1 Lags=1	Model 1 Lags=2	Model 2 Lags=1	Model 2 Lags=2	Expected sign
lnipr	0.672 (1.73)	**0.739** **(2.10)**	**1.096** **(4.77)**	**1.026** **(4.81)**	+
rp	**−0.031** **(−3.57)**	**−0.029** **(−3.74)**	**−0.042** **(−7.51)**	**−0.038** **(−7.40)**	−
raged	**9.361** **(6.51)**	**8.735** **(7.13)**	**12.815** **(12.67)**	**11.774** **(13.78)**	+
constant	**5.345** **(5.60)**	**5.671** **(6.01)**	3.558	3.401	+−

Note : All explanatory variables are current time period values. The T-values of the coefficients are presented in parentheses. The constant terms of Model 2 are arbitrary ones.

Table 5. Adjustment Coefficient of Error Correcting Term

Model 1 : the model for lnmepr, lnipr, rp, raged
Model 2 : the model for lnmepr, lnipr, rp, raged, dum97q4 1991 : 1—1999 : 4

Vector autoregression	Model 1 Lags=1	Model 1 Lags=2	Model 2 Lags=1	Model 2 Lags=2
lnmepr	0.025 (0.57)	0.027 (0.45)	0.145 (1.57)	0.140 (1.23)
lnipr	0.036 (0.62)	−0.068 (−0.88)	**0.272** **(2.31)**	**0.269** **(1.94)**
rp	−1.377 (−0.56)	−2.160 (−0.68)	**−13.503** **(−2.96)**	**−14.138** **(−2.57)**
raged	−0.001 (−7.31)	−0.001 (−6.28)	−0.001 (−2.67)	−0.001 (−3.25)

Note : The T-values of the coefficients are presented in parentheses.

(10) The other key factor to sustaining the social insurance system is the elimination of behaviors that are harmful to health. Kumagai (2004) revealed that, for the elderly, quitting smoking is important in shrinking health care expenditures in the long run. He presents a 2-step calculation that if the smoking rate of males would decreased by 3 percent (while the smoking rate of females remained constant), the risk of the elderly based on their lifestyle would decrease by 1 percent and the health care expenditures of the elderly would be reduced by 10 thousand yen per capita.

4. Conclusion

The hypothesis that health care for the elderly is a necessity or a luxury was investigated in this paper. Quarterly data from the period 1991-1999 in Japan was arranged by age group of the senior population, and health care functions of the elderly were estimated. The magnitude of income elasticity exceeds one when there was a dummy variable to capture the effect of changes in out-of-pocket payments in the vector error correction models. The relative price also played the role of adjusting short-run interactions among the variables in the model. We can then conclude that the characteristics of health care expenditures depend on the representative individual's response to expanded income with regards to changes in out-of-pocket payments. If an econometric estimation model captures such structural changes in payment, it can be considered that health care expenditure for the elderly is a luxury. Therefore, the scheme to finance health care expenditures of the elderly should be reconsidered if the extent of the working generation's contribution to social insurance is a major determinant of the characteristics of health care for the elderly. Further, it should be studied whether the introduction of public long term insurance has affected the luxury status of health care for the elderly.

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Appendix : Two-stage technique of Engle and Granger (1987)

The E-G method was applied for estimation. The following function is the result of estimation by ordinary least squares (OLS) in the first stage. The residual series of the regression was stationary since the unit root hypothesis was

rejected at the 1 percent significance level. It is shown that most of the parameters estimated by recursive OLS fluctuated in the sample period in Figure 1. Thus, it seems that the E-G method is not adequate for obtaining a stable estimate of the income elasticity of health care expenditures in the long run.

$$\ln mepr = 2.700 + 0.459 \ln ipr - 0.013 rp + 7.482 raged$$
$$(6.53) \quad (2.52) \quad (-3.42) \quad (11.38)$$
$$\bar{R}^2 = .942 \quad S.E. = .020 \quad D.W. = .58 \qquad 1991{:}1 — 1999{:}4$$

The variable $\bar{R}^2$ is adjusted R- squared ; S.E., standard error of regression ; and D.W., the Durbin-Watson statistics. T-values are in parentheses.

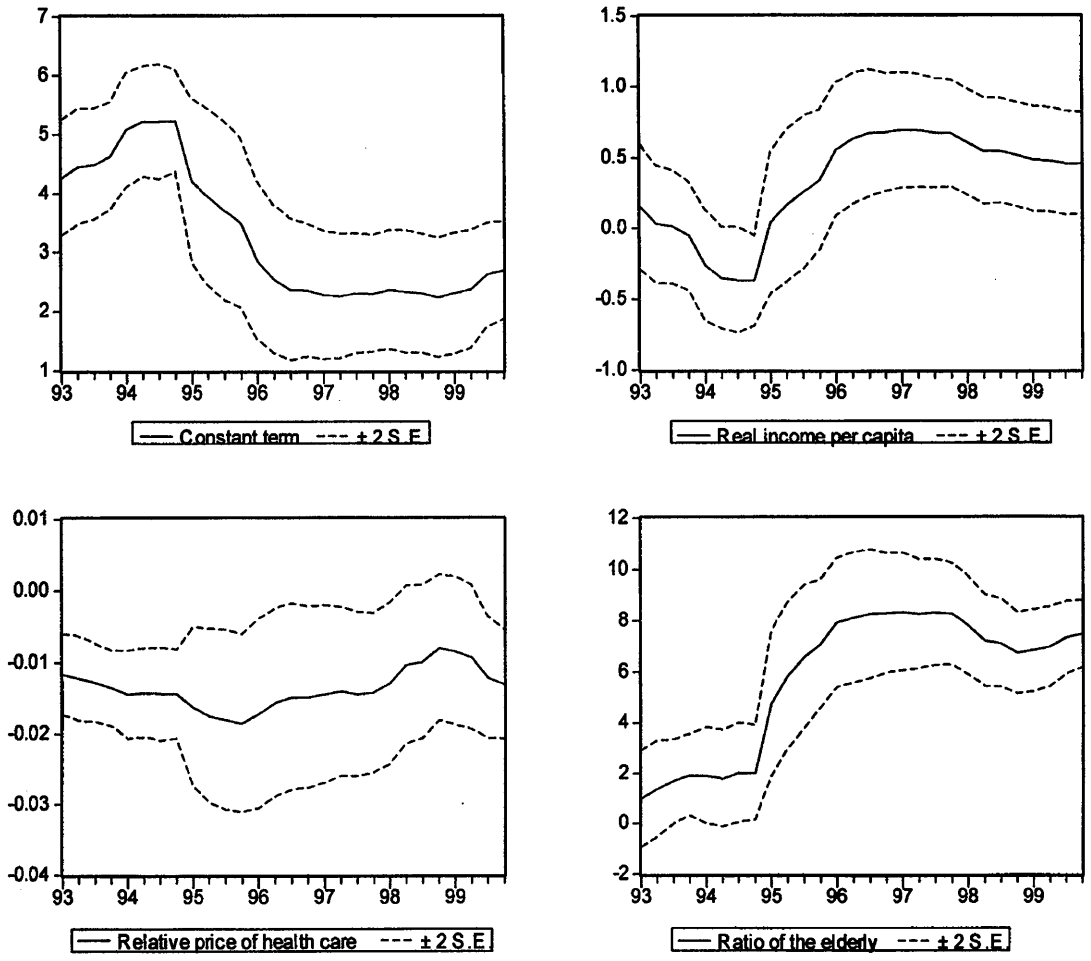

Figure 1. Coefficients estimated by recursive OLS