

On the Causality among Social Insurance Burden Rate, Health Care Expenditures and Public Pension

Narimasa Kumagai¹

Kikuo Takabayashi

Abstract

Despite a decrease in the number of working generations supporting Japan's social security system, the relationship between public pension benefits and health care expenditures since the inception of universal health insurance system has not been explored. We examined the causal relationships among health care expenditures per month, public pension benefits per beneficiary and the social insurance burden rate in a cointegration model. We obtained one stable long-run equilibrium relationship among those three variables over the period from 1966 to 2002. It was concluded that the increase in health care expenditures caused a rise in public pension benefits and a hike in the social insurance burden rate. The latter half of this study investigated price policy in the health care sector. The null hypothesis of no serial correlation for vector error correction model was rejected. We finally accepted the dynamic OLS model with lead lags as an aggregated health care function. The price elasticity of health care has declined in absolute value since the universal health insurance system started, and it has been around 0.6 since the early 1980s. The policy which eliminated health care fees for the elderly in the 1970s was a mistake since the elderly who had previously been subject to small copayments increased their health care expenditures. The rate of out-of-pocket expenses for health care of the elderly should have been raised in the 1970s.

Keywords : causality, cointegration, dynamic OLS, price elasticity of health care, vector error correction model

1 Introduction

Because of a falling birth rate and increasing life expectancy, the labor force is expected to decrease in Japan. The most serious effect of this trend is a decrease in the number of persons supporting the social security system. The Japanese social security system consists of four major components : public assistance, public health maintenance, social insurance and social welfare services. Japan has a social insurance system covering the entire population and family allowances for the elderly, sickness, work injury, and unemployment. The aging of population has increased the pension benefits being paid out, as well as health and long-term care insurance. Most of the benefits paid for the elderly under the public health

insurance system have been financed through social insurance premiums paid by the working generations. In this environment, many researchers are concerned about how to pay for health care expenditures and limit the public pension burden. This study focuses on health care expenditures and public pension benefits because these costs occupy large shares of social security in Japan.

In 1973, a revision of the Welfare Law for the Aged eliminated health care fees for the elderly. Our question is what happened next. Did the social insurance burden rate increase? Did health care expenditures rise because of public pension wealth increase? Since the inception of the universal health insurance system, the causal relationship between public pension benefits and health care expenditures in

¹ Corresponding author.

E-mail address : narimasa@kindai.ac.jp (N. Kumagai)

Japan has not been examined. We examine the relationship among the social insurance burden rate, health care expenditures and public pension and explore the policy which eliminated health care fees for the elderly in this paper.

Section 2 provides a brief overview of the social security system in Japan. Social insurance schemes and taxation constitute the main revenues of the social security system. In Section 3, we investigate the long-run causal relationships among health care expenditures, public pension benefits and the social insurance burden rate. The relationship between public pension benefits and health care expenditures appears to have changed in 2002, when the prices of medical services and drugs were cut by an average of 2.7 percent. We thus investigate the hypothesis that increases in pension benefits caused an increase in health care expenditures during the period 1966-2002. Section 4 presents new empirical evidence of aggregated health care function, while the null hypothesis of no serial correlation for the residuals of cointegration regression model is rejected. Section 5 concludes with a summary and a discussion of extensions of our work.

2 Overview of Social Security System in Japan

In 1961, a universal health insurance system and pensions for all Japanese citizens were put into effect. The health care system is based on a compulsory health insurance scheme through income-based premiums. Social insurance schemes and taxation constitute the main sources of health funding in Japan. Approximately half of the national health care expenditures are financed by health insurance plans and the remainder is financed by subsidies from the government, co-payments and other out-of-pocket expenses.

2-1. Health Insurance

Japan's health insurance covers entire population.

Many people in Japan obtain their insurance via employer-related groups. For example, employees of large companies and their dependent family members enroll in plans for which occupation-based cooperatives are the insurers. Insurance societies or mutual aid societies are established in industries. Most of the employer-group plans require copayments for dependents. These plans also have a catastrophic cap feature that limits monthly out-of-pocket expenses.² Japanese public health insurance systems are roughly classified into [1] insurance for employees and their dependents, [2] insurance for the self-employed, retirees and their dependents, and [3] insurance for the elderly. Retired persons are covered by the plan with contributions from employment and community plans plus funds from both national and local governments, with small copayments for patients at the time of medical service.

The first type of insurance is Employee's Health Insurance, which consists of Government-managed Health Insurance (GHI), Society-managed Health Insurance (SHI), Mutual Aid Associations (MAA) and Seamen's Insurance (SI). GHI includes workers employed by small and medium-sized companies. The insurer of GHI is the national government. The GHI received around 8.3 percent of the insured's monthly income in the 1990s, evenly split between employer and employee. In SHI, large firms organize their own insurance group instead of making their employees enroll with GHI. MAA includes national and local public employees and private school teachers and staff. Self-employed individuals, farmers, and retired employees enroll in National Health Insurance (NHI) for which municipalities are the insurers. Employees' Insurance contributes to NHI to cover retired employees. For most NHI insurers, the premium is supplemented by governmental subsidies.

In 1982, a Health Care System for the Elderly (HCSE) was established. The elderly was defined as age 70 and over in the 1990s. The definition of the elderly has changed in the 2000s. Since October 2002, the minimum eligibility age has been increased by one

² When the monthly out-of-pocket amount was higher than the ceiling, the excess amount was paid back to the patient from insurance funds. A ceiling on patient cost-sharing was introduced for the first time in 1973.

year each year and continued to rise until it reached 75 in October 2007. Seniors 75 and older enroll in HCSE and receive benefits through contributions from other insurance plans. It is well known that one of the major causes for the financial difficulty of health insurers is the Contribution for the HCSE (Rojin-hoken-kyosyutsukin) , which is imposed on insurers to finance the health care expenditures of the elderly.

Reimbursement to health care providers is uniform across regions with little concern for differences in the type of facility or severity of illness because the fee schedule and drug prices are set by the government. According to Campbell and Ikegami (1998) , the fee schedule is decided in a key biennial negotiation between insurers and providers, and that forum - the Central Social Insurance Medical Care Council (Chuikyō) - has provided a mechanism for dealing with many recurring issues in a routine way with very restricted participation. Campbell and Ikegami (1998) explained that the Japan Medical Association (Nihon Ishikai) dominates the provider's side in the Central Council in terms of both income growth and their share of medical spending. Since all reimbursement is regulated by a uniform fee schedule, it is possible for the government to exert moderately rigid control over total expenditures.

2-2. Public Pension

The public pension system in Japan is constituted of Employee's pension insurance, National pension, Mutual Aid Association of National Government Employees, Mutual Aid Associations of Local Government Employees and others.³ The public pension system was established at a time when the percentage of workers other than wage-earners in the labor force was relatively high. The National Pension System was created to cover the self-employed and others ; together with the existing Employees' pension and various mutual aid pensions. In 1973, revised national pension regulations introduced a sliding scale reflecting changes in commodity prices ; this change raised pension levels. In 1986, the Basic Pension was

instituted and the National Pension System was reorganized into two tiers : a basic pension of fixed benefits and a second tier of remuneration-based benefits to replace the Employees' pension. The first tier pension is the national pension, to which people contribute between ages 20 to 60. For the national pension, the insured population is classified into [1] students and the self-employed, who make their insurance contributions as individuals, [2] salaried persons working for companies, and [3] spouses who are supported by salaried persons. Those spouses are exempt from insurance contributions.

The government has been implementing structural reforms to the social security system. In 2000, employees' pension benefits for new recipients were cut by 5 percent in order to improve the finances, and the wage-slide system was frozen. The pension reform of 2004 introduced a mechanism by which benefits would be adjusted by keeping the income replacement rate at no less than 50%.

3 Causal Relationships among Contribution of Social Insurance, Health Care Expenditures and Public Pension

The introduction of a public pension system can substantially alter the amount of individual lifetime savings. It is well known that such changes are the consequences of three effects. Those are (1) the retirement effect, (2) the wealth substitution effect and (3) the bequest effect. When individuals reach the age at which they can begin to receive benefits through the public pension system, they may be induced to retire earlier than they might have otherwise. This retirement effect tends to increase household savings. If workers in younger generation view contributions to public pension as a means of saving for their future benefits, they will tend to save less on their own. This phenomenon is referred to as the wealth substitution effect which tends to reduce household savings. Since the social insurance system tends to shift income from working generation to elderly people, parents may

³ Payments through the NTT mutual benefit association, the JR mutual benefit association and the JT mutual benefit association or their antecedent associations are included in Employee's pension insurance from FY 1997.

save more to increase bequests to their children so as to offset the intra-generational distributional effect. This is referred to as the bequest effect.

Taking into account these three effects at the same time, Feldstein (1996) found the coefficient on social security wealth is statistically significant value of 0.028 by econometric analysis. This positive sign suggests that the wealth substitution effect dominates the retirement and bequest effect. Thus, increases in public pension wealth (social security wealth) increase consumption and hence, decrease savings. As pointed out by Feldstein (1974), the existence of a public pension system will reduce household savings assuming that the wealth replacement effect is larger than the induced retirement effect, and national savings will also be reduced if the pension system is a pay-as-you-go system. Empirical work on Japan using time series aggregated data has tended to find that the public pension system has reduced household savings (see, e.g., Nakayama 1997, Kumagai 2000).

On the other hand, can health care be 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 the cross-national estimate exceeds unity 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.⁴ 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 greater income is different than the nation's response to greater income (see Getzen 2000), the level of observation in an empirical analysis is important in

this matter.⁵

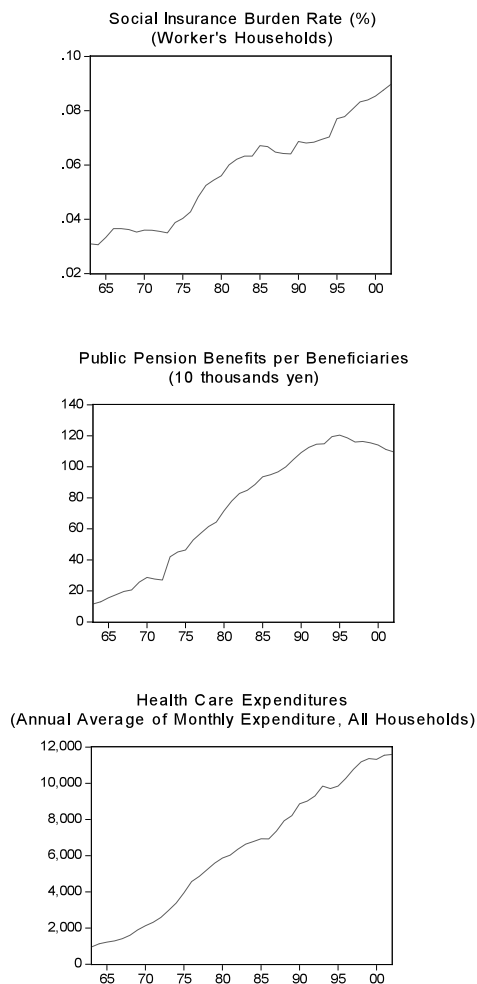


Figure 1 Social Insurance Burden Rate, Health Care Expenditures and Public Pension Benefits

We can see a boost in the social insurance burden rate over the period from 1975 to 1985 in Figure 1. In

⁴ It is known that in contrast with time-series studies, cross-section analysis commonly produce estimates of income elasticity of less than one. Cross-section estimates may have been misspecified because of omitted variables (McGuire *et al.* 1993). To avoid complicated calculations, the variance of the income elasticity as a function of both the constant term and the slope of regression equation to be estimated is as an approximation in the mean time (Parkin *et al.* 1987).

⁵ Getzen (2000) notes that symptoms of illness and pain are often more important reasons for individuals to seek out the doctor, while the available health care resources and technologies at the national level often reflect the nation's economic well-being.

⁶ The government revisited the health insurance system in 1984. Fukawa (2002) pointed out that the most important point of this revision was the introduction of a deductible, or 10 percent cost-sharing to be paid by the insured persons. According to Fukawa (2002), before the revision, the insured was granted full benefits for health care expenses, except for the first visit fee and for the hospitalization charge.

1973, a revision of the Welfare Law for the Aged eliminated health care fees for the elderly. The system was called a free health service system for the elderly (Fukawa 2002).⁶ When the patient cost-sharing of the elderly changed, did the ratio of health care expenditures to consumption increase? Or did health care expenditures rise because of an increase in public pension wealth? Since the inception of the universal health insurance system, the causal relationship between public pension and health care expenditures in Japan has not been examined.

Both the data of health care expenditures per month of all households and the social insurance burden rate of the working households are from the Annual Report on the Family Income and Expenditure Survey. The data on public pension benefits per beneficiaries were obtained from the number of total public pension beneficiaries and the total public pension benefits paid out. Since the mid-1990s, this series has declined because the number of new recipients of employees' pension has increased. The source of data on the public pension is The Year Book of Social Security Statistics (Prime Minister's Office). We can use those data over the sample period from 1963 to 2004. However, the sample period of this study ends in 2002 because prices of medical services and drugs were cut by an average of 2.7 percent in the 2002 regular biennial review. The review led to a change in overall health spending of -0.7 percent for the first time in the history, then the relationship between public pension and health care expenditures in Japan appears to change.⁷ We thus investigated that the hypothesis that an increase of pension benefits increased health care expenditures during the period 1966-2002. We constructed a stationary relationship among non-stationary variables concerned in the long-run.

To perform the standard statistical inferences in a regression analysis in which non-stationary time series data are used, we analyze the data generating processes of the variables concerned using the unit root tests. As the results of Dickey-Fuller tests

(Dickey and Fuller 1979) and GLS-detrended DF tests (Elliot, Rothenberg and Stock 1996), the unit root hypothesis was not rejected at the 5 percent significance level for the natural logarithm of X, Y and Z. Those variables X, Y and Z are health care expenditure per month, public pension benefits per beneficiaries and the social insurance burden rate, respectively. 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 of order one.

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 a long-run relationship, there may be short-run interactions among the variables; we employ a cointegration model for vector autoregressions involving the variables in differenced form.

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

$$z_t = \mu + \sum_{j=1}^{p-1} \Gamma_j \Delta z_{t-j} + \alpha \beta' z_{t-1} + u_t \quad (1)$$

Γ_j is a $n \times n$ coefficient matrix, μ is a vector of constants, α is an $n \times r$ matrix of adjustment parameters, β is an $n \times r$ matrix and u_t is an $n \times 1$ vector of white noise error processes in Equation 1. The symbol ΔA means the first difference of A. 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) was adopted to test for the cointegrating relationship among variables concerned. The number of

⁷ The coverage of national health care expenditures (NHCE) was changed by the introduction of public long-term care insurance in 2000. In that year, about 6 percent of NHCE was transferred to public long-term care insurance. To expand the sample period, we had to use make the wider data of health care expenditures, which include the conventional services of long-term care.

cointegrating relationships and the problem of whether an intercept and/or trend terms need to 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 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 error correcting term estimated satisfies the stationary condition as a result of the test, statistical interpretation of long-run equilibrium is given to the term.

The null hypothesis of the cointegration test is $H_0 : r \leq k$, and the alternative hypothesis is $H_1 : r > k$, where r and k is the maximum number of cointegration vectors and the number of variables in the system, respectively. The cointegration test was applied to the data over the sample period from 1966 to 2002 since 3 lags are needed to estimate the vector error correction model (VECM). Before implementing cointegration analysis, we first determined the lag length (k) and conducted diagnostic tests for the residuals. Using the likelihood-ratio test, the VECM with $k = 2$ was determined. Diagnostic tests on the residuals of each equation supported the VECM with two lags.

Table 1 Results of Cointegration Test

Sample : 1966-2002

Hypothesized	Trace			
Cointegrating eq Eigenvalue	Eigenvalue	Statistic	Critical Value	Prob.
None	0.48	36.05	35.19	0.04
At most 1	0.25	11.51	20.26	0.49

Table 2 Vector Error Correction Model

Sample : 1966-2002

Cointegrating Vector		
$\ln X = 7.70 + 0.65 \ln Y + 0.63 \ln Z$		
[6.65]	[7.00]	[2.14]
Coefficients of Speed of Adjustment		
$\Delta \ln Z$	$\Delta \ln X$	$\Delta \ln Y$
-0.100	0.025	0.131
[-3.61]	[0.73]	[2.55]

Johansen cointegration methods were used to

determine the number of cointegrating vectors. The results of the cointegration test are summarized in Table 1. The trace tests reject the hypothesis of no cointegrating vector at the 5 percent level, but fail to reject the null of one cointegrating vector. This result suggests that there is one stable long-run equilibrium relationship. Table 2 shows the estimation results of VECM with the dummy variable, which takes the value of one in 1973. T-values are shown in square brackets. The null hypothesis of no serial correlation was not rejected at the 5 percent significance level using the Lagrange Multiplier procedure.

We produced the VECM model for all the endogenous variables in the model and used it to carry out Granger causality tests (Granger 1969) over the short and long run. Long-run causality was determined by the error correction term, whereby if it was significant, then it indicated evidence of long run causality from the explanatory variable to the dependent variable.⁸ Short-run causality was determined with a test on the joint significance of the lagged explanatory variables, using an F-test. As the results of the estimation, the cointegrating vector shows that Y and Z significantly affected the long-run movements of X, and coefficients of speed of adjustment indicate that X does not play a role of adjustment in the system. However, we cannot examine whether pension increases health care expenditures. We then investigated the causal relationship among three variables (X, Y and Z) in the cointegrating relation. Since the coefficient of speed of adjustment of X was not statistically significant, our interest focuses on the causal relationship as follows : $\Delta \ln X \rightarrow \Delta \ln Z$, $\Delta \ln Y \rightarrow \Delta \ln Z$, $\Delta \ln X \rightarrow \Delta \ln Y$ and $\Delta \ln Z \rightarrow \Delta \ln Y$.

We conducted Granger's causality test using the VECM with two lags. Granger-causality statistics examine whether the lagged values of one variable help to predict another variable. As the result of Granger's causality test at the 1 percent significance level, we found a one-way causal relationship among the variables ($\Delta \ln X \rightarrow \Delta \ln Y \rightarrow \Delta \ln Z$). The relationships among the variables are depicted in

⁸ Granger and Lin (1995) note that two integrated series cannot cause each other in the long run unless they are cointegrated.

Figure 2 . The bold arrows indicate the relationship at the 1 percent significance level, and the dotted line indicates the relationship at the 5 percent significance level.

We examined the causal relationship among health care expenditures per month, public pension benefits per beneficiaries and the social insurance burden rate in a cointegrating relation. It is concluded that the increase in health care expenditures causes a rise in public pension benefits and a hike in the social insurance burden rate in the short run.⁹ Therefore, it is possible the policy which eliminated health care fees for the elderly was a grievous mistake. In next section, we analyze the pricing policy in the health care sector at the macro level.

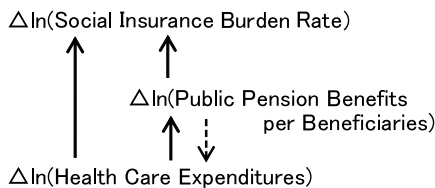


Figure 2 Results of Granger's Causality Test

4 Health Care Function : VECM or Dynamic OLS ?

We must pay attention to the relationship between the aging of the population and the health care system at the macro level. Although age effects are also absent from seminal study by Newhouse (1977) , the link between aging and aggregate health care expenditures cannot be viewed as a simple demand function because the supply of workers in the market depends on the wage rate which mirrors the prices that have to be paid for the health care services provided (Zweifel and Ferrari 1992) . Thus, aging affects not only the demand side but also the supply side of health care.¹⁰

Because public long-term care insurance was

introduced in 2000, we estimate the health care function to analyze the price policy in the health care sector over the sample period from 1958 to 2000. The base year of the function is 2000 and the function is constituted by five variables :

H_R : health care expenditure adjusted by the deflator (CPI Medical)

Income_R : annual average of monthly household income of workers' households adjusted by the deflator (CPI General Index)

REP : relative price of health care (CPI Medical/CPI General Index)

Phy_P : physicians per 10 thousands persons

R65 : the ratio of persons aged 65 and over

Johansen's method was adopted to obtain stationary relationship among those five variables. The results of the cointegration test are summarized in Table 3 . The trace tests reject the hypothesis of no cointegrating vector at the 5 percent level, but fail to reject the null hypothesis of one cointegrating vector. This result suggests that there is one stable long-run equilibrium relationship. Table 4 shows the estimation results of VECM with the dummy variable, which takes the value of one in 1973-1974. T-values are shown in square brackets. It is noted that the speed of adjustment of the relative price of health care is almost two years ($2.28 = 1/0.438$) . We can consider that the estimation results are reflected in the fee schedule in a key biennial negotiation between insurers and providers.

Table 3 Results of Cointegration Test (Health Care Function)
Sample : 1958-2000

Hypothesized	Trace			
Cointegrating eq Eigenvalue	Statistic	Critical Value	Prob.	
None	0.60	80.54	69.82	0.01
At most 1	0.39	40.97	47.86	0.19

⁹ A simple theoretical analysis under the pay-as-you-go system which is given in the Appendix supports the empirical results.

¹⁰ The expected positive relationship between the ratio of the elderly and health care expenditures have often failed to materialize. Some studies (Schneider and Brody 1983, Myers and Manton 1984, Wolfe 1986) focusing on the impact of health care on longevity have suggested that increased health care expenditures do not contribute to increased life expectancy beyond age 40.

Table 4 Vector Error Correction Model
Sample : 1958-2000

<u>Cointegrating Vector</u>		
$\ln(H_R) = 2.72 + 0.933 \ln(\text{Income_R})$		
[4.04]		
$-0.517\text{REP} - 0.011(\text{Phy_P}) + 1.627 \ln R65$		
[-2.49]	[-4.04]	[5.35]
<u>Coefficients of Speed of Adjustment</u>		
$\Delta \ln(H_R)$	$\Delta \ln(\text{Income_R})$	ΔREP
0.337	0.122	-0.438
[2.18]	[1.63]	[-3.72]
$\Delta(\text{Phy_P})$	$\Delta \ln R65$	
-1.904	-0.042	
[-0.62]	[-1.70]	

Using the Lagrange Multiplier procedure, the null hypothesis of no serial correlation for VECM was rejected at the 5 percent significance level. Therefore, the residuals can be estimated using either the dynamic ordinary least squares (DOLS) estimator which corrects for serial correlation and endogeneity of regressors. By comparison with DOLS estimators, we finally accepted the regression model with lead lags as an aggregated health care function because the standard deviation of the regression model with lead lags was smaller than that of the regression model without lead lags.¹¹ Table 5 shows the estimation result of the DOLS model with lead lags. Although most of the first-difference series were not statistically significant, we did find that all the explanatory variables constituting the cointegrating relation were statistically significant. The income elasticity of health care was about 0.7 and the elasticity of aging was beyond one in the long run. The estimated coefficient of physician density was almost zero. Using the estimated coefficient of relative price of health care, we can measure the changes in price elasticity of

health care during the sample period and argue the price policy in the health care sector. Changes in the price elasticity of health care during the sample period are depicted in Figure 3.

We can see the price elasticity of health care had dramatically declined in absolute value since a universal health insurance system started and it had been around 0.6 since the early 1980s. Changes in price elasticity imply that health care was a luxury for the nation before a universal health insurance system started, but the character of health care had changed because of the introduction of health insurance. A free health service system by which the elderly did not make copayments at the time of medical service was established in 1973. The working generation had supported the system through contributions from employment and community plans plus funds from both national and local governments. As a result, the elderly who previously had been subject to small copayments increased their health care expenditures. We conclude that the policy which eliminated health care fees for the elderly in the 1970s was a grievous mistake. We should review the free health service system for the elderly in the second half of 1970s because the increase in the patient's coinsurance rate had the effect of restraining health care costs.¹²

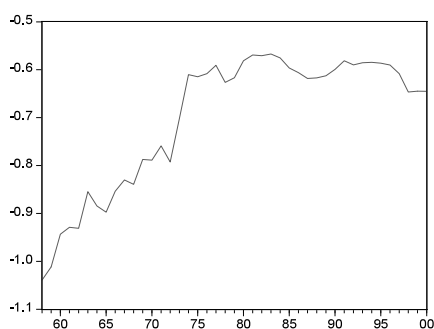


Figure 3 Price Elasticity of Health Care

¹¹ Hayakawa and Kurozumi (2006) revealed that lead lags are not necessary when the cointegrating regression error does not Granger-cause the first difference of the I (1) regressors. Granger non-causality tests using second-order vector autoregressive model suggests that a few cointegrating regression errors did Granger-cause the first difference of the I (1) regressors in this study. The result indicates that we should not accept the VECM.

¹² Kumagai (2007) constructed a four-variable VAR model of the health sector over a sample period from November 1999 to March 2004 and concluded that the increase in the patient's coinsurance rate had the effect of restraining health care costs but that a labor productivity shock did not have a permanent effect on the doctor consultation.

Table 5 Dynamic OLS Model

Dependent variable	Sample: 1958 2000			
ln (H_R)				
	Coefficient	Std. Error	t-Statistic	Prob
Constant	4.767	2.510	1.899	0.069
ln (Income_R)	0.696	0.149	4.671	0.000
REP	-0.645	0.120	-5.366	0.000
Phy_P	-0.008	0.002	-4.221	0.000
lnR65	1.252	0.260	4.824	0.000
Δ ln (Income_R) [1]	0.237	0.169	1.399	0.174
Δ ln (Income_R)	0.317	0.305	1.039	0.308
Δ ln (Income_R) [-1]	0.029	0.211	0.135	0.894
Δ REP [1]	-0.140	0.167	-0.837	0.410
Δ REP	-0.082	0.171	-0.479	0.636
Δ REP [-1]	-0.036	0.153	-0.238	0.814
Δ Phy_P [1]	-0.015	0.003	-4.262	0.000
Δ Phy_P	0.003	0.006	0.537	0.596
Δ Phy_P [-1]	0.000	0.006	-0.076	0.940
Δ lnR65 [1]	-0.825	0.947	-0.872	0.391
Δ lnR65	-2.039	0.778	-2.621	0.014
Δ lnR65 [-1]	-0.473	0.755	-0.627	0.536
Adjusted R-squared	0.997			
S.E. of regression	0.028			
Durbin-Watson stat	1.473			

5 Conclusions

We examined the causal relationships among health care expenditures per month, public pension benefits per beneficiaries and the social insurance burden rate in a cointegrating relation. The sample period of this study is 1966-2002 because prices of medical services and drugs were cut by an average of 2.7 percent in the 2002. The hypothesis that the pension benefits increased health care expenditures during the period 1966-2002 was tested using VECM. We obtained one stable long-run equilibrium relationship among health care expenditure per month, public pension benefits per beneficiaries and the social insurance burden rate and concluded that the increase in health care expenditures caused a rise in public pension benefits and a hike in the social insurance burden rate.

The latter half of this study investigated price policy in the health care sector. Because public long-term care insurance was introduced in 2000, we estimated the health care function over the sample period from 1958 to 2000. By using the Lagrange Multiplier procedure, the null hypothesis of no serial correlation for VECM was rejected at the 5 percent significance level. We continued to estimate DOLS models and finally accepted the regression model with lead lags as an aggregated health care function. The price elasticity of health care has declined in absolute value since the inception of a universal health insurance system, and it had been around 0.6 since the early 1980s. We concluded that the policy which eliminated health care fees for the elderly in the 1970s was a mistake since the elderly who were previously subject to small copayments increased their health care expenditures.

In terms of the economics of the policy, the rate of out-of-pocket expenses for health care of the elderly should have been raised in the 1970s.

Another issue regarding health care expenditures at the macro level is the tax burden. Social security and the transfer to local governments are the largest source of expenditure expansion for the central government. The size of Japan's social security benefits has been over 80 trillion yen in recent years. The share of social security of the 2008 budget of the central government's expenditure was about 26.2 percent. The contribution from the central government to the costs of social security is about 21.8 trillion yen. Health care is about 8.6 trillion yen and is the largest part of social security.¹³ Aging will increase the tax burden since uses for social security costs are weighted toward the elderly. We should pay attention to the growth rate of the tax burden. The financing for an increased public burden and the intergenerational allocation of income remains an important issue in the future.

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Appendix : Two-period overlapping generation model

Suppose that a pay-as-you-go system is implemented. Both the public pension and health insurance is defined to be a program in which each contribution equals benefits in each period. A representative household comprise one salaried person working for companies and a spouse who are supported by the salaried person. For simplicity, we do not take into account pension benefits for spouses who are exempt from insurance contributions and tax transfer for national pension in the following model. The social insurance system in period 2 is as follows :

$$\begin{aligned} \text{consumption}^y &= \text{health care expenditure}^y + \text{other} \\ &\quad \text{expenditure}^y \\ &= \text{income}^y - \text{social insurance}^y - \text{savings}^y \end{aligned} \tag{A1}$$

$$\begin{aligned} \text{social insurance}^y &= \text{public pension contribution}^y \\ &\quad + \text{premium of health insurance}^y \end{aligned} \tag{A2}$$

$$\begin{aligned} \text{benefits from health insurance}^o & \\ &= \text{the premium of health insurance}^y \\ &= \alpha \times \text{health care expenditure}^o \\ (0 < \alpha < 1) \end{aligned} \tag{A3}$$

$$\begin{aligned} \text{public pension benefits}^o & \\ &= \text{the growth rate of population} \\ &\quad \times \text{public pension contribution}^y \end{aligned} \tag{A4}$$

$$\begin{aligned} \text{consumption}^o &= \text{health care expenditure}^o + \text{the other} \\ &\quad \text{expenditure}^o \\ &= \text{interest rate} \times \text{saving}^o + \text{public} \\ &\quad \text{pension benefits}^o \end{aligned} \tag{A5}$$

where the growth rate of population = n , the interest rate = $1+r$, and the ratio of out-of-pocket to health care expenses = $1-\alpha$.

By using Equations (A2) and (A3) ,

$$\begin{aligned} \text{premium of health insurance}^y & \\ &= \text{social insurance}^y - \text{benefits from health insurance}^o \end{aligned} \tag{A6}$$

From Equations (A4) and (A6) , we obtain the relationship among health care expenditures, public pension benefits and the social insurance burden rate under a pay-as-you-go system.

$$\begin{aligned} B / (1+n) + \alpha M &= tY, \\ \text{where } B : \text{public pension benefits}^o, M : \text{health care} \\ &\quad \text{expenditure}^o, \\ t : \text{the social insurance burden rate}^y, Y : \text{income}^y \end{aligned} \tag{A7}$$

¹³ Share of interests and amortization is 24.3 percent, and share of general-purpose grants to local governments is 18.8 percent.

By total differentiating Equation (A7),

$$-(1+n)^{-2} B + (1+n)^{-1} dB + \alpha dM + d\alpha M = dtY + tdY \quad (A8)$$

In the case of $1+n > 0$, two causal relationships can be derived from Equation (A8).

[I] an increase in public pension benefits^a → a hike in the social insurance burden rate^b

$$[dt/dB = (1+n)^{-1}/Y > 0]$$

[II] an increase in health care expenditure^c → a hike in the social insurance burden rate^b [$dt/dM = \alpha/Y > 0$]

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