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Theoretical and Empirical Analysis of the Influences of Risks over Time and with Age on Medical Expenditures: Evidence from the Japanese One-Person Households

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Abstract

This paper theoretically and empirically analyzes the relationship between medical expenditures and risk. First, the influences of two risk parameters on medical expenditures are theoretically investigated. The decrease in the time risk, which is interpreted to represent social risks such as medical technology and public health, reduces the expenditure on medical care. The increase in the age risk, which is interpreted to represent individual risks such as aging, increases the expenditure on medical care. Second, the medical expenditures of Japanese one-person households from 1969 to 1994 are estimated. The influences of two risk parameters on the medical expenditures are confirmed as expected, and the gender distinction and the institutional change are also important.

1. Introduction

Since developed countries are now confronted with fiscal crises resulting from the rapid increase in medical expenses, a dynamic analysis of medical expenses and health risks will have interesting implications for medical policies. It was Grossman (1972) who first investigated health as capital and medical care as investment; he assumed that individuals inherit an initial stock of health that depreciates with age and can be increased by health investment. Although he did not explicitly deal with death risk, a considerable number of studies have been made that incorporate death risk into models: see Cropper (1977), Wolfe (1985), Dardanoni and Wagstaff (1987, 1990), Liljas (1998), Picone, Uribe, and Wilson (1998), for example. On the other hand, in the last few years, a considerable number of empirical articles have been devoted to the study of the relationship between value of life and death risks: see Viscusi, Hakes and Carlin (1997), Hammitt and Graham (1999), and Krupnick, et al. (2002), for example[1].

The purposes of this paper are to establish the Grossman-type model with endogenous death and to theoretically and empirically investigate the influences of two risk parameters on medical expenditures. The first risk represents the relationship between health stock and death risk. Since the death risk decreases over time owing to the progress in medical technology and public health, it will be a decreasing factor in

[1] Sakai (1996) and Nishimura (2000) are very informative on the general discussions concerning risks and Japanese society as well.

medical expenditures. Let us call this type of risk 'time risk'. We will, first, theoretically predict that the time risk is positively correlated with medical expenditures and, second, empirically confirm this relationship, interpreting the time risk as an age-adjusted death rate in a selected year. The second risk represents the depreciation rate of health stock. Since this increases with age, it will be an increasing factor in medical expenditures. We will, first, theoretically predict that the age risk is also positively correlated with medical expenditures and, second, empirically confirm this relationship, interpreting the age risk as a death rate at a selected age.

Furthermore, we will discuss medical-policy implications for one-person households. There are two reasons why the data for one-person households are used for this empirical analysis. The first is a technical reason. In the ordinary family data, we cannot completely identify who purchases what; on the other hand, in the one-person households data, we can specify the characteristics of a household such as the age, income, and gender distinction with the expenditures. The second is a policy reason. The composition of a typical Japanese family has changed from three-generation family, to nuclear family, and further to one-person household after World War II.

Three-generation families used to be very common before the war because carrying on the family line was important and the eldest son and his wife had to inherit the house and look after his parents. However, the number of nuclear families has increased because young people moved out of the rural areas to the cities as a result of Japan's industrialization after the war. According to statistics, 60% of all households were nuclear families, whereas three-generation families declined to 10% of the total in 1990. Furthermore, the number of people living alone has been rapidly increasing. One reason for this is that the number of unmarried people has been rising. The 1990 NATIONAL CENSUS indicated that 32.6% of men and 13.9% of women in their early thirties were unmarried. Another reason is that Japanese society has continued to age and more than 10% of elderly people are living alone. In 1969 only 7% of one-person households were over fifty years old while in 1994 this figure rose to 50%. In addition, since the average life expectancy of women is longer than that of men, 84% of the elderly one-person households were female in 1994.

The points we will make are as follows. The elasticity of medical expenditure with respect to income is lower than 1 so that it has a characteristic of necessities. Also, a decrease in the time risk leads to a large decrease in medical expenditures, while for the age risk the effect is small. Furthermore, the increase in the number of the one-person households is currently becoming an issue in debates on medical policy, firstly because most of them are elderly, whose death rates are high and thus whose medical expenditures are large, and secondly because most of them are female, and tend to spend more on medical care.

The paper consists of the following four sections. Section 2 carries out the theoretical analysis: first, the model is set up, and the equilibrium is examined; next, the influences of two risk parameters on health investment are analyzed with comparative statics. Section 3 performs the empirical analysis: first, the two theoretical hypotheses are verified; second, the influences of various variables on medical expenditures are investigated from the viewpoints of time series and cross section. Section 4 draws a conclusive discussion.

2. Theoretical analysis

2.1 A basic model

A basic model is set up here. The death of an individual is modeled using probability. The hazard rate, which is the conditional probability of dying in a short interval of time after having survived, is assumed to be a decreasing function of health stock. Definitions are as follows: $F_t \equiv F(t)$: the probabilistic distribution of dying at t ($F_0=0$, $F_T=1$), $f_t \equiv f(t)$: the probabilistic density of dying at t, $H_t \equiv H(t)$: the health stock at t, $\mu_t \equiv \mu(H_t) \equiv f_t/(1-F_t)$: the conditional probability of dying at t ($d\mu_t/dH_t \leq 0$), $1-F_t=\int_t^T f_s ds=Exp(-\int_0^t \mu_s ds)$: the probability of surviving at least until t.

The time available for the individual is divided into healthy time and sick time, where healthy time is positively related to the health stock while sick time is negatively related. Definitions are as follows: $TH_t \equiv TH(H_t)$: healthy time at t ($dTH_t/dH_t>0$),

$TL_t \equiv TL(H_t)$: sick time at t ($dTL_t/dH_t<0$), T_t: time possibly available for economic activity at t, $T_t=TH_t+TL_t$: time budget constraint, Z_t: other consumption goods.

The individual can obtain two utilities from health: (1) the direct utility of being healthy, which is brought by the healthy state itself, and (2) the indirect utility of being healthy, which one can get by working and consuming. Here let us suppose for convenience that two utilities are additively separable. The intertemporal utility is an expected value over a lifetime that is discounted by the interest rate, r. Definitions are as follows: $u_t \equiv u(TH_t)$: the direct utility of being healthy at t, $u'>0$, $u''<0$, $v_t \equiv v(Z_t)$: the indirect utility of being healthy at t, $v'>0$, $v''<0$, $U_t \equiv u_t+v_t$: the instantaneous utility at t, $\int_0^T F_t(\int_0^t Exp(-rt)U_t ds)dt$ $=\int_0^T Exp(-rt)(1-F_t)U_t d$ $=\int_0^T Exp(-rt)Exp(-\int_0^t \mu_s ds)U_t dt$: the intertemporal utility over a lifetime.

Let us set the price of consumption goods as 1, wage w, the price of health investment p, health investment I_t, and the depreciation rate of health stock δ_t. There are three kinds of constraints. (1) The income budget constraint, $wT_t=pI_t+Z_t+wTL_t$. This represents the fact that the maximum income that we would get if we worked all the time available to us is equal to the sum of the expenditure on health investment, the expenditure on consumption goods and the income foregone owing to sickness. (2) The health stock condition, $I_t=dH_t/dt+\delta_t H_t$. This represents the health investment equaling the net increase in health stock plus its depreciation. (3) The initial condition of health stock, $H_0=H(0)$.

2.2 The optimization problem and the maximum principle

The optimization problem is expressed as follows:

$$\text{MAX} \quad \int_0^T \text{Exp}(-rt)(1-F_t)U_t dt, \quad \text{S.T. } Z_t=wTH_t-pI_t,\ dH_t/d_t=I_t-\delta_t H_t,\ H_0=H(0).$$

Let us set $\lambda_t \equiv \lambda(t)$ as a costate variable. The current-value Hamiltonian then becomes $L \equiv (1-F_t)U_t+\lambda_t(I_t-\delta_t H_t)$. The maximum principle for the above problem is as follows:

$$\partial L/\partial I_t=-p(1-F_t)v_t'+\lambda_t=0 \qquad (1)$$

$$dH_t/dt=I_t-\delta_t H_t \qquad (2)$$

$$d\lambda_t/dt=r\lambda_t-LH_t=(r+\delta_t)\lambda_t+f_t(u_t+v_t)-(1-F_t)(u_t'+wv_t')TH_t' \qquad (3)$$

$$\text{Exp}(-rT)\lambda_T=0 \qquad (4)$$

$$H_0=H(0). \qquad (5)$$

Substituting for λ_t, $d\lambda_t/dt$, dH_t/dt in equations (1)-(3), the following is derived:

$$dI_t/dt=[(wTH_t'-\mu_t v_t'/v_t'')(I_t-\delta_t H_t)-(r+\delta_t)v_t'/v_t''-\mu_t(u_t+v_t)/pv_t''+(u_t'+wv_t')TH_t'/pv_t'']/p.$$

(6)

Equations (2) and (6) indicate a differential equations system concerning health stock and health investment. We can draw a dynamic phase diagram for them given initial conditions. However, the current system seems too general to examine, and therefore we need to specify the functional forms in order to easily understand the characteristics of the equilibrium.

2.3 The specification of functional forms and the equilibrium

To specify functional forms, we omit the direct utility of health and only consider the indirect utility. (1) v_t=-Exp(-α(wTH_t-pI_t)), $v_t'/v_t''=-1/\alpha$, $v_t/v_t''=1/\alpha$, $\alpha>0$: assume the utility of consumption goods to be a constant absolute-risk-aversion function. (2) $TH_t=\beta LogH_t$, $TH_t'=\beta/H_t$: the relationship between health stock and healthy time is logarithmic. (3) $\mu_t=\gamma/H_t$: the health stock is in inverse proportion to the conditional probabilistic density of death. (4) $T_t=T$, $\delta_t=\delta$: the available time and the depreciation rate are constant. After specifying the functional forms, equations (2) and (6) can be rewritten as follows:

$$dH_t/dt=I_t-\delta H_t \qquad (7)$$

$$dI_t/dt=[(\alpha\beta w+\gamma)/\alpha pH_t][I_t-\{(\alpha\beta w+\gamma-1)\delta-r\}H_t/(\alpha\beta w+\gamma)-1/p\alpha]. \qquad (8)$$

Equations (7) and (8) are autonomous. By assuming dH_t/dt and dI_t/dt to be zero in Equations (7) and (8), we have the following equations:

$$I_t=\delta H_t \tag{9}$$

$$I_t=\{(\alpha\beta w+\gamma-1)\delta-r\}H_t/(\alpha\beta w+\gamma)+1/p\alpha. \tag{10}$$

Equations (9) and (10) depict isoclines where the changing rates of health stock and health investment are zero. Both are linear, and the slope in equation (9) is always steeper than the one in equation (10). Furthermore, since the line expressed by equation (10) cuts the I-axis above zero while the line expressed by equation (9) intersects the origin, equations (9) and (10) have a point of equilibrium:

$$(H^*, I^*)=((\alpha\beta w+\gamma)/p\alpha(\delta+r),\ \delta(\alpha\beta w+\gamma)/p\alpha(\delta+r)).$$

Although the sign of the isocline's slope of equation (10) is indefinite, let us now suppose that it is negative, $(\alpha\beta w+\gamma-1)\delta<r$, which in fact needs not to be assumed for comparative statistics in the next section. In this case, we can easily verify that the steady state, (H^*, I^*), is a saddle point, to which there is only a unique path. See the Appendix for further discussion. Figure 1 depicts the saddle point. The dotted lines in the phase plane diagram represent two separatrices: the one whose slope is negative converges to the steady state as time passes, whereas the other whose slope is positive diverges[2].

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[2] It is interesting to note that this result is very similar to Cropper's (1977), even though his model seems to be rather different from ours.

<Figure 1>

2.4 Comparative statics concerning two risk parameters

We move on to perform a comparative statics analysis. It should be noted that all conclusions drawn hold even in the case where the equilibrium is not a saddle point. This model has two risk parameters: (1) the depreciation rate of health stock, δ, and (2) the risk rate of health stock on death, γ. It seems that the former relates to an individual healthy state and therefore is a risk parameter with age; on the other hand, the latter relates to a socially healthy status such as medical technology and public health and therefore is a risk parameter over time. How do the risk parameters influence health investment? First, let us start with δ. Because of $\partial I^*/\partial\delta=r(\alpha\beta w+\gamma)/p\alpha(\delta+r)^2>0$, the relationship between δ and health investment is positive. Since δ is generally thought to be higher in old people, the expenditure on medical care will increase with age. See Figure 2a, for example, in the case of the saddle point. Next, let us turn to γ. Because of $\partial I^*/\partial\gamma=\delta/p\alpha(\delta+r)>0$, the relationship between γ and health investment is also positive. Since γ is expected to decrease as medicine advances, the expenditure on medical care will decrease over time. See Figure 2b, for example, in the case of the saddle point.

<Figure 2>

3. Empirical analysis

3.1 Definitions and data

Having studied the dynamic model of health investment, we now turn to the empirical analysis of the theoretical conclusion. First, we start with the definitions of data in our regression model. The induced variable is the real (1994) expenditure on medical care in a month (Medical care, ¥1) [3]. The explanatory variables are the real (1994) income in a month (Income, ¥1000), the age-adjusted death rate in a selected year (Time risk, per 1000 population), the death rate at a selected age (Age risk, per 10000 population), the female dummy (D-female), and the year dummy (D-year)[4]. The data are drawn from THE NATIONAL SURVEY OF FAMILY INCOME AND EXPENDITURE: ONE-PERSON HOUSEHOLDS (by MANAGEMENT AND COORDINATION AGENCY, JAPAN) and THE LIFE TABLETS (by MINISTRY OF HEALTH AND WELFARE, JAPAN).

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[3] This includes expenditures on (1) medicine, (2) health fortification, (3) medical supplies and applications, and (4) medical services.

[4] The year dummy is interpreted to represent the transition in the social structure and the change in the health insurance system. For example, in Japan, since the introduction of the universal health insurance system in 1961, the contribution paid by the aged for medical service was first reduced and then became free of charge in 1972. However, due to the budget deficit caused by the oil crisis, the policy was completely changed and the contribution of the aged has gradually risen since the 1980s.

The data will be described next. Since THE NATIONAL SURVEY is published every five years, the data for 1969/1974/1979/1984/1989/1994 are pooled. It will be useful at this point to explain the data that is to be estimated. The total number of data is 21943, the average monthly income ¥221470, the average monthly medical expenditure ¥2572, the female ratio 0.52, the average age 39, the death rate corresponding to this age 0.0047, and the age-adjusted death rate 0.0071. Next, let us divide the data into the under-50 year olds and the over-50 year olds. For the under-50 year olds, the total number of data is 14914, the average monthly income ¥229090, the average monthly medical expenditure ¥1462, the female ratio 0.38, the average age 27, the death rate corresponding to this age 0.0001, and the age-adjusted death rate 0.0079. For the over-50 year olds, the total number of data is 7029, the average monthly income ¥205280, the average monthly medical expenditure ¥4927, the female ratio 0.83, the average age 64, the death rate corresponding to this age 0.0126, and the age-adjusted death rate 0.0052. The above figures are summarized in Table 1. It can be observed that the female ratio, the age risk, and the ratio of medical expenditure to income are higher in the elderly one-person households than in the young one-person households.

<Table 1>

3.2 The method and result of the estimation

We turn to the estimation by using the weighted regression model as follows. The weight is the number of tabulated households (N). The coefficients are a~f, and the disturbance term is u.

$$(N_i)^{1/2}MC_i=(N_i)^{1/2}a+b(N_i)^{1/2}INC_i+c(N_i)^{1/2}TR_i+d(N_i)^{1/2}AR_i$$
$$+e(N_i)^{1/2}D\text{-}F_i+(N_i)^{1/2}\Sigma f_j D\text{-}Y_i+(N_i)^{1/2}u_i.$$

Table 2 shows the result of the estimation. Adjusted R^2 is 0.66, and all t-values are significant at the 5% level. Although the constant is negative, all other coefficients are positive as expected. This is consistent with our theoretical conclusion that the coefficients of two risk parameters, time risk and age risk, are positive. The time risk is represented by the age-adjusted death rate in a selected year. The time risk decreases as time passes, which is showed in Figure 3 (a), because of the development of medical technology and the improvement of public health. Thus the decrease in the time risk results in the decrease in medical expenditures, reflecting the positive correlation between this risk and the medical expenditures. On the other hand, the age risk is represented by the death rate at a selected age. The age risk increases with age, which is shown in Figure 3 (b). Thus the increase in the age risk results in the increase in medical expenditures, reflecting the positive correlation between this risk and the medical expenditures.

<Table 2 and Figure 3>

Next, we will calculate the elasticity of medical expenditure according to the estimates. The result of the calculation is shown in Table 3. The elasticity of the average medical expenditure with respect to the average income is 0.5168 (corresponding to ¥13.3), for the average female ratio 2.2560 (corresponding to ¥58.0), for the average time risk 7.1625 (corresponding to ¥184.2), for the average age risk 0.1796 (corresponding to ¥4.6).

<Table 3>

3.3 The time series and cross section analyses

Table 4 shows the time-series change in medical expenditures as a comparison of the Japanese one-person households between 1969 and 1994. In 1969, the real (1994) average expenditure on medical care per month was ¥837.7, the real (1994) average income per month ¥127800, the female ratio 0.45, the time risk 0.0105, the average age 27.3, and the age risk corresponding to this age 0.0018. On the other hand, in 1994, the average expenditure on medical care per month was ¥4637.9, the average income per month ¥276400, the female ratio 0.60, the time risk 0.0051, the average age 66.4, and the age risk corresponding to this age 0.0065. Concerning the percentage contribution to the difference in medical expenditures between 1969 and 1994, ¥3800.2, the negative effect of the time risk (-368%) and the positive effect of the year dummy

(390%) are particularly large, but cancel each other out (hence the net effect of time is 21%), in comparison with the other contributions of income (23%), the age risk (12%), and the female dummy (42%).

<Table 4>

Let me summarize the main points. First, the effect of time is considerable: the 50% reduction in the age-adjusted death rates throughout 1969-1994 decreases the medical expenditures significantly, while the institutional and structural change of the society, represented by the dummy variables, increases the medical expenditures substantially. It may be that the changing medical environments, such as the increase in long-term care and chronic diseases, lead to the large increase in medical expenditures, while the death rate declined largely due to the development of medical technology and the improvement in living conditions. Second, the growth in the number of single women living alone results in the substantial increase in medical expenditures. This is, firstly, because women tend to spend more on medical care and, secondly, most female one-person households are elderly. Third, on the other hand, the four fold increase in death rate at an average age, reflecting the arrival of an aging society, does not lead to the large increase in medical expenditures, and also the doubling in real income does not contribute significantly to the increase in medical expenditures.

Table 5 shows the cross-sectional change in medical expenditures in 1994 as a comparison between one-person households where the individual concerned is under 50, and households where he or she is over that age. The expenditure on medical care for the under-50 group per month was on average ¥3679.9, the income per month ¥308800, the female ratio 0.36, the time risk 0.0059, the average age 29.3, and the age risk corresponding to this age 0.0008. On the other hand, the expenditure on medical care for the over-50 group per month was on average ¥5613.3, the income per month ¥243500, the female ratio 0.84, the time risk 0.0043, the average age 66.4, and the age risk corresponding to this age 0.0123. Concerning the percentage contribution to the difference in medical expenditures between the under-50 and the over-50 group, ¥1933.4, the negative effect of the time risk (-211%) and the positive effect of the female dummy (272%) are particularly large[5], but cancel each other out (hence the net effect of gender is 61%), in comparison with the other contributions of income (-20%), and the age risk (58%).

<Table 5>

Let me summarize the main points. First, the large proportion of elderly females living alone raises medical expenditures substantially, while the lower age-adjusted

[5] Here the effect of the time risk is based on the difference in the age-adjusted death rate between males and females.

death rate of women reduces medical expenditures significantly. The net contribution of this gender effect to the increase in medical expenditures accounts for more than half, and this becomes one of the biggest factors in the increase in medical expenditures, along with the difference in death rate between the old and the young one-person households. Second, the death rate of the elderly group is sixteen times as high as that of the young group, which accounts for more than half of the increase in medical expenditures. Third, in contrast, the reduction in income of the elderly group is a decreasing factor in the change in medical expenditures.

4. Conclusive discussion

The rapid increase in medical expenses is a common headache for all developed countries. This paper has theoretically and empirically discussed this problem from the viewpoint of risk. First, the dynamic model of health investment with endogenous death was established and the influences of two risk parameters were investigated. Second, the medical expenditures of Japanese one-person households from 1969 to 1994 were estimated using some explanatory variables.

Consequently, the results can be summarized in:

Conclusion 1. It is theoretically predicted that both the age risk, which represents the depreciation rate of health stock, and the time risk, which represents the risk rate of health stock on death, are positively correlated with medical expenditures.

Conclusion 2. The theoretical prediction, stated in Conclusion 1, is empirically confirmed. Since the time risk decreases as time passes and the age risk increases with age, the two risks have opposite effects on the medical expenditures.

Conclusion 3. The elasticity of medical expenditure with respect to income is lower than 1 so that it has the characteristic of necessities. Furthermore, a decrease in the time risk leads to a large decrease in medical expenditures, while for the age risk the effect is small.

Conclusion 4. The increase in the number of the one-person households is currently becoming an issue in debates on medical policy, firstly because most of them are elderly, whose death rates are high and thus whose medical expenditures are large, and secondly because most of them are female, and tend to spend more on medical care.

However, the model we use in this paper is quite simplified in its functional forms, and we only examine the data for one-person households. Much still remains to be done, and this is a small step towards a complete study of the complicated relationship between medical expenditure and risk.

APPENDIX

We will prove that the equilibrium is a saddle point. By a linear approximation around the equilibrium point, Equations (7) and (8) can be written as follows:

$$dH/dt=F_H(H^*,I^*)(H-H^*)+F_I(H^*,I^*)(I-I^*) \quad (11)$$

s.t. $F_H(I^*,H^*)=-\delta$, and $F_I(I^*,H^*)=1$,

$$dI/dt=G_H(H^*,I^*)(H-H^*)+G_I(H^*,I^*)(I-I^*) \quad (12)$$

s.t. $G_H(I^*,H^*)=-[((\alpha\beta w+\gamma-1)\delta-r)(\delta+r)]/(\alpha\beta w+\gamma)$, and $G_I(I^*,H^*)=\delta+r$.

Defining $H'=H-H^*$ and $I'=I-I^*$, Equations (11) and (12) are rewritten as follows:

$$dH'/dt=F_H(H^*,I^*)H'+F_I(H^*,I^*)I', \quad (13)$$

$$dI'/dt=G_H(H^*,I^*)H'+G_I(H^*,I^*)I'. \quad (14)$$

Combining Equations (13) and (14), the following is obtained:

$$d^2I'/dt^2+pdI'/dt+qI=0 \quad (15)$$

s.t. $p=-(F_H(H^*,I^*)+G_I(H^*,I^*))$,

and $q=F_I(H^*,I^*)G_H(H^*,I^*)-F_H(H^*,I^*)G_I(H^*,I^*)$.

Letting x_1 and x_2 be two different roots for $x^2+px+q=0$, we obtain $I'=c_1\exp(k_1t)+c_2\exp(k_2t)$. In the case of $q<0$, x_1 and x_2 are real and of opposite signs, and the equilibrium is a saddle point. Here, on the assumption, $(\alpha\beta w+\gamma-1)\delta<r$, the following necessarily holds:

$$q=(\delta+r)[-\delta+((\alpha\beta w+\gamma-1)\delta-r]/(\alpha\beta w+\gamma)]<0. \quad (16)$$

Thus we have proved that the equilibrium (H^*, I^*) is the saddle point.

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Table 1. The description of data

	No. of households	Age	Income (¥1000)	Medical care	Female ratio	Time risk	Age risk
All average	21943	39.03	221.47	2571.96	0.52	7.07	46.92
Under-50 average	14914	27.10	229.09	1461.97	0.38	7.93	9.75
Over-50 average	7029	64.34	205.28	4927.12	0.83	5.25	125.77

Table 2. Estimation result (R^2=0.661053)

Variable	Const.	Income	Time risk	Age risk	D-female	D-1974	D-1979	D-1984	D-1989	D-1994
Coefficient	-32503.1	6.00	2605.97	9.85	11122.60	3530.44	7959.05	9788.32	12806.40	14835.40
Standard error	10149	2.82	834.45	1.83	2924.06	1164.58	2512.86	3084.66	3759.67	4049.63
t-statistic	-3.20259	2.13	3.12	5.38	3.80	3.03	3.17	3.17	3.41	3.66

Table 3. Elasticities of medical expenditure

	Income	Female ratio	Time risk	Age risk
Elasticities	0.5168	2.2560	7.1625	0.1796

Table 4. Increase in medical care per month over time (1969/1994)

	Medical care	Income (¥1000)	Female ratio	Time risk	Age risk	D-1994
Average1969	837.7	127.8	0.45	10.5	18.2	0.0
Average 1994	4637.9	276.4	0.60	5.1	64.7	1.0
Difference	3800.2	148.6	0.14	-5.4	46.5	1.0
Coeff.*Diff.	3800.1	892.0	1593.5	-13978.6	457.7	14835.4
Contribution	100%	23%	42%	-368%	12%	390%

Table 5. Increase in medical care per month with age (under-50/ over-50 in 1994)

	Medical care	Income (¥1000)	Female ratio	Time risk	Age risk	D-1994
Under -50	3679.9	308.8	0.36	5.9	7.7	1
Over-50	5613.3	243.5	0.84	4.3	122.6	1
Difference	1933.4	-65.3	0.47	-1.6	114.9	0
Coeff.*Diff.	1934.3	-391.9	5268.2	-4073.3	1131.3	0
Contribution	100%	-20%	272%	-211%	58%	0%

Figure 1. Equilibrium phase

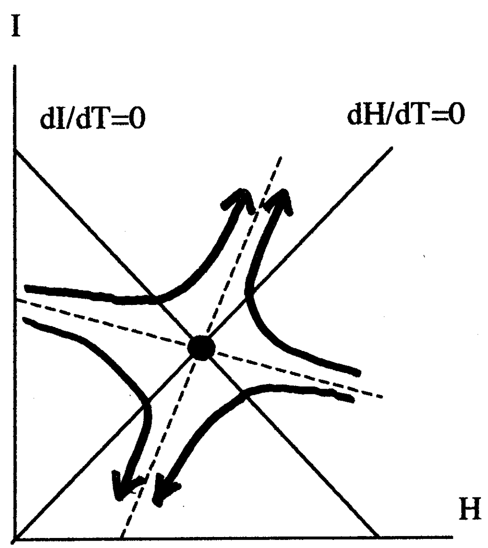


Figure 2. (a) Increase in δ

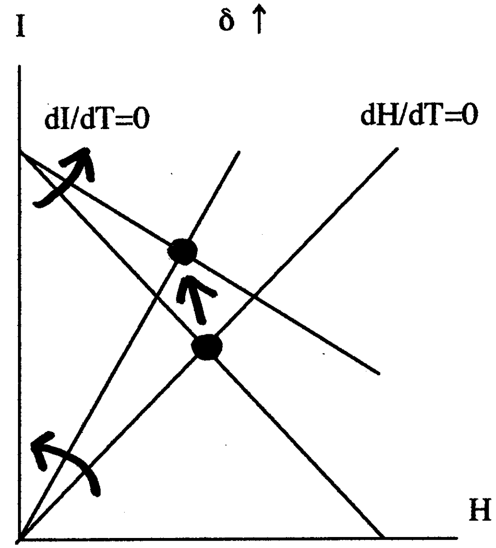


Figure 2. (b) Decrease in γ

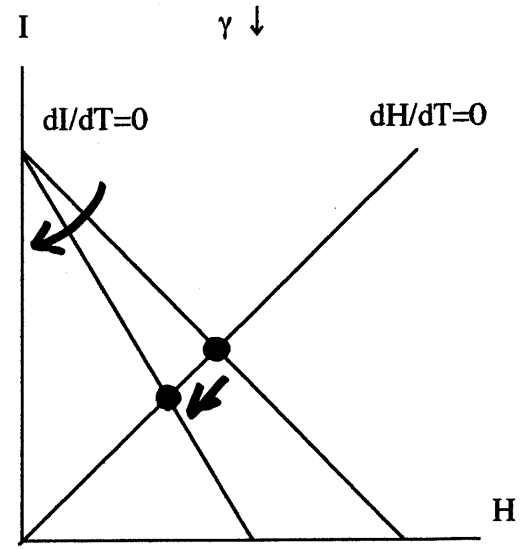
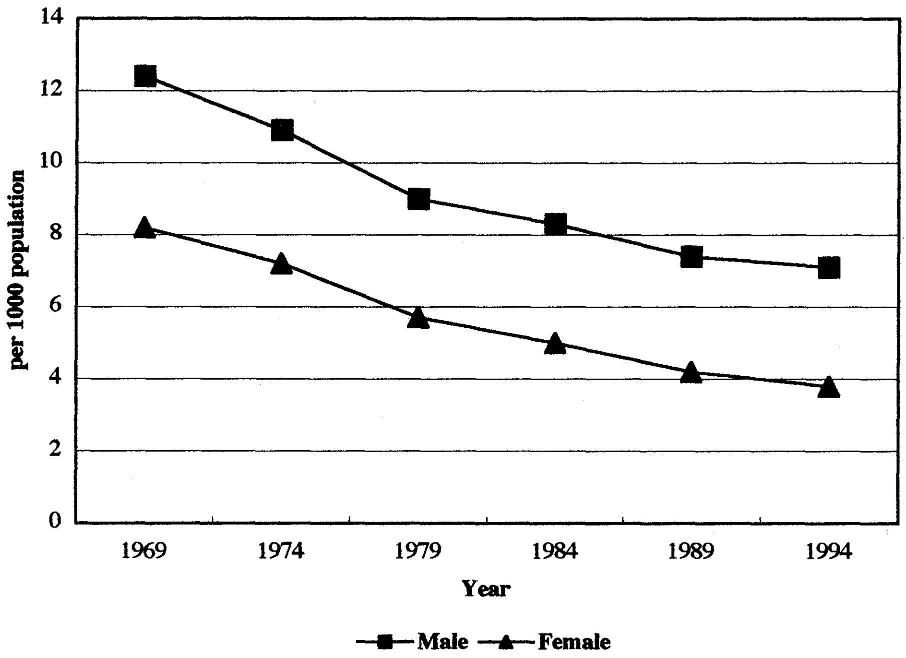


Figure 3. The time risk and the age risk

(a) The age-adjusted death rate in a selected year



(b) The death rate at a selected age