The Precautionary Behavior of Korean Households under Health Uncertainty

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Abstract

This paper tests the existence of precautionary saving motive under health uncertainty, using household level panel data from Korea. For this purpose, this paper considers a dynamic health capital model with health uncertainty and derives testable equations for changes in consumption and medical expenditures. Under this framework, households who face future health uncertainty will exhibit precautionary behavior by depressing consumption or increasing investment in health. To test this hypothesis, the paper uses the conditional variance of health as the direct measure of health uncertainty, obtained by estimating a multinomial logit model. Empirical results using the Korean Household Panel Study (KHPS, 1993 – 1997) suggest that Korean elderly households follow the precautionary behavior to insure against future health risk.

Keywords:

Health Uncertainty; Precautionary Saving

Introduction

In health economics, many researchers have pointed out that one of the important risks that an individual faces is the uncertainty surrounding his or her health status and consequently, uncertain medical expenditures. A few theoretical studies have focused on the direct effect of health uncertainty on the demand for medical care at an individual level by using the Grossman's [1] health capital model (for example, [2], [3], [4], [5], [6]). In particular, Picone et al. [6] emphasize the importance of the precautionary saving motive for retired individuals who insure against future health risk. They characterize the response to health uncertainty as a pattern of the precautionary behavior, and obtain the solutions to the model numerically. Since their findings are not followed by empirical analysis, their simulation results are merely suggestive not conclusive. On the other hand, a few empirical studies on precautionary saving also analyze the quantitative effects of health risk (for example, [7], [8]), but they are not conducted within a health capital framework: health risk variables are simply included in the model with little theoretical justification.

This study improves on previous work on precautionary saving under health uncertainty in several ways. First, the paper presents testable equations – the changes in consumption equation and the changes in medical expenditures equation – to be used in examining the existence of precautionary saving motive under health uncertainty. Unlike Picone et al. [6] who rely on the numerical solution, we solve the individual's optimization problem analytically and derive the relationships that reflect the precautionary behavior under health uncertainty. Second, the paper uses the conditional variance of health as the more direct measure of health uncertainty, whereas some previous studies use proxy variables such as the number of days ill [7] or the health insurance coverage [8]. With this explicitly constructed health uncertainty, we test the existence of the precautionary saving motive under health uncertainty, using household level panel data from Korea.

This paper is organized as follows: Section 2 introduces the model this paper considers. In Section 3, we give a brief description of the data, followed by the explanation of the method for obtaining conditional health variance. We then present the empirical results of testing the precautionary saving hypothesis. Section 4 concludes and suggests possible extensions for the future research.

Approach and Methods

In order to evaluate the importance of the precautionary saving motive under health uncertainty, we begin with a simplified version of Grossman's [1] health capital model from which it is relatively simple to obtain closed-form equations for consumption and medical expenditures changes. At each stage of the life-cycle, individual i chooses consumption and medical expenditures to maximize the lifetime utility:

$$\max_{C_{i,t},M_{i,t}} E_t \sum_{j=0}^{T-t} \left(\frac{1}{1+\rho} \right)^j U(C_{i,t+j}, H_{i,t+j}), \quad (1)$$

where E_t denotes the expectation conditioned on information set available at time t, $C_{i,t}$ is real consumption, $H_{i,t}$ is the health stock, $M_{i,t}$ is the real (out-of-pocket) medical expenditures, ρ indicates the subjective rate of time preference, and T is the end time. Since we focus only on the effect of health uncertainty, we consider the individuals with no labor income as in Picone et al [6]. Then, the per-period budget constraint becomes:

$$W_{i,t+1} = (1+r)(W_{i,t} - C_{i,t} - M_{i,t}), \quad (2)$$

where $W_{i,t}$ is the real stock of wealth at the beginning of the period t, and r is the real interest rate. In this framework the health stock, $H_{i,t}$, has the consumption aspect only; it generates the direct utility when it enters the utility function as a separate argument. The health stock at the end of the period t evolves:

$$H_{i,t} = (1-\delta)H_{i,t-1} + M_{i,t} + \eta_{i,t}, \quad (3)$$

where δ is the depreciation rate of health stock and $\eta_{i,t}$ is assumed to be a normally distributed random variable which allows for the introduction of uncertainty into the health evolution process. Each individual is assumed to have no bequest motive, hence exhausts his or her assets before time $T+1$ (i.e., $W_{i,T+1} = 0$).

The maximization problem can be considered as a dynamic programming problem. Solving the problem yields the following first-order conditions:

$$U_C(C_{i,t}, H_{i,t}) = \left(\frac{1+r}{1+\rho} \right) E_t \left[U_C(C_{i,t+1}, H_{i,t+1}) \right], \quad (4)$$

$$U_H(C_{i,t}, H_{i,t}) = \left(\frac{1+r}{1+\rho} \right) E_t \left[U_H(C_{i,t+1}, H_{i,t+1}) \right], \quad (5)$$

$$U_C(C_{i,t}, H_{i,t}) = \left(\frac{1+r}{r+\delta} \right) U_H(C_{i,t}, H_{i,t}), \quad (6)$$

where U_C and U_H are the first derivatives of U with respect to C and H, respectively.

We assume a constant absolute risk aversion (CARA) utility function in which consumption and health stock are separable:

$$U(C_{i,t}, H_{i,t}) = -\frac{1}{\alpha} e^{-\alpha C_{i,t}} - \frac{1}{\gamma} e^{-\gamma H_{i,t}}, \quad (7)$$

where α and γ are the coefficients of absolute risk aversion with respect to consumption and health stock, respectively. If α and γ are positive, the utility function implies that the marginal utility is convex in both consumption and health stock ($U''' > 0$, with respect to both C and H), and an increase in uncertainty raises the expected marginal utility.

Substituting Eq. (7) into the first-order conditions of Eq. (4) – (6) and using a Taylor series expansion, we can derive the following equations for changes in consumption and changes in medical expenditures:

$$\Delta C_{i,t+1} = \frac{r-\rho}{\alpha} + \frac{\alpha\gamma^2}{2(\alpha+\gamma)^2} Var_{i,t}(\eta_{i,t+1}) + \varepsilon_{i,t+1}, \quad (8)$$

$$\begin{aligned} \Delta M_{i,t+1} = {} & \frac{(r-\rho)\delta}{\gamma} + \frac{\alpha^2\gamma}{2(\alpha+\gamma)^2} Var_{i,t}(\eta_{i,t+1}) \\ & - \frac{\alpha^2\gamma(1-\delta)}{2(\alpha+\gamma)^2} Var_{i,t-1}(\eta_{i,t}) - (1-\delta)\xi_{i,t} + \xi_{i,t+1}, \end{aligned} \quad (9)$$

where $Var_{i,t}$ denotes the variance conditioned on the information set available at time t, and $\varepsilon_{i,t}$ and $\xi_{i,t}$ are expectation errors.[1] The conditional variance terms in the above equations represent health uncertainty. The strength of the precautionary saving motive depends on the degree of risk aversion with respect to consumption and health stock, and on the depreciation rate of health stock.

Since we assume that individuals are risk-averse, i.e. α and γ are positive, the future health uncertainty has a positive effect both on changes in consumption and on changes in medical expenditures. This implies that individuals who face future health uncertainty will exhibit precautionary behavior by depressing consumption or increasing investment in health, in advance. In the next section, we will test the prediction of the model that individuals modify their consumption and medical expenditures to insure against future health uncertainty.

Results

Data

Data from the Korean Household Panel Study (KHPS), ranging from 1993 – 1997, were used to estimate the effect of health uncertainty on changes in consumption and medical expenditures. The KHPS is a nationwide panel survey that interviewed a representative sample of the non-institutional Korean population, aged 18 and older. Each household member in the sample was surveyed once a year between August and October. For each household, the survey contains detailed information on household income and consumption, household assets, ownership of the dwelling, household size, and household members' characteristics such as age, gender, marital status, health status, education, employment, smoking habits, and drinking habits.

Since the question on self-assessed health status was omitted from the survey in 1995, we used the four-year panel data

[1] A detailed procedure to derive these equations is available from the authors upon request.

composed of 1993, 1994, 1996, and 1997 waves. The number of respondents was 10,460 in the 1993 wave, 8,567 in 1994, 6,729 in 1996, and 6,320 in 1997. After excluding the individuals from the original data due to missing or internally inconsistent responses, we have constructed a working sample of a balanced panel composed of 4,950 individuals.

Consumption does not include durable goods consumption and consists of expenditures on food, housing, clothing/footwear, and cultural/recreation. These components are referred to as "nondurable consumption" by the KHPS classification. Both consumption and medical expenditures have been adjusted using the consumer price indexes and expressed in 1995 constant prices.

In the KHPS, the self-assessed health status was measured by asking each individual to describe his or her general health status as 5 categories: "excellent", "good", "average", "poor", or "very poor". Description of the variables included in this study is presented in Table 1.

Table 1. Description of the Variables

Variables	Description
Gender	0: female, 1: male
Age	age in years
Age Squared	$Age^2/100$
Education	0: without high school degree, 1: with high school degree
Marital Status	0: single, 1: married
Household Size	number of household members
Smoking	0: non-smoker, 1: current smoker
Drinking	0: non-drinker, 1: current drinker
Health Status	1: very poor, 2: poor, 3: average, 4: good, 5 : excellent
Consumption	annual consumption expenditures on food, housing, clothing/footwear, and cultural/recreation (10 thousand Won)
Medical Expenditures	annual medical expenditures (10 thousand Won)

Measurement of Conditional Health Variance

In order to estimate Eq. (8) and Eq. (9), the conditional variance must be determined first. In measuring the health uncertainty, previous studies employed proxy variables for health risk; for example, Guiso et al. [7] used 'the number of days ill' and Starr-McCluer [8] used 'the health insurance coverage'. This study uses the conditional variance of health as the direct measure of health uncertainty and directly calculates the conditional variance as follows: From the definition of conditional variance,

$$Var_{i,t}(H_{i,t} \mid S_{i,t-1}=j) = E[H_{i,t}^2 \mid S_{i,t-1}=j] - \{E[H_{i,t} \mid S_{i,t-1}=j]\}^2$$
$$\approx \sum_{k=1}^{5} H_k^2 P(S_{it}=k \mid S_{it-1}=j) - \left(\sum_{k=1}^{5} H_k P(S_{it}=k \mid S_{it-1}=j)\right)^2, \quad \text{for } j=1,\ldots,5, \qquad (10)$$

where $H_{i,t}$ is the (latent) health, $S_{i,t}$ is the health status of individual i at year t represented by the discrete values from 1 (very poor) to 5 (excellent); H_k is the (latent) health score corresponding to the health status k; and P is the transition probability of health status.

Since we do not have a continuous measure of health in the KHPS, the latent health scores (H_k) are obtained from the information contained in the self-assessed health status. It is generally believed that empirical distributions of self-assessed health are skewed to the lower level of health status. The sample distribution of self-assessed health in the KHPS also exhibits a skewed distribution to the lower level. Therefore, as in Wagstaff and van Doorslaer [9] and Kakwani et al. [10], we assume that underlying the responses is a continuous latent self-assessed health variable with a standard lognormal distribution. Following the method suggested in Wagstaff and van Doorslaer [9], we first divided up the area under the standard lognormal distribution in proportion to the numbers in each response category for pooled four-year data, and then obtained the corresponding latent health scores for each category. Note that the latent health scores obtained by this method indicate 'ill-health' not 'health'.

To estimate the transition probabilities of future health status given current health status, a multinomial logit model is employed as in Palumbo [11]. Then the Markov transition probability of the individual's health status in year t conditioned that his or her health status in year $t-1$ is j is:

$$P(S_{i,t}=k \mid S_{i,t-1}=j) = \frac{\exp(\beta_{kj} X_{i,t})}{\sum_{j=1}^{5}\exp(\beta_{kj} X_{i,t})}, \quad k=1,\ldots,5, \qquad (11)$$

where $X_{i,t}$ is a vector of individual i's characteristics in year t. We estimate the coefficients for five different multinomial logit models (i.e., one for each of the five health status being considered upon). The explanatory variables are age, age squared, gender, marital status, education, smoking, and drinking.

The results of the multinomial logit estimation are presented in Tables 2. The estimates for direct effect of age indicate that individuals are less likely to move into better health status as they are aging: age significantly decrease the probabilities of transition into good health from very poor health and transition into (or remaining in) excellent health from poor, average, or excellent health. It is also observed that the consumers with high school degrees are more likely to move into better health status. This is in accordance with the general notion of a positive relationship between education and health status. The effects of smoking are insignificant except for the case of 'good health last year'. The coefficients for smoking are positively significant for explaining the probability of moving into poor, average, or good health relative to very poor health. Drinking also significantly increases the probability of moving into poor, average, or good health relative to very poor health.

After calculating the health transition probabilities given current health status and the (latent) health scores, the conditional health variance for each individual in Eq. (10) can be determined. Substituting these variances into Eq. (8) and Eq. (9), we are now ready to test the prediction of the model.

Table 2. Results of Multinomial Logit Estimation

Variables	Poor Health This Year	Average Health This Year	Good Health This Year	Excellent Health This Year
Conditioned on Very Poor Health Last Year (N = 821)				
Age	−0.073 (0.051)	−0.054 (0.063)	−0.202 (0.067)***	−0.014 (0.200)
Age Squared	0.072 (0.046)	0.046 (0.059)	0.190 (0.063)***	−0.097 (0.220)
Gender	0.823 (0.233)***	0.895 (0.294)***	0.917 (0.339)***	0.640 (0.758)
Education	−0.100 (0.270)	0.604 (0.300)**	0.839 (0.358)**	−0.181 (0.719)
Marital Status	0.328 (0.215)	0.906 (0.311)***	1.122 (0.376)***	0.120 (0.741)
Smoking	0.171 (0.237)	0.122 (0.296)	−0.412 (0.369)	0.122 (0.846)
Drinking	0.741 (0.231)***	1.268 (0.272)***	1.454 (0.314)***	0.605 (0.662)
Conditioned on Poor Health Last Year (N = 2634)				
Age	−0.0008 (0.040)	−0.028 (0.041)	−0.068 (0.044)	−0.150 (0.067)**
Age Squared	−0.016 (0.036)	−0.006 (0.038)	0.028 (0.041)	0.099 (0.065)
Gender	0.517 (0.195)***	0.438 (0.200)**	0.164 (0.217)	−0.016 (0.352)
Education	0.390 (0.224)*	0.890 (0.222)***	0.698 (0.236)***	0.840 (0.353)**
Marital Status	0.302 (0.182)*	0.637 (0.197)***	0.521 (0.219)**	0.418 (0.374)
Smoking	0.087 (0.195)	0.209 (0.201)	0.099 (0.219)	−0.142 (0.368)
Drinking	0.629 (0.183)***	0.659 (0.185)***	0.698 (0.198)***	0.522 (0.309)*
Conditioned on Average Health Last Year (N = 5291)				
Age	−0.0008 (0.040)	−0.028 (0.041)	−0.068 (0.044)	−0.150 (0.067)**
Age Squared	−0.016 (0.036)	−0.006 (0.038)	0.028 (0.041)	0.099 (0.065)
Gender	0.517 (0.195)***	0.438 (0.200)**	0.164 (0.217)	−0.016 (0.352)
Education	0.390 (0.224)*	0.890 (0.222)***	0.698 (0.236)***	0.840 (0.353)**
Marital Status	0.302 (0.182)*	0.637 (0.197)***	0.521 (0.219)**	0.418 (0.374)
Smoking	0.087 (0.195)	0.209 (0.201)	0.099 (0.219)	−0.142 (0.368)
Drinking	0.629 (0.183)***	0.659 (0.185)***	0.698 (0.198)***	0.522 (0.309)*
Conditioned on Good Health Last Year (N = 4641)				
Age	0.076 (0.039)*	0.058 (0.038)	−0.013 (0.039)	−0.009 (0.051)
Age Squared	−0.081 (0.037)**	−0.105 (0.037)	−0.036 (0.038)	−0.046 (0.051)
Gender	0.373 (0.230)	0.208 (0.220)	−0.055 (0.224)	−0.087 (0.271)
Education	−0.031 (0.216)	0.333 (0.206)	0.328 (0.210)	0.227 (0.244)
Marital Status	0.588 (0.224)***	0.655 (0.215)***	0.512 (0.219)**	0.627 (0.285)**
Smoking	0.557 (0.249)**	0.614 (0.239)**	0.411 (0.243)*	0.449 (0.284)
Drinking	0.373 (0.210)*	0.528 (0.200)***	0.556 (0.203)***	0.795 (0.236)***
Conditioned on Excellent Health Last Year (N = 1463)				
Age	−0.007 (0.052)	−0.006 (0.050)	−0.046 (0.050)	−0.127 (0.056)**
Age Squared	−0.007 (0.049)	−0.037 (0.047)	−0.005 (0.047)	0.073 (0.054)
Gender	0.358 (0.299)	0.303 (0.283)	0.068 (0.281)	−0.409 (0.311)
Education	0.043 (0.277)	0.551 (0.261)**	0.566 (0.260)**	0.432 (0.287)
Marital Status	0.121 (0.319)	0.556 (0.306)*	0.374 (0.303)	0.227 (0.338)
Smoking	−0.013 (0.299)	0.136 (0.282)	−0.069 (0.280)	−0.333 (0.308)
Drinking	0.360 (0.259)	0.441 (0.245)*	0.523 (0.244)**	0.456 (0.266)*

Notes: All coefficient estimates are relative to the health transition into very poor health this year. Standard errors are in parentheses. ***Significant at the 1% level. **Significant at the 5% level. *Significant at the 10% level.

The Contribution of Health Variance to Consumption and Medical Expenditures Changes

In order to test the prediction of the model in this paper, we estimate Eq. (8) and Eq. (9) using the generalized method of moments (GMM) method. Since we consider only the households with no labor income, we select households headed by a person at least 65 years old in 1993 which is the beginning year of the panel. Instrumental variables include age, gender, education, martial status, change in household size, and lagged conditional variance of health. The estimation results are provided in Table 3. The results show that the coefficient for health variance in the consumption change equation has a positive sign as predicted by the model and is significant at the 1% level. Similarly, the coefficients for current health variance and past health variance in the medical expenditures change equation have theoretically correct signs, but only current health variance is significant at the 1% level.

Table 3. Results of Precautionary Saving Regressions

$$\Delta C_{t+1} = -13.022 + 1.979 HVAR_t$$
$$(1.808) \quad (0.034)$$
$$\Delta M_{t+1} = 1.147 + 0.0008 HVAR_t - 0.00001 HVAR_{t-1}$$
$$(0.056) \quad (0.00003) \qquad (0.00003)$$

Notes: Sample size = 81. HVAR is the conditional health variance. Instrumental variables include age, gender, education, martial status, change in household size, and lagged HVAR. Newey-West [12] heteroskedasticity and autocorrelation consistent standard errors are in parentheses.

From these results, we can conclude that precautionary saving motive against health risk can explain Korean elderly households' behavior of consumption and medical expenditures decision. As Skinner [13] stated, the precautionary saving depends on the proportion of the lifetime resources at risk. In the context of the health capital model, health is regarded as the lifetime resource. Thus, the future risk related to (out of pocket) medical expenditures may be perceived as an important factor in elderly households' consumption decision.

Conclusion

In this paper, we examined the precautionary saving motive under health uncertainty. This paper is distinguished from the preceding studies in that it provides testable equations for empirical analysis using a dynamic health capital model and suggests a direct measure of health uncertainty.

The empirical results using the Korean Household Panel Study indicate that Korean elderly households have a precautionary saving motive to insure against future health uncertainty as predicted by the model. More work needs to be done to be able to calculate the precise measure of health uncertainty, and specifically, for younger households which are not included in our study, the interaction of households' labor income and health seems to be a promising area for future research.

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