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ABSTRACT

The effect of new health information on individuals' expectations about their longevity is examined using a Bayesian learning model. Using two-period panel-structured survey data from Taiwan, we find that subjective probabilities of living to age 75 and 85 are significantly smaller for respondents with more abnormal medical test outcomes and for those receiving more extensive advice on health behavior from their physicians. The subjective probability of survival declines with health shocks such as developing heart disease. Using pooled cross-sectional data, we find that males and married persons are more optimistic about their longevity expectations than females and single persons, and that income is strongly correlated with the subjective probability of living to age 75. Consistent with previous studies, the longevity of the same-sex parent is strongly associated with an individual's own expectation of living to age 75.

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1. Introduction

The quality of individuals' decisions about health care, savings and investment, and other topics depends on the accuracy of their expectations about how long they are likely to live. In an early study, Hamermesh (1985) found that subjective longevity perceptions did not accurately correspond to actuarial distributions. The subjective distributions were flatter, exhibiting greater uncertainty about longevity than is experienced. Moreover, the respondents tended to disproportionately base their subjective life expectancies on the longevity of their older relatives.

Recent studies have examined the evolution of subjective longevity expectations using US panel data from the Health and Retirement Study (HRS) and the Asset and Health Dynamics among the Oldest-Old (AHEAD) Study. The HRS provides a nationally-representative sample of individuals ranging in age from 51 to 61 years, while the AHEAD study focuses on the oldest segment of the population, those aged 70 and above. Using these data, Hurd and his colleagues have provided consistent evidence of the predictive validity of subjective probabilities on actual mortality. Hurd and McGarry (1995) found that the subjective probabilities of living to age 75 and 85 were reasonably consistent with life-table probabilities, and that variations in these probabilities were correlated with risk factors and other individual characteristics. Individuals with higher socioeconomic status (measured by income, wealth, and education) reported higher probabilities of survival and smokers reported lower probabilities. Using two waves of the HRS, Hurd and McGarry (2002) concluded that individuals modified their survival probabilities in response to new information, with survival probability declining on the death of a parent and the arrival of a new health shock (a diagnosis of cancer).

Using the panel-structured data of the AHEAD study, Hurd et al. (1998) and Hurd et al. (1999) found that a significant proportion of the more unrealistic subjective survival probabilities stated by the respondents – focal-point responses and non-responses – were associated with low cognitive performance. After controlling for selection bias, Hurd et al. (1998) found a generally strong relationship between personal survival probabilities and covariates, with males, blacks, and married persons being more optimistic than females, whites, and unmarried persons. Furthermore, survival expectations were positively correlated with self-rated health status and the longevity of the same-sex parent. Hurd et al. (1999) also confirmed that subjective beliefs responded to the onset of adverse health conditions, such as cancer, high blood pressure, diabetes or depression.

Following the framework for updating risk estimates proposed by Viscusi and O'Connor (1984) and Viscusi (1985), Sloan et al. (1999) and Smith et al. (2001) analyzed panel data from the HRS to evaluate how exogenous health shocks affect longevity expectations. Their findings revealed that the process of risk perception was quite different for smokers, whose expectations were sensitive only to smoking-related illnesses, than for former smokers and never smokers who reacted to a wider range of health signals. Using three waves of the HRS to test the Bayesian updating model, Sloan et al. (1999) found that smokers perceived that they were more likely to experience diseases associated with smoking, and thus tended to be more pessimistic about their chances of living to age 75. Using four waves of the HRS, Smith et al. (2001) found that serious health shocks and limitations on new activities significantly reduced expected longevity.

This study addresses two issues. First, we use pooled cross-sectional data to investigate the determinants of the subjective probability of living to age 75 or 85. Second, using panel-structured data, we explore how longevity expectations respond to new health information obtained by physical examination. We use a simple Bayesian learning model (Viscusi and O'Connor, 1984;

Viscusi, 1985) to describe how individuals adjust their expectations in response to new information.

Using three surveys of Taiwanese between the ages of 40 and 64 years, we find that men tend to significantly overestimate their chances of living to 75 or 85, compared with life-table rates. In contrast, women tend to underestimate the probability of living to 75 and overestimate the chance of living to 85. Overall, the longevity expectations of males and married persons are more optimistic than those of females and single persons. We also find that income is positively correlated with the subjective probability of living to age 75, but education appears to have little association with survival expectations. Consistent with the previous literature, longevity of the same-sex parent is strongly associated with an individual’s perceived probability of living to 75. Consistent with actuarial data, the subjective probability of living to age 75 or 85 increases at an increasing rate with age.

Our results suggest that individuals who acquire new adverse health information from their physical examination revise downwards their chances of survival. A diagnosis of heart disease is found to have a strong negative effect on longevity expectations. Survival probabilities are also significantly reduced for individuals with a larger number of abnormal test outcomes and those receiving more extensive advice on health behavior from their physicians.

The remainder of the paper is organized as follows. Section 2 describes the data sources and provides a descriptive analysis, including comparison of subjective survival probabilities with actuarial estimates. Section 3 presents the empirical model specifications for the cross-sectional and panel analyses. Empirical results are reported in Section 4, and the conclusions are in Section 5.

2. Data and Descriptive Analysis

The National Health Insurance (NHI) program in Taiwan was implemented in March 1995. The program is characterized by universal coverage, low premiums, comprehensive scope of benefits, easy access to medical treatment, proper care for disadvantaged groups, and high public satisfaction. As of the end of 2005, more than 20 millions individuals were enrolled in the NHI with a coverage rate of 99 percent.

This study incorporates data from three surveys conducted at the Mackay Memorial Hospital in Taipei, Taiwan, which is one of the hospitals contracted to the NHI program. The first two surveys (waves 1 and 2 of the 2001 survey) can be combined to provide a panel-structured dataset, while the final survey (the 2002 survey) provides cross-sectional data. The sample was restricted to individuals between 40 and 64 years old participating in the voluntary physical examination which is provided free of charge to adults of these ages by the Bureau of National Health Insurance (BNHI). The majority of our sample resides in Taipei City or Taipei County, near the hospital.

Our analysis is based on individuals' subjective perceptions of longevity before and after their physical examinations, as well as their medical diagnoses and advice on health behavior provided by their physicians. Wave 1 of the 2001 survey was administered by in-person interview between July and December 2001. The questionnaire covered socio-demographic characteristics, subjective health status, health behaviors, and longevity expectations. Wave 2 consisted of follow-up telephone interviews between two and three months later, after the respondents had received their physical examination reports from the hospital. Wave 2 interviews included information on the participants' understanding of the diagnosed diseases from which they were suffering, their health behaviors, and their longevity expectations. The physical examination reports provided information on the outcomes of test items, diagnosed diseases and the extent of the advice on health behaviors provided by their physicians. Our measures of new health information are constructed as the incidence of newly diagnosed health conditions, test results, and physician advice recorded on the medical examination reports. The 2002 survey was similar to wave 1 of the 2001 survey. It was administered at the same hospital between July and December 2002. Funding limitations precluded a second wave of this survey.

Seven hundred respondents participated in waves 1 and 2 of the 2001 survey, and an additional 930 respondents participated in the 2002 survey. After discarding observations with incomplete information on key variables, a total of 1,390 observations remain for analysis (620 from the 2001 survey and 770 from the 2002 survey).

Our panel data (from the two waves of the 2001 survey) have several limitations. First, females are over-represented compared with their share of the national population. Second, there is a potential selection issue because those participating in the physical examinations may be more health-conscious than non-participants, which might influence their longevity expectations. Third, the interval between the two waves was between two and three months, which does not allow us to examine the evolution of longevity expectations over a longer period.

The variables of greatest interest to this study are the measures of subjective survival probability. Longevity expectations were elicited from the participants' responses to the following questions: "Using any number from 0 to 100, where '0' means absolutely no chance and '100' means absolute certainty, what do you think are the chances of you living to be 75 (or 85)?" After rescaling the responses to the zero-one interval we treat them as measures of the subjective probabilities of surviving to ages 75 and 85, denoted P75 and P85, respectively.[1] Previous studies (e.g., Hurd and McGarry, 1995) have used a similar question format. Viscusi

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[1] To reduce potential cognition and response errors, interviewers were asked to explain the meaning of the 0-100 point scale to each respondent prior to asking the survival questions.

and Hakes (2003) found that HRS responses to a similar question (which required respondents to provide a value between 0 and 10) may not be interpretable as probabilities since they do not respond to changes in age and other characteristics in a consistent fashion.

Figures 1 and 2 illustrate the frequency distributions of the subjective probabilities of surviving to age 75 (P75) and 85 (P85), respectively. The figures are for the pooled cross-sectional data comprised of wave 1 of the 2001 survey and the 2002 survey. Many respondents gave focal-point responses. For P75, 32 percent reported '1.0', 17 percent reported '0.5', and 11 percent reported '0'. For P85, 15 percent reported '1.0', 18 percent reported '0.5', and 27 percent reported '0'. One interpretation of these results is that many respondents chose one of these three points according to whether they are rather confident, uncertain, or not at all confident of reaching ages 75 and 85. Alternatively, the spikes may reveal cognition error or misunderstanding. Hurd and McGarry (1995) obtained a similar distribution with spikes at these focal values for US respondents. Compared with their results, we find about 10 percent more respondents who reported they are absolutely certain ('1.0') to live to age 75 and about 10 percent more who reported absolutely no chance ('0') of surviving to age 85.

Table 1 reports the average values of P75 and P85 by age and Table 2 reports the frequency distributions of survival expectations by age. In all groups, the average probabilities satisfy basic logical requirements: the average probability of living to 75 is (substantially) larger than that of living to 85 and the average probabilities of living to 75 and 85 increase with age (except for women aged 55-59). Consistent with prior studies, women report smaller average probabilities than men, despite their larger actuarial probabilities. Compared with Taiwanese life-tables, men substantially overestimate their probabilities of living to age 75 and 85. Women also overestimate the probability of living to 85 but underestimate the probability of living to 75. In the US, Viscusi and Hakes (2003) found that white males and females both underestimate the probabilities of living to 75. In contrast, white males overestimate their probability of living to 85 while white females appear to overestimate this probability at younger ages and underestimate it at older ages.

Following the approach proposed by Viscusi and Hakes (2003), we test the validity of the responses in Table 3. The first two columns report results of estimating a regression of subjective probability on actuarial probability of survival (P75 and P85) and the last column reports the results of estimating a regression of the spread in subjective probability of survival against the actual survival probability spread (P75 – P85). The estimated slopes are well below one and close to zero. All three slopes are significantly different from one and none are significantly different from zero. These results imply that people are poorly informed about their survival chances or that the question format does not yield a good probability estimate, consistent with Viscusi's and Hakes' (2003) findings.

Since current health status can influence survival probability, we report the average values of P75 and P85 by self-assessed health status in Table 4. Respondents were asked to assess their health as compared with others of the same age. As in the US (Hurd and McGarry, 2002), respondents with better self-reported health report higher survival probabilities. Within health categories, survival probabilities are again higher among men than women. Differences in self-reported health status are associated with large variations in survival expectations. As health ranges between excellent and poor, P75 ranges from 0.94 to 0.33 for men and from 0.83 to 0.28 for women. A similar pattern exists for P85.

Table 5 provides information about how survival expectations change in response to new health information obtained through the medical examinations that occurred between waves 1 and 2 of the 2001 survey. As most of the new information is adverse, more respondents reported a decline in survival probabilities than an increase. For the probability of living to age 75, about 65 percent reported a smaller value in wave 2 than in wave 1 while 25 percent reported a higher value and 10 percent reported exactly the same value. A similar pattern prevails for the probability of living to 85.

3. Econometric Models

This section describes the models used for a cross-sectional analysis of how longevity expectations vary with respondent characteristics and a panel analysis of how longevity expectations respond to new information obtained through the physical examination.

3.1 Cross-Sectional Analysis

In the cross-sectional analysis, we examine the relationships between subjective survival probabilities and socio-demographic characteristics, self-reported health status and diseases, health conditions, and health behavior using multiple regression. The regression function can be written as:

$$P = f\,(X, S, H_1, H_2, e) \qquad (1)$$

where the dependent variable P is the subjective probability of living to age 75 (P75) or 85 (P85). The socio-demographic variables, represented by X, include age, gender, martial status, educational level, income, parental mortality, and whether the respondent lives with children. Subjective health status, S, is a vector of self-reported diseases and two measures of self-reported health status (current health compared with others of the same age and compared with the respondent's own health a year earlier). The vector H_1 measures health conditions, including number of hospital admissions, number of visits to outpatient clinics, insomnia, unhappiness, and obesity. Health behaviors, represented by $H_{2,}$ include exercise, smoking, drinking, and the habit of eating breakfast. Finally, the residual e represents unobservable determinants of the subjective survival probability.

Socio-demographic characteristics

Socio-demographic characteristics include age, gender, marital status, educational level, personal disposable income, and family background. With the exception of age and income, all are categorical. *Age* and *age squared* are included to test for a non-linear relationship between age and longevity expectations.

We create three binary variables for educational level, describing the number of years of schooling completed. They are *Junior high school, Senior high school,* and *College (or above)*; the reference group is respondents with elementary-school education or less. *Personal disposable income* is measured as the logarithm of personal monthly income (or monthly retirement payments and income provided by family members).[2]

We include information on respondents' social background, such as parental mortality and whether they live with their children. Prior studies have found that individuals' subjective probabilities of survival increase with the longevity of their parents (Feinstein, 1993; Hurd and McGarry, 1995). We measure *Parental mortality* as 1 if the either of the respondent's parents has died, 0 otherwise. Since men may be more influenced by the experience of their father's mortality, and women more by the experience of their mother's mortality, we include four interaction variables describing the mortality experience of the parents by the gender of the respondent: *male×father died, male×mother died, female×father died, and female×mother died*.[3]

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[2] For retired workers, housewives, and unemployed respondents, we use either monthly retirement payments received or income provided by family members as a proxy for personal income. Income is measured in thousands of NT dollars. The approximate exchange rate is 35 NT$ to 1 US$.

[3] The effect of a parent's death on longevity expectations may operate through both biological and psychological mechanisms.

As living with children may increase an individual's emotional well-being, such respondents may adopt a more optimistic attitude towards longevity. *Children* is defined as 1 if the respondent lives with his or her children, and 0 otherwise.

Self-reported health status and diseases

Psychological studies note that people's self-evaluations are generally formed by comparison with their peers (Gibbons, 1999; Mallinson, 2002). For perceived general health, we use two measures of health status. The first is defined by comparison with other people of the same age (*Subjective health status - compared with others*), while the second is defined as an internal comparison, with respondents being asked to compare their health now with their health a year earlier (*Subjective health status - compared with oneself)*). The answers to these questions were coded using a standard five-point scale: (1) 'excellent', (2) 'very good', (3) 'good', (4) 'fair', and (5) 'poor'. The two measures of subjective health status were defined as 1 if the respondent's answer was 'excellent' and 0 otherwise.

Survey participants were asked if they suffered from any of twelve diseases over the previous year. The diseases were gastric or duodenal ulcer, hepatitis, hypertension, hyperlipidemia, heart disease, asthma, diabetes mellitus, thyroid disease, gout, bladder or urethral disease, lumbago or spondylosis, and cancer or malignant tumors. *Self-reported diseases* was defined as a count of these diseases from which the respondent reported suffering.

Health conditions

Five measures of physical and mental health conditions were constructed. *Hospital* was defined as 1 if the respondent had been admitted to a hospital during the previous year and *Clinic* was defined as the number of visits to an outpatient clinic in the previous month. *Insomnia* was defined as 1 if the respondent's answer to the question: "How often have you suffered from insomnia this year?" was 'quite often' or 'every day', and 0 if his answer was 'never' or 'occasionally'. The indicator of depressed mood, *Unhappy* , was defined as 1 if the respondent answered the question: "In general, do you feel happy with your present life?" with 'unhappy' or 'very unhappy', and 0 if he answered 'OK'; 'happy'; or 'very happy'.

We also included a variable to measure obesity, as much evidence shows that obesity impairs health and longevity (e.g., Himes, 2000; Philipson, 2001). *Obesity* is defined as 1 if the respondent's body mass index (BMI) is more than 27 kg/m^2, and 0 otherwise. BMI is calculated using measured height and weight from clinical records (not self reports), and the cutoff is based on guidelines provided by the Taiwan Department of Health.[4]

Health behaviors

Four types of health behaviors are examined, based on respondents' self reports. *Exercise* was defined as 1 if the respondent reported exercising more than three times during the previous week, and 0 otherwise. *Smoke* was defined as 1 if the respondent is a current smoker and 0 otherwise. *Drink* was measured as 1 if the respondent occasionally or regularly drinks alcoholic beverages and 0 otherwise. *Breakfast* was measured as 1 if the respondent eats breakfast every day, and 0 otherwise.

Definitions of variables and summary statistics for the cross-sectional data are reported in Table 6.

3.2 Risk-updating Model

Following the risk-updating approach developed by Viscusi and O'Connor (1984) and Viscusi (1985) and used by Sloan et al. (1999), Smith et al. (2001), and Viscusi and Hakes (2003), we evaluate how new health information, acquired from a physical examination, affects an individual's longevity expectations. The individual's perceived survival probability posterior to

[4] See Department of Health, Taiwan (2005): http://www.bhp.doh.gov.tw.

receipt of the results of a physical examination, P_t, is hypothesized to be a weighted average of his longevity assessment prior to the physical examination, P_{t-1}, and the unobserved risk equivalent, S_t, of any new health information provided by the examination. The posterior assessment of an individual's probability of living to age 75 or 85, P_t, is modeled as a weighted average of prior beliefs, weighted by the precision of the prior beliefs, $\theta/(\theta+\gamma)$, and the risk equivalent of the new information, S_t, weighted by its relative precision, $\gamma/(\theta+\gamma)$:

$$P_t = \frac{\theta P_{t-1} + \gamma S_t}{\theta + \gamma}. \tag{2}$$

Note that the risk equivalent of the new information, S_t, is measured as a probability and is bounded to the zero-one interval.

Our primary hypothesis is that the physical examination report provides new information which induces a revision of the individual's subjective probability of survival. The physical examination report contains information on the outcomes of seven test items, five areas of health-behavior advice provided by physicians, and six diagnosed diseases.

We described information provided by the physical examination using a set of binary variables associated with medical tests, physician advice, and health shocks. Test information (*T*) includes the outcomes of the seven test items – urinalysis, complete blood count, blood sugar, liver function, renal function, lipids, and uric acid. Physician advice (*D*) includes advice on 'quitting smoking', 'quitting drinking', 'oral hygiene', 'weight control', and 'diet and nutrition'. Health shocks or the onset of new health conditions (*H*) experienced between waves 1 and 2 of the 2001 survey are defined to occur when an individual is diagnosed with one of six diseases (hypertension, thyroid disease, heart disease, hepatitis, hyperlipidemia, gout) that were not self-reported in wave 1 of the 2001 survey.

In addition to these binary variables, we constructed three aggregate measures of health information, defined as the number of abnormal test outcomes, the number of areas of advice provided by physicians, and the number of health shocks. These variables are based on the assumption that abnormal test outcomes, greater amounts of advice by physicians, and any new health shocks all represent adverse information. Our unobservable indicator of the risk equivalent of new health information, S_t, is hypothesized to be a function of these measures,

$$S_t = f\,(T, P, H, X, u). \tag{3}$$

Socio-demographic characteristics (*X*), such as age, gender, marital status, and level of education are included to account for the possibility that either the significance of the information or the individual's response to it may differ among individuals, and u is a residual. Substituting equation (3) into (2) and using a linear approximation for the function *f(•)* yields our empirical model relating the posterior and prior longevity expectations,

$$P_t = aP_{t-1} + \sum_{i=1}^{k} b_i Z_i \ , \tag{4}$$

where the vector *Z* represents the factors in equation (3), including an intercept.

Given estimates of P_t and P_{t-1}, it is possible to estimate the risk equivalent of new health information, S_t, and the relative informational value of the new information, $\psi = \gamma/\theta$, as

$$S_t = \frac{\sum_{i=1}^{k} b_i Z_i}{1-a} = \frac{P_t - aP_{t-1}}{1-a} \tag{5a}$$

$$\psi = \frac{\gamma}{\theta} = \frac{1}{a} - 1 \ , \tag{5b}$$

Higher values of ψ imply that the new information is more informative relative to the respondent's prior beliefs.

Variable definitions and summary statistics for the panel data are reported in Table 7.

4. Empirical Results

The results of the cross-sectional analysis of subjective survival probabilities and the panel analysis of risk-updating analyses are reported in this section.

4.1 Cross-Sectional Analysis

Our analysis begins with an examination of the determinants of survival probabilities using the pooled cross-sectional data (wave 1 of the 2001 survey and the 2002 survey). Parameter estimates for OLS regressions describing the subjective probability of surviving to ages 75 and 85 are presented in Table 8. Since the survival probabilities are restricted to the interval between 0 and 1, we also report maximum likelihood estimates using a two-limit Tobit model in the Appendix (Table A1).[5] The basic results are similar to those in Table 7.

As shown in Table 8, men and married persons tend to be more optimistic than females and single persons. Those who live with their children tend to report a higher perceived probability of living to age 75. Income has a significantly positive correlation with P75, but not with P85, while education has a weak positive association with subjective survival probabilities. All the measures of health behavior are insignificantly negative, reflecting little association with longevity expectations. We also find evidence of a convex (U-shaped) relationship between longevity expectations and age.[6]

The subjective probability of survival is highly correlated with self-assessed health measures. Respondents who describe their own health as ‘excellent’ compared with their own health a year earlier, and especially compared with other people of the same age, have higher

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[5] Smith and Desvousges (1988) used the two-limit Tobit model to investigate the ways in which risk perceptions are updated in response to information about risks from radon.

[6] Using age classes rather than age and age squared, we find that, compared with respondents aged 40-44, those aged 60-64 report significantly higher probability of living to 75 but only marginally significantly higher probability of living to 85.

subjective survival probabilities. In contrast, respondents with more self-reported diseases tend to report smaller perceived survival probabilities.[7] Moreover, respondents who are obese, less happy, suffering from insomnia, or who visit outpatient clinics more frequently also have more pessimistic longevity expectations.

The mortality experience of the respondent's parents has an important and predictable relationship with both P75 and P85. As shown in columns 1 and 3 of Table 8, the coefficients of parental mortality are statistically significant and negative, suggesting that the death of a parent reduces an individual's subjective survival probability. In columns 2 and 4, we include interactions between the respondents' gender and dummy variables indicating whether his mother or father has died. The results suggest that the decrease in the subjective probability of living to 75 from the death of a same-sex parent is larger than that from the death of an opposite-sex parent. If a male respondent's father has died, the estimated reduction in P75 is 0.03 more than if his mother has died. If a female respondent's mother has died, the estimated effect is 0.04 larger than if her father has died (these effects are not statistically significant for P85). The larger effect of the death of a same-sex parent is consistent with the results of Hamermesh (1985) and Hurd et al. (1999) for the US.

To investigate the effects of non-response or focal-point-response bias, we estimate the model including a sample-selection correction using an inverse Mills ratio. The probit selection equation is specified as a function of age, gender, marital status, level of education, employment status, subjective health status, and health knowledge.[8] We find that respondents who are older,

[7] Self-reported asthma is found to significantly reduce the subjective probability of living to 75, while hyperlipidemia and heart disease are found to significantly decrease the probability of living to 85.

[8] The measure of health knowledge is based on the number of correct responses to whether each of ten health problems are associated with obesity, and ranges from 0 to 10.

less-educated, less knowledgeable about health, unemployed, and with lower incomes have a higher propensity toward either not responding or providing a focal-point response (i.e., 0, 0.5, or 1). The insignificant coefficient of the inverse Mills ratio indicates that the sample selection bias should not be regarded as a significant influence.[9]

Table 9 uses the difference between the subjective and actuarial survival probabilities as an alternative dependent variable for the models in Table 8. The results suggest that respondents who are male, have higher income, better perceived health status, live with their children, and whose parents are both alive have subjective survival probabilities that are significantly larger than their actuarial survival probabilities, whereas those who are less happy, suffering from insomnia, or who report more self-reported diseases have subjective probabilities that are significantly smaller than their actuarial probabilities.

4.2 Risk-Updating Model

In this section, we use the Bayesian updating model to describe how respondents update their longevity expectations between the two periods of the panel data (waves 1 and 2 of the 2001 survey).[10] We explore how new information on test outcomes, advice provided by physicians, and health shocks affect the subjective probabilities of living to 75 or 85. To save space, we report only the estimated coefficients for prior subjective probability and the aggregate measures of new health information. The OLS estimates are reported in Table 10 and two-limit Tobit maximum-likelihood estimates in the Appendix (Table A2).[11] The coefficient estimates from the two approaches are very similar and we focus our discussion on the OLS results.

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[9] To save space, we do not report estimates of the sample-selection model.

[10] We find that respondents who are older, less-educated, and report fair or poor health compared with other people of the same age are more likely to refuse to participate in the wave 2 survey.

[11] The dependent variable of the two-limit Tobit model in Table A2 is the difference between two probabilities and is bounded by -1 and 1.

As shown in Table 10, the coefficients of P75 and P85 in wave 1 are significantly greater than zero, suggesting that prior beliefs play an important role in shaping posterior survival expectations. An F test allows us to reject the hypothesis that all of the coefficients are jointly zero. In the case of P75, the estimated risk-equivalent value of new health information, S_t, is 0.52, about three-quarters as large as the respondents' prior survival probability, 0.71 (reported in Table 6). The estimate of ψ, calculated at the sample mean, implies that the new health information is slightly more than three times as influential as the respondents' prior beliefs in forming the posterior subjective probability. For P85, the risk-equivalent measure of new health information, S_t, is 0.24, about half as large as the respondents' prior value of 0.47 (reported in Table 6). The estimated value of ψ is slightly more than 10, implying that respondents view the new information as more than ten times as informative as their prior information.[12] These findings offer support for a connection between prior and posterior longevity expectations, which is consistent with the Bayesian learning model.

The models reported in columns (1) – (4) of Table 10, including alternative aggregate measures of new health information (i.e., the numbers of adverse test results, topics on which physicians provided advice, and new diagnoses) yield virtually identical estimates of the risk-equivalent measure of new information and the relative precision of the new and prior health information. The estimated coefficients on the number of adverse test outcomes and the number of topics on which physicians provided advice are statistically significant predictors of the posterior survival estimate, for both P75 and P85. Although the estimated coefficients on the number of newly diagnosed diseases are not statistically significant, the estimated values of these

[12] Uncertainty about the estimates of S_t and ψ is characterized using a parametric bootstrap assuming the estimate of the coefficient of the prior subjective probability is normally distributed. Because the distribution of $\psi = 1/a - 1$ (eqn. (5b)) is highly skewed and poorly estimated for P85 we report the 0.1 and 0.9 fractiles of the bootstrap distribution.

coefficients are larger than for the other aggregate measures, which is consistent with the notion that diagnosis of disease causes a larger reduction in subjective survival probability than does an adverse test result or receiving advice about health behavior from a physician.

In auxiliary models similar to those reported in Table 10, we include variables describing specific test outcomes, types of physician advice, and disease diagnoses, to determine which types of information were most influential. Of the test outcomes, abnormalities of lipid and liver function have a significant negative effect on subjective expectations of longevity. A recommendation about weight control is the only type of physician advice which significantly reduces subjective survival probabilities. Among the health shocks, a diagnosis of heart disease has the strongest influence on subjective survival probabilities. It is associated with a reduction of 0.19 in the subjective probability of living to age 75 and a reduction of 0.16 in the probability of living to age 85. A diagnosis of hepatitis decreases the subjective probability of living to age 75 while a diagnosis of thyroid disease decreases the subjective probability of living to age 85.

5. Conclusions

We examine the determinants of subjective survival probabilities and explore how individuals' longevity expectations respond to new health information. Our analysis is based on Taiwanese individuals' subjective assessments of their perceived longevity before and after physical examinations, which provided new information in the form of medical diagnoses, advice from physicians to modify behavior, and results of medical tests. Using pooled cross-sectional data, we find that males and married persons are more optimistic about their longevity expectations than females and single persons. We find the expected increasing convex relationship between subjective survival probabilities and age. Income is positively correlated with the probability of living to age 75 but education has little association with survival expectations. Consistent with previous studies, the longevity of a same-sex parent has a strong influence on an individual's own survival expectations.

Our findings using panel data support the Bayesian learning model, which describes how individuals use new health information to revise their longevity expectations. We find that individuals with more abnormal test outcomes and those receiving more extensive advice on health behavior from their physicians significantly reduce their subjective probabilities of living to 75 or 85. The subjective probability of survival also declines with health shocks such as the diagnosis of heart disease. Our results support the belief that individuals who acquire more adverse health information revise downwards their perceived chances of survival.

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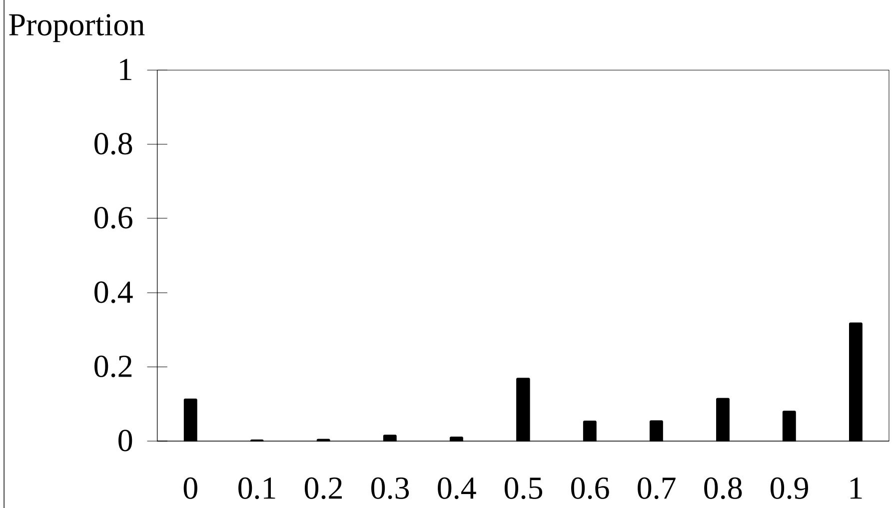

Figure 1. Subjective Probability of Survival to 75

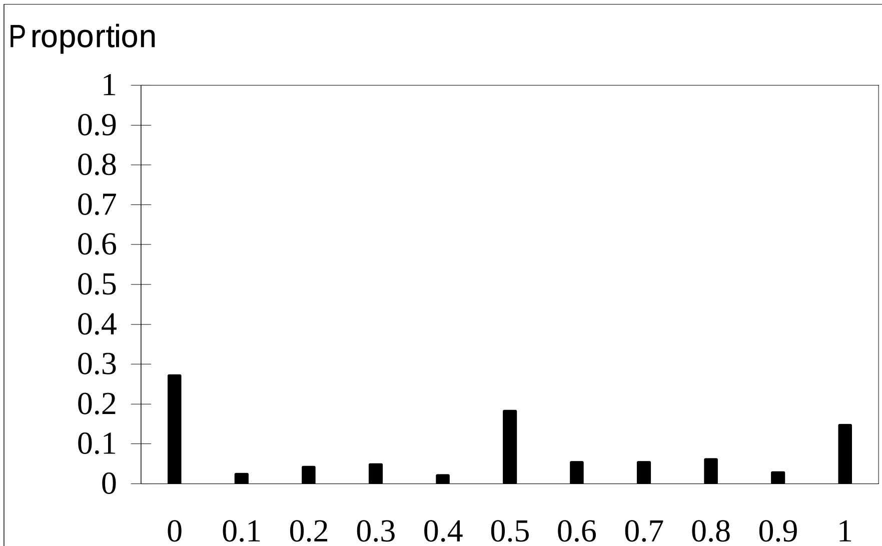

Figure 2. Subjective Probability of Survival to 85

Table 1. Perceived and Actuarial Average Probabilities of Living to Age 75 or 85

	Male		Female		All	
Age range	P75	P85	P75	P85	P75	P85
40-44	0.74	0.48	0.62	0.39	0.66	0.42
	(0.57)	(0.19)	(0.74)	(0.32)	(0.65)	(0.25)
45-49	0.76	0.51	0.67	0.43	0.70	0.46
	(0.58)	(0.20)	(0.74)	(0.33)	(0.66)	(0.25)
50-54	0.77	0.54	0.67	0.44	0.70	0.47
	(0.59)	(0.20)	(0.75)	(0.33)	(0.67)	(0.26)
55-59	0.76	0.55	0.60	0.35	0.66	0.42
	(0.62)	(0.21)	(0.76)	(0.34)	(0.69)	(0.26)
60-64	0.79	0.59	0.80	0.51	0.80	0.54
	(0.65)	(0.22)	(0.78)	(0.35)	(0.72)	(0.28)

Note: Actuarial survival risks are in parentheses, calculated from "Abridged life table in Taiwan" (http://www.moi.gov.tw/stat/english/index.asp).

Table 2. Distribution of Perceived Probabilities of Living to Age 75 or 85 (percentage)

	P75				
Age range	0	0.01-0.49	0.5	0.51-0.99	1
40-44	11.11	3.18	24.34	35.45	25.93
45-49	6.98	1.16	15.12	41.86	34.88
50-54	6.67	5.83	20.83	30.00	36.67
55-59	11.11	5.55	16.67	20.37	46.30
60-64	4.76	0.00	9.52	40.47	45.24
	P85				
Age range	0	0.01-0.49	0.5	0.51-0.49	1
40-44	28.57	19.58	19.58	20.63	11.64
45-49	26.16	33.71	21.51	28.50	11.63
50-54	22.50	20.84	13.33	22.49	20.83
55-59	33.33	16.67	14.81	16.67	18.52
60-64	16.67	7.14	19.05	26.19	30.95

Table 3. Tests of Risk Responses

	P75	P85	Spread between p75 and p85
Intercept	0.6969	0.5126	0.1803
	(11.45)***	(12.18)***	(1.38)
Actuarial probability of living to age 75	0.0902		
	(1.05)		
Actuarial probability of living to age 85		0.0247	
		(0.17)	
Actuarial probability spread between living to age 75 and living to age 85			0.0422
			(0.13)
R^2	0.001	0.001	0.001

Note: Figures in parenthesis are t-statistics. ***, ** and * represent statistical significance at 1%, 5% and 10% level, respectively.

Table 4. Perceived Average Probabilities of Living to Age 75 or 85: Subjective Health Status – Compared with Others

	Male		Female		All	
Health status	P75	P85	P75	P85	P75	P85
Excellent	0.94	0.68	0.83	0.66	0.88	0.67
Very good	0.88	0.64	0.79	0.55	0.82	0.59
Good	0.73	0.49	0.67	0.41	0.69	0.44
Fair	0.63	0.43	0.54	0.31	0.57	0.35
Poor	0.33	0.18	0.28	0.12	0.29	0.13

Table 5. Comparison of Survival Probabilities Between Waves of 2001 Survey

	Percentage of respondents	
Probability comparison	P75	P85
Wave 2 probability < Wave 1 probability	64.7	78.6
Wave 2 probability > Wave 1 probability	24.9	13.9
Wave 2 probability = Wave 1 probability	10.4	7.5
Both probabilities = 0	1.0	3.8
Both probabilities = 0.5	2.7	2.3
Both probabilities = 1.0	3.0	1.0
Both probabilities = some other value	3.7	0.4

Table 6. Variable Definitions and Summary Statistics for the Cross-Sectional Analysis

Variable	Definition	Mean (std. dev.)
Subjective survival probability		
P75	Subjective probability of living to age 75	0.702 (0.32)
P85	Subjective probability of living to age 85	0.464 (0.36)
Socio-demographic characteristics		
Age	Age	50.95 (8.30)
Age squared	Age squared/100	26.65 (9.26)
Male	1 if respondent is male, 0 otherwise	0.340 (0.47)
Marital status	1 if respondent is married, 0 otherwise	0.799 (0.40)
Junior high school	1 if respondent's educational attainment is junior high school, 0 otherwise	0.134 (0.34)
Senior high school	1 if respondent's educational attainment is senior high school, 0 otherwise	0.286 (0.45)
College (or above)	1 if respondent's educational attainment is college or graduate school, 0 otherwise	0.330 (0.47)
Personal disposable income	Log of personal monthly income (NT$1000, 1US$=35NT$)	2.838 (1.47)
Parental mortality	1 if respondent's father or mother died, 0 otherwise	0.716 (0.45)
Father died	1 if respondent's father died, 0 otherwise	0.660 (0.47)
Mother died	1 if respondent's mother died, 0 otherwise	0.412 (0.49)
Children	1 if respondent lives with own children, 0 otherwise	0.768 (0.42)

Self-reported health status and diseases		
Subjective health status – compared with others	1 if respondent's health status is 'excellent' compared with other people of same age, 0 otherwise	0.066 (0.25)
Subjective health status – compared with self	1 if the respondent's health status is 'excellent' compared with his/her own status a year earlier, 0 otherwise	0.057 (0.23)
Self-reported disease	Number of up to 12 diseases respondent believes he has	1.217 (1.39)
Health conditions		
Hospital	1 if respondent was admitted to hospital in previous year, 0 otherwise	0.054 (0.23)
Clinic	Number of visits to an outpatient clinic in previous month	0.875 (1.34)
Insomnia	1 if respondent suffers from insomnia 'quite often' or 'every day', 0 otherwise	0.200 (0.40)
Unhappy	1 if respondent is 'unhappy' or 'very unhappy', 0 otherwise	0.065 (0.25)
Obesity	1 if respondent is obese, 0 otherwise	0.117 (0.32)
Health behaviors		
Exercise	1 if respondent exercised more than three times in past week, 0 otherwise	0.668 (0.47)
Smoke	1 if respondent is a current smoker, 0 otherwise	0.142 (0.35)
Drink	1 if respondent is an occasional or regular drinker, 0 otherwise	0.177 (0.38)
Breakfast	1 if respondent eats breakfast every day	0.691 (0.46)

Note: 1,390 observations.

Table 7. Variable Definitions and Summary Statistics for Risk-Updating Model

Variable	Definition	Mean (std.dev.)
Subjective survival probability		
P75 in wave 2	Subjective probability of living to 75 in wave 2	0.563 (0.20)
P85 in wave 2	Subjective probability of living to 85 in wave 2	0.262 (0.23)
P75 in wave 1	Subjective probability of living to 75 in wave 1	0.714 (0.30)
P85 in wave 1	Subjective probability of living to 85 in wave 1	0.468 (0.36)
Socio-demographic characteristics		
Age	Age	49.10 (6.98)
Male	1 if respondent is male, 0 otherwise	0.279 (0.45)
Marital status	1 if the respondent is married, 0 otherwise	0.836 (0.37)
Junior high school	1 if respondent's educational attainment is junior high school, 0 otherwise	0.122 (0.33)
Senior high school	1 if respondent's educational attainment is senior high school, 0 otherwise	0.283 (0.45)
College (or above)	1 if respondent's educational attainment is college or graduate school, 0 otherwise	0.415 (0.49)
Test outcomes		
Complete blood count	1 if respondent's complete blood count is abnormal, 0 otherwise	0.300 (0.46)
Liver function	1 if respondent's liver function is abnormal, 0 otherwise	0.201 (0.40)
Blood sugar	1 if respondent's blood sugar is abnormal, 0 otherwise	0.042 (0.20)
Lipid	1 if respondent's lipid is abnormal, 0 otherwise	0.245 (0.43)

Renal function	1 if respondent's renal function is abnormal, 0 otherwise	0.042 (0.20)
Uric acid	1 if respondent's uric acid is abnormal, 0 otherwise	0.107 (0.31)
Physician advice		
Quit drinking	1 if respondent advised to quit drinking by physician, 0 otherwise	0.062 (0.24)
Oral hygiene	1 if respondent advised to improve oral hygiene by physician, 0 otherwise	0.166 (0.37)
Weight control	1 if respondent advised to lose weight control by physician, otherwise	0.359 (0.48)
Diet and nutrition	1 if the respondent advised to modify diet and nutrition by physician, 0 otherwise	0.750 (0.43)
Health shocks		
Thyroid disease	1 if respondent diagnosed with thyroid disease, 0 otherwise	0.022 (0.15)
Heart disease	1 if respondent diagnosed with heart disease, 0 otherwise	0.010 (0.10)
Hepatitis	1 if respondent diagnosed with hepatitis, 0 otherwise	0.033 (0.18)
Hyperlipidemia	1 if respondent diagnosed with hyperlipidemia, 0 otherwise	0.005 (0.07)
Sum of abnormal test items	Number of abnormal test items	1.365 (1.06)
Sum of physician advices	Number of items with physician advice	1.463 (1.04)
Sum of health shocks	Number of health shocks	0.082 (0.27)

Note: 596 observations

Table 8. Determinants of Subjective Survival Probabilities:
Cross-Sectional Analysis – OLS

	P75		P85	
	(1)	(2)	(1)	(2)
Socio-demographic characteristics				
Age	-0.0176	-0.0183	-0.0384	-0.0396
	(-1.87)*	(-1.95)**	(-3.39)***	(-3.49)***
Age squared	0.0221	0.0236	0.0403	0.0419
	(2.67)***	(2.86)***	(4.06)***	(4.22)***
Male	0.0606	0.1072	0.0659	0.1065
	(2.91)***	(3.28)***	(2.58)***	(2.64)***
Marital status	0.0373	0.0365	0.0482	0.0493
	(1.66)*	(1.62)*	(1.74)*	(1.77)*
Junior high school	-0.0229	-0.0204	-0.0247	-0.0212
	(-0.80)	(-0.72)	(-0.70)	(-0.60)
Senior high school	0.0310	0.0303	-0.0269	-0.0249
	(1.26)	(1.24)	(-0.88)	(-0.81)
College (or above)	0.0376	0.0354	-0.0036	-0.0033
	(1.49)	(1.40)	(-0.12)	(-0.11)
Personal disposal income	0.0139	0.0144	0.0093	0.0094
	(2.22)**	(2.29)**	(1.20)	(1.20)
Parental mortality	-0.0429		-0.0430	
	(-2.25)**		(-1.83)*	
Male × Father died		-0.0764		-0.0430
		(-2.45)***		(-1.13)
Male × Mother died		-0.0469		-0.0570
		(-1.55)		(-1.55)
Female × Father died		-0.0060		0.0027
		(-0.27)		(0.10)
Female × Mother died		-0.0488		-0.0330
		(-2.19)**		(-1.20)
Children	0.0391	0.0409	0.0158	0.0171
	(1.83)*	(1.92)*	(0.59)	(0.64)
Self-reported health status and diseases				

Subjective health status	0.1348	0.1346	0.1497	0.1522
- compared with others	(4.04)***	(4.05)***	(3.59)***	(3.64)***
Subjective health status	0.0449	0.0461	0.0814	0.0838
- compared with oneself	(1.27)	(1.31)	(1.89)*	(1.94)**
Self-reported diseases	-0.0098	-0.0104	-0.0218	-0.0226
	(-1.63)*	(-1.71)*	(-2.93)***	(-3.04)***
Health conditions				
Hospital	-0.0353	-0.0357	0.0001	-0.0001
	(-0.97)	(-0.99)	(0.00)	(-0.00)
Clinic	-0.0107	-0.0101	-0.0136	-0.0135
	(-1.70)*	(-1.62)	(-1.81)*	(-1.79)*
Insomnia	-0.0771	-0.0776	-0.0495	-0.0499
	(-3.64)***	(-3.66)***	(-1.92)**	(-1.93)**
Unhappy	-0.1392	-0.1406	-0.1067	-0.1042
	(-4.05)***	(-4.10)***	(-2.52)***	(-2.46)***
Obesity	-0.0564	-0.0585	-0.0137	-0.0152
	(-2.19)**	(-2.28)**	(-0.43)	(-0.48)
Health behaviors				
Exercise	-0.0032	-0.0016	0.0134	0.0142
	(-0.17)	(-0.09)	(0.60)	(0.63)
Smoke	0.0175	0.0131	0.0334	0.0304
	(0.67)	(0.50)	(1.05)	(0.95)
Drink	-0.0303	-0.0319	-0.0218	-0.0252
	(-1.27)	(-1.34)	(-0.74)	(-0.86)
Breakfast	0.0106	0.0102	0.0095	0.0096
	(0.56)	(0.54)	(0.40)	(0.41)
R^2	0.13	0.14	0.11	0.11
N	1,390	1,390	1,229	1,229

Note: All regressions include intercept and year dummy for 2001. Figures in parenthesis are t-statistics. ***, ** and * represent statistical significance at 1%, 5% and 10% level, respectively.

Table 9. Regressions of the Difference between Subjective Probability and Actual Probability – OLS

	The difference between P75 and actual probability of living to 75		The difference between P85 and actual probability of living to 85	
	(1)	(2)	(1)	(2)
Socio-demographic characteristics				
Age	0.0200	0.0135	0.0177	0.0142
	(0.91)	(0.61)	(0.66)	(0.52)
Age squared	-0.0181	-0.0108	-0.0159	-0.0120
	(-0.85)	(-0.50)	(-0.60)	(-0.45)
Male	0.2327	0.2623	0.2135	0.2281
	(10.50)***	(7.89)***	(7.91)***	(5.60)***
Marital status	0.0320	0.0300	0.0457	0.0455
	(1.32)	(1.24)	(1.54)	(1.53)
Junior high school	-0.0289	-0.0267	-0.0296	-0.0273
	(-0.95)	(-0.88)	(-0.80)	(-0.73)
Senior high school	0.0250	0.0239	-0.0370	-0.0360
	(0.96)	(0.92)	(-1.16)	(-1.13)
College (or above)	0.0324	0.0295	-0.0096	-0.0103
	(1.21)	(1.10)	(-0.29)	(-0.31)
Personal disposal income	0.0154	0.0502	0.0080	0.0082
	(2.31)**	(2.19)**	(0.98)	(1.00)
Parental mortality	-0.0420		-0.0407	
	(-2.18)**		(-1.73) *	
Male × Father died		-0.0653		-0.0239
		(-2.05)**		(-0.63)
Male × Mother died		-0.0426		-0.0449
		(-1.34)		(-1.17)
Female × Father died		-0.0085		-0.0011
		(-0.38)		(-0.04)
Female × Mother died		-0.0610		-0.0442
		(-2.63)**		(-1.57)
Children	0.0480	0.0502	0.0243	0.0258
	(2.09)**	(2.19)**	(0.86)	(0.91)

Subjective health status	0.1334	0.1335	0.1756	0.1785
- compared with others	(3.78)***	(3.79)***	(3.98)***	(4.04)***
Subjective health status	0.0662	0.0686	0.0961	0.0988
- compared with oneself	(1.75)*	(1.81)*	(2.10)**	(2.16)**
Self-reported diseases	-0.0106	-0.0110	-0.0193	-0.0198
	(-1.65)*	(-1.71)*	(-2.48)**	(-2.54)***
Health conditions				
Hospital	-0.0198	-0.0211	-0.0013	-0.0014
	(0.51)	(-0.54)	(-0.03)	(-0.03)
Clinic	-0.0076	-0.0071	-0.0103	-0.0101
	(-1.16)	(-1.09)	(-1.32)	(-1.29)
Insomnia	-0.0744	-0.0743	-0.0357	-0.0353
	(-3.34)***	(-3.33)***	(-1.33)	(-1.30)
Unhappy	-0.1396	-0.1417	-0.1183	-0.1166
	(-3.91)***	(-3.97)***	(-2.70)***	(-2.66)***
Obesity	-0.0483	-0.0494	-0.0103	-0.0118
	(-1.73)*	(-1.77)*	(-0.30)	(-0.34)
Health behaviors				
Exercise	0.0013	0.0038	0.0167	0.0188
	(0.07)	(0.20)	(0.72)	(0.80)
Smoke	0.0062	0.0032	0.0299	0.0294
	(0.23)	(0.12)	(0.91)	(0.89)
Drink	-0.0352	-0.0371	-0.0316	-0.0347
	(-1.43)	(-1.51)	(-1.05)	(-1.15)
Breakfast	0.0091	0.0083	0.0090	0.0089
	(0.46)	(0.42)	(0.37)	(0.37)
R^2	0.21	0.21	0.15	0.15
N	1,390	1,390	1,220	1,220

Note: See Table 8.

Table 10. Risk Updating Model for Subjective Survival Probabilities – OLS

	P75 in wave 2			
	(1)	(2)	(3)	(4)
P75 in wave 1	0.2366	0.2360	0.2398	0.2359
	(8.98)***	(9.06)***	(9.20)***	(8.97)***
Number of abnormal test items		-0.0188		
		(-2.57)***		
Number of physician advices			-0.0161	
			(-2.06)**	
Number of health shocks				-0.0421
				(-1.49)
R^2	0.15	0.16	0.16	0.15
S	0.52	0.52	0.52	0.52
	(0.007)	(0.007)	(0.007)	(0.007)
ψ	3.3	3.3	3.2	3.3
	(0.5)	(0.5)	(0.5)	(0.5)
N	596	596	596	596
	P85 in wave 2			
	(1)	(2)	(3)	(4)
P85 in wave 1	0.0903	0.0904	0.0896	0.0895
	(3.41)***	(3.46)***	(3.43)***	(3.37)***
Number of abnormal test items		-0.0193		
		(-2.19)**		
Number of physician advices			-0.0196	
			(-2.10)**	
Number of health shocks				-0.0240
				(-0.71)
R^2	0.08	0.09	0.08	0.08
S	0.24	0.24	0.24	0.24
	(0.007)	(0.007)	(0.007)	(0.007)
ψ	11	11	12	12
[0.1 – 0.9 fractiles]	[7 – 17]	[7 – 17]	[7 – 17]	[7 – 17]
N	584	584	584	584

Note: All regressions include intercept, age, gender, martial status, and three education dummies. Figures in parenthesis are t-statistics. ***, ** and * represent statistical significance at 1%, 5% and 10% level, respectively.

Appendix

Table A1. Determinants of Subjective Survival Probabilities: Cross-Sectional Analysis – Two-Limit Tobit

	P75		P85	
	(1)	(2)	(1)	(2)
Socio-demographic characteristics				
Age	-0.0710	-0.0737	-0.0830	-0.0853
	(-3.82)***	(-3.95)***	(-4.08)***	(-4.19)***
Age squared	0.0767	0.0809	0.0854	0.0885
	(4.55)***	(4.77)***	(4.72)***	(4.89)***
Male	0.1056	0.2000	0.1159	0.0170
	(2.99)***	(3.61)***	(2.73)***	(2.56)***
Marital status	0.0744	0.0731	0.0776	0.0778
	(1.96)**	(1.93)*	(1.66)*	(1.67)*
Junior high school	-0.0194	-0.0152	-0.0251	-0.0201
	(-0.40)	(-0.32)	(-0.43)	(-0.34)
Senior high school	0.0538	0.0518	-0.0284	-0.0266
	(1.30)	(1.25)	(-0.56)	(-0.53)
College (or above)	0.0533	0.0486	0.0186	0.0172
	(1.25)	(1.14)	(0.36)	(0.34)
Personal disposal income	0.0198	0.0208	0.0117	0.0123
	(1.88)*	(1.98)**	(0.91)	(0.96)
Parental mortality	-0.0801		-0.0805	
	(-2.51)**		(-2.08)**	
Male × Father died		-0.1507		-0.0707
		(-2.86)***		(-1.14)
Male × Mother died		-0.0885		-0.0961
		(-1.74)*		(-1.59)
Female × Father died		-0.0046		0.0010
		(-0.13)		(0.02)
Female × Mother died		-0.0954		-0.0790
		(-2.57)***		(-1.72)*
Children	0.0370	0.0396	0.0168	0.0184
	(1.02)	(1.10)	(0.38)	(0.42)
Self-reported health status and diseases				

Subjective health status	0.2787	0.2791	0.2438	0.2476
- compared with others	(4.60)***	(4.62)***	(3.47)***	(3.52)***
Subjective health status	0.0688	0.0722	0.1222	0.1268
- compared with oneself	(1.14)	(1.20)	(1.72)*	(1.79)*
Self-reported diseases	-0.1534	-0.0165	-0.0395	-0.0408
	(-1.50)	(-1.61)	(-3.15)***	(-3.26)***
Health conditions				
Hospital	-0.0814	-0.0840	-0.0196	-0.0210
	(-1.34)	(-1.39)	(-0.25)	(-0.27)
Clinic	-0.0164	-0.0155	-0.0211	-0.0209
	(-1.58)	(-1.50)	(-1.69)*	(-1.67)*
Insomnia	-0.11798	-0.1189	-0.0833	-0.0833
	(-3.33)***	(-3.36)***	(-1.94)**	(-1.94)**
Unhappy	-0.2284	-0.2309	-0.1831	-0.1793
	(-4.02)***	(-4.07)***	(-2.53)***	(-2.48)***
Obesity	-0.1054	-0.1091	-0.0181	-0.0206
	(-2.43)**	(-2.52)***	(-0.35)	(-0.39)
Health behaviors				
Exercise	0.0037	0.0070	0.0234	0.0255
	(0.12)	(0.23)	(0.63)	(0.69)
Smoke	0.0310	0.0235	0.0488	0.0452
	(0.71)	(0.54)	(0.93)	(0.86)
Drink	-0.0522	-0.0547	-0.0352	-0.0411
	(-1.31)	(-1.38)	(-0.73)	(-0.85)
Breakfast	0.0129	0.0120	0.0208	0.0211
	(0.41)	(0.38)	(0.53)	(0.54)
Log likelihood	-1058.59	-1051.71	-1061.76	-1060.17
N	1390	1390	1229	1229

Note: See Table 7.

Table A2. Risk Updating Model – Two Limit Tobit

	P75 in wave 2			
	(1)	(2)	(3)	(4)
P75 in wave 1	0.2484	0.2492	0.2518	0.2477
	(8.80)***	(8.86)***	(9.05)***	(8.79)***
Sum of abnormal test items		-0.0003		
		(-2.10)**		
Sum of physician advices			-0.0169	
			(-2.07)**	
Sum of health shocks				-0.0468
				(-1.56)
Log likelihood	-40.52	-42.79	-51.45	-41.73
N	596	596	596	596
	P85 in wave 2			
	(1)	(2)	(3)	(4)
P85 in wave 1	0.1052	0.1040	0.1041	0.1054
	(3.57)***	(3.55)***	(3.58)***	(3.58)***
Sum of abnormal test items		-0.0004		
		(-2.52)***		
Sum of physician advices			-0.0007	
			(-3.68)***	
Sum of health shocks				-0.0300
				(-0.79)
Log likelihood	-90.62	-87.41	-83.29	-90.31
N	584	584	584	584

Note: See Table 8.