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Full Length Research Paper

Estimating the effect of stochastic health on employment, hours of work, and saving decisions

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The object of this paper is to examine the empirical relationship between individuals' perceived health uncertainty, labor inputs, and saving decisions. Most existing empirical studies treat health status as a known variable to individuals, thereby omitting health uncertainty in context of labor market outcomes. We distinguish our study by assuming a precautionary motivation for risk-averse individuals, to work harder and save more when facing the uncertainty of their health condition. We test this hypothetical relationship by applying the data collected from the 2003–2005 Panel Study of Family Dynamics (PSFD) in Taiwan. The study result indicates that while uncertainty over the health condition would discourage people from joining the labor market, those who are already in the labor market will input more working hours to earn extra income for the future consumption. In addition, stochastic health has a positive and significant effect on saving decision.

Key words: Health, stochastic health, labor supply, saving.

INTRODUCTION

This paper aims to empirically examine the effects of perceived health uncertainty on people's labor supply and saving decisions in Taiwan. Early studies regarding human capital and labor market outcomes often treated health as a sub-category of human capital investment (Mushkin, 1962; Becker, 1964; Fuchs 1966)[1]. Grossman (1972a, b) made a significant, ground-breaking contribu-tion to the health economics literature by emphasizing the importance of health and pointing out that the benefits of investment in health capital is to increase the time available for productive activities.

In Grossman's perspective, health capital is an endogenously determined variable that directly affects the hours of labor inputs. In principle, the improvement in health status depends on the investments in health capital (e.g., preventive medicine, money to buy a membership in a health club) and the decisions of time allocation to health-related activities (e.g., taking time to exercise). An important implicit assumption made by Grossman is that, any effort to improve a person's health condition is expected to yield a positive effect on the quantity of labor supplied. Most following studies tried to explain the effects of health on labor force participation and earnings by assuming health status as a variable known by the individuals.

Consequentially, the problem of stochastic health uncertainty had been omitted from the model-building process based on Grossman's theoretical foundation (Luft, 1975; Bartel and Taubman, 1979; Dwyer and Mitchell, 1999; Pelkowski and Berger, 2004).

However, the uncertainty over the health condition is a common issue even for the most developed parts of the world, which challenges Grossman's basic assumption of endogeneity. Regardless of the impressive improvement in modern medical techniques for the past century, an explicit degree of uncertainty over the human health condition always persists. According to O'Donnell's

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[1] For instance, Becker (1992) suggested that individuals would make investment decisions of human capital by weighting the benefits and costs based on their backgrounds of education, training, additional knowledge at work, medical care, and health condition.

theoretical analysis (2005), an increase in the degree of uncertainty regarding health can create a positive effect on labor supply and saving; a risk-averse individual would work harder and save more on a regular basis in order to avoid the decrease of future consumption in case unpredicted health problems were to occur.

Nevertheless, to our best knowledge, there are no empirical studies in labor economics that have tested O'Donnell's argument of stochastic health. There are only a few empirical efforts that can be found on the relationship between health condition and hours of work (e.g., Haveman et al., 1994; Pelkowski and Berger, 2004). None of these available empirical efforts have allowed the existence of health uncertainty into labor and saving functions.

This paper contributes to the literature by empirically examining whether and how people consider stochastic health condition when making labor supply and saving decisions. We presume each individual makes the ex ante decisions to allocate working hours and the amount of savings based on his/her forecast of future health status. Health status is assumed to be randomly distributed with a known probability density function. Under the assumption that the distribution of perceived future health is a function of previous health condition with one or two time lags, this study assumes the uncertainty of sickness is captured by employing a residual estimate of the forecast health model.

Taiwan's labor market and social welfare programs are both in their early stages of finding the optimal path for a sustainable future. Similar to other African and Asian countries, Taiwan had been the colonial territory for Dutch, Japan, and different Chinese dynasties from late 17th century to 1954 (Blussé, 1999; Huang, 2003). As Taiwan's government often struggles to find the balance between traditional and modern Western economic systems when formatting its welfare policies, the complex historiical background and its recent economic and political relationship with Mainland China have created a general sense of uncertainty that can also be found by other pre-colonial economies.

Moreover, the Taiwanese government initiated a universal health insurance system (titled "National Health Insurance", NHI) in 1995 that complicates the decision of health investment. While there is no solid evidence to indicate how changes in perceived uncertainty contribute to the people's labor input and saving decision in Taiwan, this study attempts to provide the first empirical research for the policy makers in Taiwan and other emerging economies to identify the relationship and the importance of this relationship[2]. On the other hand, Taiwan has successfully combined industrialization with income equality equality in the second half of the past century (Brautigam, 1994). Taiwan's experience should serve as a valuable reference for other Asian and African developing countries with similar political and socio-economic policy preferences, especially if income equality is an important policy goal (Chhibber and Leechor , 1995).

By applying the data collected from the 2003–2005 panel study of family dynamics (PSFD) in Taiwan, the results of this study indicate that stochastic sickness has significant effects on an individual's decision to work and save. While uncertainty over the health condition discourages people from participating in the labor market, those who still manage to participate in the labor market will put in more working hours because they want to ensure that they can afford their future consumption requirements. In addition, the rate of saving will increase as a response to the higher uncertainty over health condition.

METHODOLOGY AND EMPIRICAL MODEL

This section introduces the approach applied to examine the decision of labor supply and saving for individuals who face stochastic health condition. While a significant amount of studies have ascertained the effects of health on various labor outcomes such as labor force participation and earnings (Luft, 1975; Bartel and Taubman, 1979; Dwyer and Mitchell, 1999; Pelkowski and Berger, 2004), relatively few empirical efforts can be found in the literature on the relationship between an individual's health condition and hours of work (Haveman et al., 1994; Pelkowski and Berger, 2004).

In addition, most current empirical studies assume health status as a variable known to the individuals in order to omit health uncertainty from the model-building process which we consider as unrealistic. Therefore, this paper distinguishes itself from previous studies by including the health uncertainty consideration into our labor-supply and saving-decision functions. We construct a two-stage decision making model to examine the effect of stochastic health condition based on O'Donnell's theoretical model (1995). The unforeseen sickness is assumed by the model to cause a decrease in consumption due to the loss of salary at any period of time. For a risk-averse individual, uncertainty about sickness provides a precautionary motivation that influences the decision regarding the amount of saving and the hours of work. Hence, saving and labor supply are assumed to increase when this individual faces a greater uncertainty of future health condition.

At the first stage, people's conceptual uncertainty of future health condition is modeled by the method suggested by Hughes and McGuire (2003). Given that hospitals often face uncertain demand, Hughes and McGuire (2003) assumed the distribution of demand for the hospital's in-patient services to be conditionally based on the realizations of the demand during previous periods, where emergency admission is treated as a proxy for hospital demand. A potential problem of Hughes and McGuire's model may occur because emergency admissions are often simultaneously decided by both demand and supply. By simply applying emergency admission as an index of hospital demand, the model ignores the importance of supply-side consideration[3]. By contract, the major concern of this study is uncertainty in health, which generally does not have such a simultaneity problem. Therefore, this study chooses to employ Hughes and McGuire's methodology to take

[2] The World Bank' 1993 report on *The East Asian Miracle* prompted a wave of comparative research to guide African countries from the development experience of eight performing Asian economics (Japan, South Korea, Hong Kong, Taiwan, Thailand, Malaysia, Singapore, and Indonesia). We expect the results of this study would contribute to this wave of research.

[3] We appreciate the reviewer's suggestion in pointing out this perspective.

advantage of its effeteness in modeling uncertainty.

The current stochastic health status is assumed to be the function of two variables, time-lagged prior health status and personal characteristics as shown in equation (1):[4]

$$BadHealth_t = \alpha_0 + \alpha_1 BadHeath_{t-1} + \alpha_2 BadHealth_{t-2} + a_3 X + \varepsilon \quad (1)$$

Where; *BadHealth* is the continuous dependent variable that contains the information of self-evaluated health status ranging from 1 to 5; *t* indicates the time period.

While potential biases resulting from self-reported health status may exist, previous studies have established the creditability of subjective, self-reported health condition variables. When respondents have considerable health and mortality related information, the self-reported health status often correctly assembles the real health status (Benitez-Silva and Ni, 2008; Hurd, 2009).

Moreover, Huynh and Jung (2010) applied data collected from 1992-2004 health retirement study (RAND-HRS) and proved that subjective health expectations about future health are consistent in predicting future health outcomes. Therefore, we feel it is appropriate to apply self-reported health status information in equation (1). Vector X contains selected demographic variables including gender, age, education, and region of residence.

At the second stage, the squared value of the residual from equation (1) will be used as a proxy for health uncertainty (denotes *StochasticsSickness*) for modeling labor supply and saving decisions[5]. Given Emp is a dummy variable indicating the decision to participle in the labor market, the participation decision is a latent regression function as shown in equation (2)[6]:

$$Emp^* = \beta_0 + \beta_1 BadHealth_{t-1} + \beta_2 Stochastic\ Sickenss + \beta_3 X_1 + V \quad (2)$$

where X_1 contains a set of exogenous variables that may affect the decision to participate in the labor market including gender, age, education, marital status, and number of children. In addition, we assume:

$Emp = 1$ (in labor force) if $Emp^* > 0$

$Emp = 0$ (not in labor force) if $Emp^* \le 0$

If $Emp_i = 1$, then the function of hours-of-work is estimated as shown in Equation (3):

$$WorkTime_t = \gamma_0 + \gamma_1 BadHealth_{t-1} + \gamma_2 StochasticSickness_t + \gamma_3 E_t + u \quad (3)$$

Where work time is the number of weekly work hours; E_t contains a of exogenous variables controlling workers' characteristics such as gender, age, education, marital status, number of children, and job factors.

The health variable (*BadHealth*) is given a one period time lag to reflect the dependency of labor market outcomes on the prior health status as suggested by Haveman et al. (1994). Considering the correlation (ρ) between the error terms of equations (2) and (3), Heckman's two-step method (1979) is employed to carry out the estimates of the labor-market models. If the correlation in the error terms between equation (2) and (3) (that is, ρ) exists, we should apply the framework of the simultaneous equation models to estimate the coefficient values of these equations. However, if the estimated value of ρ is zero, the conventional single equation approach will be applied to estimate equations (2) and (3), respectively.

Let save be the yearly saving rate;[7] the saving function is written as:

$$Save_t = \alpha_0 + \alpha_1 BadHealth_{t-1} + \alpha_2 Stochastickness_t + \alpha_3 E_t + e \quad (4)$$

O'Donnell (1995) made no theoretical prediction regarding the effect of stochastic sickness on labor participation. Therefore, an important object of this paper is to examine the effects of *StochasticSickness* on labor input and saving decisions through coefficients γ_2 and α_2 .

Data and variables

The study adopts the data collected from the 2003–2005 Panel Study of Family Dynamics (PSFD). The PSFD provides researchers detailed information to study socio-economic issues such as economic, social, and psychological structures and the evolution of customs in Taiwan. The PSFD comprises a multi-year panel survey beginning in 1999, but the questionnaires are not identical over the years. In 1999, 2000, 2003, and 2004, new sample age cohorts were added, in addition to the previously included cohorts. Once a specific interviewee is included in the survey, PSFD will update this respondent's information whenever a new survey is conducted. The key reason we selected PSFD data for use in this study is because PSFD is the only panel data available in Taiwan that longitude data of information that is required for the object of this study. Table 1 summarizes the available year and age cohorts for the PSFD.

Our research focuses on the data from 2005 panel PSFD (survey period 7), which contains four cohorts of respondents who were born in 1935–1954, 1953–1964, 1964–1976, and 1976–1979.[8] However, the age cohort 1976–1979 is not included in our study due to the lack of time-lag data. The complete data set included in this paper contains 2,389 out of a total 3,319 observations. A dummy variable "$No\_response$" is created to indicate that 635 respondents chose not to respond to the question regarding the saving rate. We assume the value "0" of this dummy for those observations.[9] All variables included in our model are listed and

[4] An ordered probit model was conducted previously by treating bad health as a categorical dependent variable. However, the ordered probit model failed to reach convergence in estimation.

[5] Hughes and McGuire (2003) used the residual from the forecast demand equation as the unpredicted demand indicator. However, we argue the magnitude of uncertainty should not be affected by the sign of the residual based on the theoretical specification. Instead, this study employs the squared value of the residual.

[6] Labor supply theory states that workers make the decision of optimal hours of work by comparing the wage rate and the marginal rate of substitution between leisure and work (Borjas, 2005). Hence, an implicit assumption in this study is that a rational individual will only participate in the labor market if the marginal rate of substitution is bigger than the wage rate.

[7] If a specific respondent is unmarried, we calculate saving rate by dividing this person's saving over personal income in the previous year. For married respondents, saving rate is calculated by the couple's total saving over total income in the previous year.

[8] The questionnaire and the details of the survey are available at http://psfd.sinica.edu.tw/check.htm

[9] We also attempted to delete non-response observations and reconstruct the completed data without missing value. The estimated results for saving decision model are virtually unchanged.

Table 1. The year and age cohorts available for the PSFD.

Survey period	Conduction year	Age cohorts included
1	1999	1953–1964
2	2000	1935–1954, 1953–1964
5	2003	1935–1954, 1953–1964, 1964–1976
7	2005	1935–1954, 1953–1964, 1964–1976, 1976–1979

*Source: http://psfd.sinica.edu.tw/check.htm.

defined in Table 2.

The descriptive statistics of these variables are shown in Table 3. The corresponding means of the self-evaluated health condition (*BadHealth*) from 2003, 2004, and 2005 are 2.3933, 2.5326, and 2.6223, respectively. The increase in numbers of *BadHealth* over the three-year survey period implies the deterioration of health status as people age. Due to the fact that the PSFD only records the heads of reference households, our sample observations are mostly married, middle-aged and older adults. Consequentially, the education level for our sample is also low. Taiwan's education reform that provides subsidies for the citizens to access affordable junior high school education (equivalent to a lower secondary education in the U.S.) did not start until 1968. Furthermore, Taiwan's government did not focus on the importance of higher education before 1988. A majority of our sample respondents did not have the opportunity to take advantage of the progresses in Taiwan's education policy. As the main household financial providers, the rate of labor force participation from respondents in our sample is relatively high (that is, 0.6784). By contrast, the ratio of self-employed workers is only 0.0127.

EMPIRICAL RESULTS AND DISCUSSION

Before examining the effect of stochastic health status on work hours and saving decisions, the health forecast result from Equation (1) needs to be examined. As shown in Table 4, the prior two time-lag health variables (BadHealth, 2003 and 2004) both have a significant and positive effect on current health (i.e., 0.1888 and 0.3588). Moreover, gender, age, education, and the region of residence all significantly affect the perceived future health status as indicated by the estimate results shown in Table 4. The F-statistics of 130.08 implies a well-fitted forecasting result in our model.

Table 5 points out the existence of a sample selection bias in Equation (3) as the coefficient (ρ) of Inverse Mill's ratio is statistically significant at 95% confidence level. This result suggests that the decision of labor participation is simultaneously correlated to the decision of the number of hours of work. Hence, Heckman's two-step approach (1979) is an appropriate method to estimate labor force participation and hours of work (that is, Equations (2) and (3)), simultaneously.

The result shown in Table 5 indicates that stochastic health status has significant but opposite effects on decisions of labor participation and working hours. As expected, the coefficients (γ_2) on variable *StochasticSickness* in Equation (3) are positive and significant (that is, 1.3236), which coincides with O'Donnell's (1995) conclusion that a higher uncertainty over sickness leads to more working hours. On the contrary, the coefficient β_2 in Equation (2) suggests that stochastic health has a significant but negative effect on the labor force participation decision (that is, -0.0779). This implies that while perceiving a worsening future health condition would discourage people from joining in the labor market, those who are already in the labor market actually will input more working hours to earn extra income for future consumption.

This study improves O'Donnell's finding (1995) by including those workers whose uncertainty of health condition is so high that they either refuse or are unable to join the labor market. Locating these workers and studying their socio-economic characteristics is crucial if the goal of the authority is to develop a program to stabilize the labor market and reduce social welfare problems. Furthermore, the universal health system (NHI) in Taiwan is expected to reduce the uncertainty over health. Nowadays, more than 95% of medical care providers were contracted with the National Insurance Bureau. Under NHI, individuals with the same occupation category pay a flat rate to obtain basic and mostly uniform services. Such a cost sharing system would have a considerable effect on people's reaction towards the change of perceived health status since the resulting costs for such a change are distorted, which may eventually reduce the incentive for an individual to work more. We suspect that this concern over lost productivity may be the reason Taiwan's employers tend to disapprove of the current public health care system.

The coefficient value on *BadHealth* for the labor participation (that is, -0.0502) is negative as expected because an individual's capability to work often decreases as the health condition worsens. However, study results also show a positive relationship (that is, 1.2639) between the number of hours of work and *BadHealth*. A possible explanation is that bad health reduces the efficiency for sick workers whom eventually have to work overtime to complete the same amount of work. Besides, a dominant effect that encourages sick workers to increase working hours may emerge due to the fact these workers may obtain a less cautious attitude toward potentially harmful effects of working overtime. We also suspect a risk-averse effect regarding a worker's health condition exists

Table 2. Variable definition.

Dependent variable	
Work time	Weekly hours of work
Save	Yearly saving rate If respondent is unmarried, save is measured by personal saving rate If respondent is married, save is measured by couples' saving rate
Demographic characteristics	
Age	Age
Male	Gender of the respondent Male =1 if male; Male=0 if female
Married	Marital status Married =1 if married Married =0 if single, divorced, or widowed
High school	Whether the respondent has at least a high school degree High school=1 if yes; High school=0 if no
College	Whether the respondent has at least a college degree College=1 if yes; College=0 if no
North	Whether the respondent lives in northern Taiwan North=1 if yes; North=0 if No
South	Whether the respondent lives in southern Taiwan South=1 if yes; South=0 if no
East	Whether the respondent lives in eastern Taiwan East=1 if yes; East=0 if no
Central	Whether the respondent lives in central Taiwan Central=1 if yes; central=0 if no
Child	Number of children
Job characteristics	
Self employed	Whether a respondent is self-employed Self-employed =1 if yes; Self-employed=0 if no
Wage	Hourly wage rate
Employment	Whether or not the respondent is employed Employment =1 if yes; Employment=0 if no
Health variables	
Bad health	A respondent's self-evaluated health status. Possible answers are: Bad health=1 if very good; bad health=2 if good; bad health=3 if just okay; bad health=4 if not very good; bad health=5 if very poor

Table 3. Descriptive statistics.

Dependent variable	Mean	S.D.
Work time	32.2071	27.5115
Save	0.1143	0.3542
Demographic characteristics		
Age	50.4060	11.7050
Male	0.4965	
Married	0.9791	
High school	0.4711	
College	0.1135	
North	0.4109	
Central	0.2294	
South	0.3089	
East	0.0508	
Child	2.4713	1.4713
Job characteristics		
Wage	142.7799	231.7016
Employment	0.6784	
Self employed	0.0127	
Health variables		
Bad health (2005)	2.6223	0.9170
Bad health (2004)	2.5326	0.9683
Bad health (2003)	2.3933	0.9836
Number of observations	2389	

Table 4. The estimate result of forecasting health condition.

Dependent variable	Badhealth (2005)
Intercept	1.2703 (12.294)***
BadHealth (2003)	0.1888 (10.353)***
BadHealth (2004)	0.3588 (19.819)***
Male	-0.0644 (-2.078)**
Age	0.0028 (1.726)*
High school	-0.1351(-3.4)***
College	-0.0633 (-1.213)
North	-0.1180 (-2.943)***
South	0.0304 (0.712)
East	-0.1221 (-1.613)
R^2	0.3250
F test	130.0800

t statistics are in parentheses. ***significant at 1% confidence level; **significance at 5 % confidence level; *significant level at 10%.

in Taiwan's job market once the working hour reaches a specific level.

The effects of demographic variables are not consistent between the decisions of labor participation and hours of work. For instance, gender, age, and marital status are all significant in explaining the labor force participation decision. The coefficient values of these variables indicate that being a younger, married male in Taiwan creates a higher willingness to participate in the labor market. Nevertheless, the demographic variables included in our

Table 5. The Heckman two-step estimates for labor supply model.

Dependent variable	Labor force participation	Hours of work
Intercept	-0.0779 (8.48)***	60.3830 (12.8)***
BadHealth	-0.0502 (-1.64)***	1.2639 (2.42)**
Stochastic sickness	-0.0779 (-2.35)**	1.3236 (2.03)**
Wage	-	-0.0210 (-10.44)***
Male	0.6987 (11.42)***	2.2609 (1.14)
Age	-0.0521 (-14.71)***	-0.0756 (-0.54)
Married	0.5188 (2.42)**	-4.7191 (-1.26)
High school	0.2144 (2.82)***	-1.1414 (-0.8)
College	0.2950 (2.39)**	-2.6956 (-1.68)*
Child	0.0066 (0.27)	0.4440 (1)
Self employed	-	-6.5163 (-1.66)*
Inverse Mill's ratio		-12.831
ρ		(-2.18)** -0.6298

t statistics are in parentheses. ***significant at 1% confidence level; **significance at 5% confidence level; *significant level at 10%.

study are not able to predict people's working hour decision.

The estimate coefficient of wage (that is, -0.021) indicates that higher wages actually reduce the working hours in Taiwan's labor market, although the magnitude of this effect is relatively minor. According to neo-classical labor theory, this result implies that the income effect dominates the substitute effect when people face the trade-off between work and leisure. However, this result does not necessarily imply that Taiwanese individuals prefer leisure over extra income. In 2003, an average Taiwanese worker worked 2,282 hours per year, which ranked among the top of the world (2003 World Competitiveness Report). It is possible that the majority of Taiwanese have already reached the upper physical limits. Therefore, the substitute effect does not affect the hour input decision even with higher wage. Moreover, Taiwan does not have a well-developed legal system to prevent employers from forcing employees to work overtime, especially for those low-paid and low-skilled industries. Most likely, higher wages are available only in better working environments or in relatively high-skilled industries where labor efficiencies are higher. Because the data available in Taiwan cannot provide enough information to explain the dominant income effect, we believe the institutional approach should be included in the future to search for the socio-economic reasons behind the statistic data.

We also find that having a college degree exhibits a positive effect on the decision to participate in the labor market but has a negative effect on the number of hours an individual is willing to work. This result supports the human capital theory: educated people have a competitive advantage in the labor market if we assume more education equals higher productivity.

Table 6 demonstrates the estimation results of saving Equation (3). The coefficient of $StochasicSickness$ (that is, 0.0133) indicates that people's rate of saving will increase as a response to the higher uncertainty over health condition. On the contrary, the estimated coefficients of $BadHealth$ are negative and insignificant (that is, -0.0059) in the saving-decision model. A possible explanation is that Taiwan's NHI system reduces the concerns regarding variations in the quality of health services and the cost burden since everyone can receive similar basic services for a comparable cost. For working-poor individuals, the heath spending is especially used to reduce current health problems. These individuals have little incentive to save or are unwilling to consider investing for future health services even if more service could possibly result in better health in the future.

The demographic variables in equation (4) show an interesting but inconsistent pattern. Age and education are positively related to the saving rate which indicates that older and better-educated individuals have a higher tendency to save. The number of children, as an indication of the necessary household consumption, has a negative effect on saving, which may imply a higher cost of living as the size of family increases. Moreover, this negative relationship may also result from Taiwan's tradition that parents generally expect their adult children to financially support them. Such expectation encourages parents with young dependants to devote more resources to the current family needs. Households residing in the northern and southern Taiwan save less than those who live in the other parts of Taiwan; this is due to the fact that the most modern and westernized cities are located in these two parts of Taiwan.

Conclusion

This paper investigated the relationship between the uncertainty over health condition and the decisions of labor

Table 6. The estimates from the saving model.

Dependent variable	Save	
	Coefficients	**t statistics**
Intercept	0.0604	(1.33)
BadHealth	-0.0059	(-0.9)
Stochastic sickness	0.0133	(1.8)*
Wage	0.0000	(0.59)
Age	0.0017	(2.27)**
Married	-0.0618	(-1.43)
High school	0.0435	(2.67)***
College	0.0623	(2.86)***
Child	-0.0168	(-3.15)***
Employment	0.0105	(0.55)
North	-0.0299	(-1.84)*
South	-0.0535	(-3.11)***
East	-0.0301	(-0.99)
No response	-0.0870	(-4.53)***
R Squared	0.0535	
F test	11.18 (P value<0.01)	

***significant at 1% confidence level; **significant at 5% confidence level; *significant level at 10%.

labor supply and saving. We derived labor supply and saving functions and estimated the parameter values to analyze this relationship by applying the survey data collected from the 2003–2005 panel study of family dynamics (PSFD). We concluded that stochastic sickness has a positive effect on the number of hours of work and saving rate but a negative effect on labor participation.

Furthermore, uncertainty over future health condition is associated with macroeconomic activities through people's saving decision. Thus, an understanding of stochastic health effects has important policy implications in evaluating the cost and effectiveness of public health programs. For instance, providing preventive medical programs (e.g. free screening and free flu shots) would not only improve citizens' health conditions but also create a useful mechanism to reduce the uncertainty over health condition. Traditional policy analyses focuses mostly on the direct effect of improving the viable, physical health condition. The results of this study points out that by ignoring the impacts of stochastic health on people's working and saving decisions, some unforeseen biases may occur when the policymakers try to evaluate the costs and benefits of different social welfare programs.

Accordingly, we recommended policymakers divert more resources to create efficient preventive medical programs. A more stable labor market and less precautionary savings, as a consequence of a better social preventive health programs, can definitely create positive multiple effects for the whole society.

For an economy with a large population and high uncertainty over their health condition, we recommend policymakers to develop programs to prevent serious loss of labor participation. Our empirical result also suggests that policymakers should prevent workers with deteriorating health conditions from being forced to put in more hours at work, which would worsen their health condition. We urge policy makers to recognize the need of these workers and develop a well-designed social welfare system to protect their physical and financial wellbeing after they lose the capability to work. Besides, the resulting labor productivity as a consequence of the trade-off between losing hours of work and increasing labor participation is also important for policy makers in other emerging economies where the universal health system is on the agenda.

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