Social Science & Medicine 76 (2013) 134–142

Contents lists available at SciVerse ScienceDirect

Social Science & Medicine

journal homepage: www.elsevier.com/locate/socscimed

Dynamic profile of health investment and the evolution of elderly health

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ARTICLE INFO

Article history:
Available online 2 November 2012

Keywords:
Taiwan
Mortality
Elderly
Discrete-time duration model
Health investment
National health insurance

ABSTRACT

A considerable number of studies have sought to examine the determinants of elderly health. Nevertheless, few of them incorporate a life-course perspective to analyze the dynamics of transition for both health conditions and their predictors. We utilize a nationally representative longitudinal data set of 4007 Taiwanese aged 60 or over and employ discrete-time duration models to investigate the association between annual mortality and its potential risk factors over a nearly twenty-year period (1989–2007). We place particular emphasis on the inherently dynamic character of Grossman's model, and specifically on how public and private health investment shape the personal health outcome over time. Our results support the hypothesis that depreciation rates depend on personal characteristics. In addition, we find that the dynamic profiles of both public and private health investment significantly influence the elderly mortality. An important implication of our study is that implementing universal health insurance and tobacco control programs are effective channels through which the government improves personal health.

Introduction

Among the numerous goals pursued by human beings, a healthy and long life is undoubtedly of the utmost importance for everyone, especially for the elderly who face a relatively high mortality risk in their later stages of life. A range of empirical studies that date back more than a hundred years, for example, Farr (1858), have attempted to investigate why some people die relatively young, while others survive to almost reach the age of a hundred. Previous studies have had a valuable contribution in relating mortality or longevity to personal characteristics measured at one moment in time. However, few of them have conducted in-depth empirical tests of Grossman's (1972) theoretical model of the demand for health. As pointed out by Wagstaff (1993), those studies fail to take into account the inherently dynamic character of the health investment process which is the most important component in Grossman's model.

Grossman (1972) was the first to construct a formal model for health capital. According to the investment identity function, an individual's health capital is determined by the initial level of stock, it depreciates with the time elapsed, and can be increased (decreased) by positive (negative) investment in health over time. When the stock of health capital falls below a critical level at some point of time, death occurs. In other words, Grossman's model implies that people choose their own optimal length of life.

Guided by Grossman's (1972) model, contemporary mortality risks should depend on a dynamic profile of health capital accumulation or the health investment process. Both public and private investment in health could affect the profile of health capital accumulation, and therefore determine the timing of death. One prominent example of positive public investment in health is the implementation of the universal health insurance program, which may slow down the decrease in the people's stock of health capital and prolong their longevity. In addition, typical examples of negative private investments in health are heavy smoking and drinking, which decrease the stock of health capital (Asano & Shibata, 2011). Considering only static personal characteristics or conditions at one point in time to be the factors of mortality would, however, produce biased estimates if the dynamic profile of health investment over time were to be ignored. Nevertheless, possibly due to the limited availability of suitable data, few empirical studies actually incorporate the dynamic component in Grossman's (1972) model, even though most studies do refer to Grossman's model in their empirical framework.

In this study, we revisit an old question in the health economics literature: how do various factors affect the evolution of elderly health? Our analysis differs in three important ways from previous research. First, we incorporate the dynamic character of Grossman's

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http://dx.doi.org/10.1016/j.socscimed.2012.10.017

(1972) theoretical model into our empirical framework by treating the investment identity function as the latent variable model of contemporary mortality risks. We emphasize how the dynamic profile of the health investment process shapes elderly health and determine the probability of death over time. Second, our analysis proceeds with much better data to adopt a life course perspective. We choose to utilize a nationally representative longitudinal data set of the elderly in Taiwan because Taiwan's good household registration system allows us to trace the exact dates of death for the elderly, which were rarely available in other countries. More specifically, the combination of a national death registry and a total of six waves of the "Survey of Health and Living Status of the Elderly in Taiwan" provides an excellent panel data source over a period of nearly 20 years. Third, we employ the discrete-time duration model, which more easily handles time-varying variables, to analyze the dynamic evolution of survival status and the role of the dynamic health investment process.

The remainder of this paper is organized as follows. Section 2 provides a brief review of previous studies involving some components in the profile of health capital accumulation. Section 3 describes the details of the research methods, including the empirical framework, the data sources, and the definitions of the variables. Section 4 presents our empirical findings, and the final section concludes and discusses the limitation and the direction of future research.

Previous studies

Socio-demographic characteristics have long been evident in explaining the differentials in mortality in the previous literature. Age, gender, marital status, ethnicity, education and income are usually regarded as control variables in studies on health status or the probability of death (Guralnik & Kaplan, 1989; House et al., 1990; Preston & Taubman, 1994; Zimmer, Martin, & Lin, 2005). Gardner and Oswald (2004) further rank the relative importance of these factors. It is found that the profitable health effect of marriage is significantly substantial, but by contrast income does not matter much while initial health conditions are controlled.

The previous literature that examined the impact of socio-economic characteristics on mortality has overlooked the dynamic component in the profile of health status and health investment transition, which is crucial in Grossman's (1972) model. Some recent studies have, however, been aware of the importance of factors at different life stages in determining the old-age health status. Frijters, Hatton, Martin, and Shields (2010) document that inferior economic status, poor household conditions, and doctor-diagnosed health problems in childhood are associated with a reduced length of life. Bengtsson and Broström (2009) further find the physiological damage to health capital to be the major pathway through which the disadvantaged condition at an early age influences the mortality in later life.

Unlike Bengtsson and Broström (2009) and Frijters et al. (2010) who utilize data at one moment in time to investigate the influence of childhood conditions on the eventual longevity, Gu, Sautter, Huang, and Zeng (2011) examine the factors predicting the static and dynamic health outcomes during a period of time. Their results show that individual health investments in both childhood and adulthood, healthy behavior, and community-level factors significantly influence the stock of health capital, but not the short-term flow of health capital. Although Gu et al. (2011) claim that their analysis incorporates life course perspectives, the time span in question from 2002 to 2005 is not sufficiently long to depict a relatively complete picture of the health transition over the life cycle. van Doorslaer (1987) and Wagstaff (1993) apply longitudinal data to fit Grossman's (1972) model of the dynamic demand for health. As noted by Grossman (2000), using longitudinal data allows researchers to take into account the effects of the unobserved heterogeneity and of the possible reverse causality between health and education. van Doorslaer (1987) estimates the health investment identity by regressing health in 1984 on health in 1979 and on variables affecting gross investment, including age, gender, education and income. Alternatively, Wagstaff (1993) empirically tests Grossman's (1972) model by means of a system of structural equations, including the investment identity function, demand-for-health equation, and demand-for-health-care equation. The focus of Wagstaff (1993) is primarily on the validity of model specification and the accurate functional form of the structural equations. His results show that the evolution of personal health does not follow instantaneous-adjustment models and the elderly health adjusts more slowly to a desired stock than the younger health does. Although van Doorslaer (1987) and Wagstaff (1993) both adopt a dynamic framework to analyze the transition of health status over time, the time span in their analysis is also too short to incorporate a life course perspective (5 years for van Doorslaer (1987) and 12 months for Wagstaff (1993)).

Method

Empirical framework

Our study links the duration analysis of elderly mortality to the dynamic character of Grossman's (1972) model by treating the investment identity function as the latent variable model of contemporary mortality risks. The conditional probability that individual i passed away during period t conditional on having survived up until the end of period $t-1$ can be specified by an index function as follows:

$$\Pr(D_{it} = 1 | D_{i,t-1} = 0, X_{it}) = F(X'_{it}\beta) \quad (1)$$

where D_{it} denotes an indicator of death, taking the value one if the death of individual i is observed in period t, and zero otherwise; $F(\mathbf{X}'_{it}\boldsymbol{\beta})$ implies some index function that takes on values in the unit interval (0, 1).

According to Grossman's (1972) framework, we observe $D_{it} = 1$ if individual i's unobserved stock of health capital H^*_{it} falls below a certain level H_0. Since H^*_{it} evolves following the investment identity function, the index function $F(\mathbf{X}'_{it}\boldsymbol{\beta})$ can be derived from an underlying latent variable model:

$$H^*_{it} = \mathrm{INV}_{i,t-1} - \delta_{i,t-1}H^*_{i,t-1} + H^*_{i,t-1}, \quad (2)$$

$$D_{it} = 1\left[H^*_{it} \le H_0\right] \quad (3)$$

where $H^*_{i,t-1}$ denotes the unobserved stock of health capital in the previous period, $\delta_{i,t-1}$ denotes individual i's depreciation rate in the previous period, and $\mathrm{INV}_{i,t-1}$ is the gross investment in the previous period, including public investment and private investment.

In this study, we employ a discrete-time duration model to analyze the contemporary mortality risks because we need to deal with a large number of dynamic transitions of covariates. Jenkins (1995) points out that discrete-time duration models have several advantages over other competing models in that they could easily incorporate both time-varying covariates and a flexible specification of baseline hazards. The contemporary mortality is usually parameterized in a proportional hazards form:

$$\Pr(D_{it} = 1 | D_{i,t-1} = 0, \mathbf{X}_{it}) = \lambda_0(t)\cdot\exp(\mathbf{Z}'_{it}\gamma) \quad (4)$$