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Going from bad to worse: Adaptation to poor health health spending, longevity, and the value of life☆

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ABSTRACT

Unhealthy people adapt to their poor state of health and are usually happier than expected by healthy people. In this paper, we investigate how adapting to a deteriorating state of health affects health spending, life expectancy, and the value of life. We set up a life-cycle model in which individuals are subject to physiological aging, calibrate it with data from gerontology, and compare behavior and outcomes of adapting and non-adapting individuals. While adaptation generally increases lifetime utility (by about 2 percent), its impact on health behavior and longevity depends crucially on whether individuals are aware of their adaptive behavior, i.e. whether they adapt in a naive or sophisticated way. We also compute the QALY change implied by health shocks and discuss whether and how adaptation influences results and the desirability of positive health innovations.

1. Introduction

From a gerontological viewpoint, the human life cycle can be characterized as the continuous deterioration of physiological fitness. Most human functions and capabilities begin to decline from early adulthood onwards (Case and Deaton, 2005; Skirbekk, 2004; Nair, 2005). Human aging, understood as "the intrinsic, cumulative, progressive, and deleterious loss of function that eventually culminates in death" (Arking, 2006), has a deep foundation in evolutionary biology (Fries, 1980; Gavrilov and Gavrilova, 1991; Robson and Kaplan, 2007) and, at the current state of medical technology, it can at best be delayed, but not avoided. It seems to be fortunate that aging humans are able to adapt to this sad state of affairs. However,

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at closer inspection, doubts may arise. Perhaps quickly adapting to worsening health induces us to invest less in health maintenance and repair, and thus, to live a shorter and perhaps overall unhappier life than we could without adaptation.

Assessing the impact of adaptation on health behavior, longevity, and happiness using lab or field experiments is difficult if not impossible because of the missing counterfactual (i.e. observing the same individual without the illness). With the help of economic theory and the design of an appropriate computational experiment, an assessment is relatively straightforward. In this paper, we propose such a computational experiment. We set up a life-cycle model of human aging, in which deliberate health investments reduce the speed of aging, and thus increase the age of death; calibrate the model with gerontological data; and compare behavior and outcomes for adapting and non-adapting individuals.

Inspired by the economics and psychology of time preference (Strotz, 1955; Rabin, 1998), we distinguish two types of adaptation behaviors: *sophisticated* types understand how their actual health and health behavior influences their adaptation, whereas *naive* types take the adaptation process as given (as a function of time or age).[1] Intuitively, this means that naive individuals observe the average adaptation process of their age cohort as they get older and believe that they will adapt in the same way. If they experience an idiosyncratic health shock, they do not take into account in the computation of expected future utility that their reference health stock adjusts as a response to the health shock. In other words, naive individuals underestimate their future utility experienced after adverse health shocks while sophisticated individuals predict it correctly. We created the novel concept of naive adaptation since, as argued below, it is more suitable for the analysis of actual adaptation processes than sophisticated behavior. We discuss sophisticated behavior mainly to better relate to the existing literature of fully rational adaptation.

We find, perhaps surprisingly, that naive adaptation is conducive to a healthier and longer life than no adaptation. Sophisticated individuals, in contrast, spend less on health and live shorter than otherwise identical non-adapting or naive individuals. We use these results to compute the implied value of life. We find, again perhaps surprisingly, that both naive and sophisticated types experience about the same lifetime utility and that both types experience a significantly higher lifetime utility than non-adapting types. We explain the economic intuition behind these results.

Since the seminal study of Brickman et al. (1978), comparing happiness of paraplegics and lottery winners, the medical and economics literature has provided ample evidence that humans adapt to their health status and rate their happiness or quality of life much higher than predicted by unaffected persons anticipating negative health events (e.g. Wu, 2001; Albrecht and Devlieger, 1999; Riis et al., 2005). This seems to be true for mild nuisances like acne (Baron et al., 2003), as well as for severe disabilities (Oswald and Powdthavee, 2008). Adaptation after a severe health shock is gradual and perhaps complete. Oswald and Powdthavee (2008) estimate hedonic adaptation of about 30 percent (50 percent) three years after the onset of severe (modest) disability, and they could not reject the hypothesis of complete adaptation after 6 years. Using a large panel of individuals observed from 1984 to 2006, Pagan-Rodriguez (2010) found gradual adaptation to disabilities and could not reject the hypothesis of complete adaptation after 7 years.

The observations that healthy people underestimate the happiness of sick people and that sick people believe they would be happier if they had never been sick (Boyd et al., 1990; Riis et al., 2005) indicates that people are not fully aware of their adaptive behavior. It indicates naive rather than sophisticated adaptation. The available evidence also suggests that adaptation to bad health is “genuine” and not driven by an overoptimistic assessment of one’s health and survival probabilities (Wu, 2001) and that the misprediction of healthy people of their adaptive capabilities is hard to explain by focussing illusion (Ubel et al., 2001; Baron et al., 2003). While most studies focus on adaptation after severe health shocks, we are mostly (but not exclusively) interested in the gradual and progressive decline of health that comes with age. In this context, it is interesting to observe that many empirical studies document that aggregate measures of happiness or wellbeing do not decline (by much) over the life cycle (e.g. Costa et al., 1987; Diener and Suh, 1998; Deaton, 2007). Recently, Harris and Kohn (2016) used different measures of past health levels as an approximation of reference health and showed a positive impact of reference health on health expenditure (as predicted by our model for a decline of reference health deficits).

The model that we set up below, in order to discuss the effects of adaptation to deteriorating health, is particularly suitable for this purpose since it is based on the notion of aging as progressive health deficit accumulation. It is easy to see that the alternative paradigm, the Grossman (1972) model, is less suitable. The Grossman model is based on health capital accumulation and the assumption that health capital depreciates at a given (potential age-specific) rate $d(t)$ such that individuals with health capital $H(t)$ lose health $d(t)H(t)$ through health depreciation. The health capital model thus assumes that among two people of the same age t, the one in better health, i.e. with more health capital $H(t)$, loses more health in the next period. The implications entailed by this counterfactual assumption are analyzed in detail by Dalgard and Strulik (2015). [2] Most importantly, health capital is a latent variable, unknown to doctors and medical scientists, a fact that confounds any serious calibration of the model. The health deficit model developed by Dalgaard and Strulik (2014), in contrast, avoids these shortcomings. Due to its gerontological foundation, it can be calibrated in a straightforward manner

[1] In the original literature these terms were applied to hyperbolical time discounting: sophisticated types were conceptualized as those individuals who understand the time inconsistency of their decisions based on hyperbolic discounting. Here, we borrow these terms to characterize adaptation processes. The analogy, however, is not perfect. While naive individuals are subject to bounded rationality in both applications, naive adaptation does not cause time-inconsistent decisions. We acknowledge that there are other potential pathways of bounded rationality in health behavior, which are ignored in the present study, like hyperbolic discounting and aspects of addiction (Cawley and Ruhm, 2012). Moreover, individuals may rationally decide to be overoptimistic about looming health problems (Oster et al., 2013b).

[2] For a critique of the health capital model, see also Case and Deaton (2005), Wagstaff (1986), Zweifel and Breyer (1997), Almond and Currie (2011).