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Social Science & Medicine 63 (2006) 817–828

SOCIAL SCIENCE & MEDICINE

www.elsevier.com/locate/socscimed

On the dynamics of health capital accumulation

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Available online 14 March 2006

Abstract

This paper presents a key model from the economics literature that has been adjusted and reinterpreted as a simple, formal, quantitative tool for formalising the inputs and outputs involved in personal health regimes undertaken to accumulate Grossman's health capital. Implications of the model fit with commonsensical clinical results. We find that higher variance of previous health capital increases leads to higher "good health" needed before health regimes are undertaken permanently. Conversely, the higher the target amount of health capital the lower the health capital "trigger" level for instigating the regime. Indeed, we find that the higher an individuals motivation is, as measured by a personal discount rate, the lower this personal "trigger" health capital level is. It is theorised that such a model can be used as a clinical application, whereby a patient's personal health history can generate the "motivation" and instigate health capital levels in a quantitative, as opposed to qualitative manner. Further implications are discussed.

Keywords: Hysteresis; Personal health; Health capital; Motivation; Real options

Introduction

In his celebrated paper, Grossman (1972) demonstrated that health can be viewed as a durable capital stock that produces an output of healthy time. Individuals can and do invest in themselves. Such investment can increase the wage rate earned by the individual, however, investing in health capital is different because it allows the investor to increase the total amount of time devoted to the production of monies and commodities.

Good health is demanded and supplied as a commodity. The input of market goods and the individuals own time determine the production of additional health capital. Personal health regimes are defined as any activity undertaken to increase the health capital of an individual by production of the health commodity. A regime can be satisfactorily assumed to involve a market good of some kind, whilst it invariably involves time. The commodity allows the person to achieve an increase in wages by allowing them to apply less time to sickness. Individuals demand this "good health" before they demand medical care. As a market good, determining the entry and exit into medical treatment could be achieved through standard neoclassical modelling.

The demand for the commodity good health is more complex however. Individuals may be aware of the need and the means of improving health on a long or short-term basis, but may choose not to undertake the changes necessary in an immediate fashion even if they are rational.

Under rationality, this state of affairs is known to cause a higher level of activity needed to induce action. In a standard market for a good, a firm may

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doi:10.1016/j.socscimed.2006.01.023

not produce a good until the profit margin is "high" as opposed to when price is more than floating cost plus fixed costs. The same firm will not abandon the production of a good when the price is less than fixed costs, losses will be far more extensive.

For an increase in health capital gained via a personal health regime, such a regime needs to acquire a level of health capital above what is traditionally "profitable"; a very large increase in "good health" is required to instigate the regime, whilst a greater reduction in "good health" is needed before the regime is abandoned.

This effect of inaction until a very high (or very low) price when profit can already be taken is known as a "hysteretic" effect. Hysteresis can be observed in any firm that chooses to produce a product when only deep profits can be made, or chooses to close a factory only after heavy looses are made on each item made, not after break-even prices are first missed.

In this paper, we turn to Dixit's (1989) real options model of entry and exit decisions under uncertainty (hereafter, the Dixit Model). This model will allow us to visualise the hysteretic effect on the entry and exit decisions of individuals who undertake to increase their health capital by instigating personal health regimes.

Hysteresis implies that the level of health capital which the health regime has to acquire for it to be followed is higher than the traditional rational level. For example, five "units" of good health may have to be gained by initiating a salt-intake reduction programme for an individual to employ the programme. A regime that generates 5 units of health capital will cause this regime to be used; this "option" will be exercised. The hysteretic effect demands that the regime should generate *more* than 5 units before it is utilised. The effect of hysteresis means that individual will not instigate personal health regimes until the benefits are higher than what they would rationally need.

The approach to hysteresis is an extension of the Dixit Model. This extension is the in extremis example of the model, where the entry level of health capital for the individual is defined as the level of acquired health capital at which the individual would instigate the regime without ever abandoning it. Contemporaneously, the exit level of health capital is defined as the level at which he or she would abandon the personal health regime if the regime could not commence again. A rudimentary approach to the health regime adoption problem allows a simple analysis of the issue which is less computationally expensive. Returning to the salt intake example, hysteresis may cause the health capital entry trigger level to be six units instead of five. If we assume that "entry" into the health regime implies that the person cannot abandon it, the result would be to increase the entry trigger to say seven units; simply a higher amount. Our approach is limited in application due to ease of exposition; however the intuition is easily followed. Any real-world applications where multiple abandonment and implementation are allowed serve to lower the spread between the traditional entry trigger level and the higher trigger level caused by hysteresis.

This paper will be split into four further sections. First, we will examine the salient features of health improvement caused by personal health regimes and examine the motivation for this paper. Second, the main conclusions of the Dixit Model will be laid out formerly. Third, we will demonstrate the significant characteristics and outcomes of the model. Finally, the paper concludes.

Health improvement

Diabetes

It is well documented that individuals such as those with diabetes mellitus struggle with the nutritional requirements that their condition puts upon them. These requirements often require the use of a diet regime specifically designed to reduce and manage fat levels (see Samanta, Denham, Jowett, & Burden, 1986).

Lerman (2005) tells us that clinicians treating diabetes should actively concentrate on adherence to personal health regimes as opposed to changing clinical methods. It is found that closely managed personal health regimes can improve adherence to pharmacological treatment. Prevention is the preferred treatment for these patients. Lifestyle changes such as improved diet are needed but are often complex, intrusive and inconvenient. These changes are paramount to improving any patient's prognosis, but lack of adherence is a major problem. Reduced motivation caused by difficulties in engaging these new lifestyle-changing health regimes is a main cause of non-adherence. Personal health regimes for diabetic patients are analogous to any regime designed to increase health capital. The individual is required to undertake the health-