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On the Golden Rule of capital accumulation under endogenous longevity☆

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ABSTRACT

Health spending obviously increase with capital per worker. This paper derives the optimal accumulation policy in such a context. The optimal accumulation rule depends on whether health spending improve consumption enjoyment, and on whether the planner adheres to an instantaneous welfarist view or to a complete life view. First, when the only role of health is to enhance longevity, we show that the capital per worker maximizing steady-state consumption per head is inferior to the standard Golden Rule. Moreover, the capital per worker maximizing steady-state consumption per head, when consumption efficiency depends on the health status, tends to exceed the optimal capital level under purely longevity-enhancing spending. Finally, when the planner adheres to a complete life view, the capital per worker maximizing steady-state expected lifetime consumption per head exceeds the optimal capital per worker under the instantaneous view.

1. Introduction

Introduced by Phelps (1961), the Golden Rule of capital accumulation states the condition under which the stock of capital per worker maximizes steady-state consumption per head. In a simple model with no technological progress, the Golden Rule states that steady-state consumption per head is maximized when the marginal productivity of capital equals the sum of the population growth rate and the rate of depreciation of capital. It does not depend on preferences.

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Whereas the Golden Rule has given rise to various studies in growth theory (see Diamond (1965) and Phelps (1965)), no attention has been paid so far to the Golden Rule of capital accumulation in an economy where some resources are spent on health and agents' lifetime is endogenous, as in Chakraborty's (2004) OLG model. Under such an endogenous (finite) time horizon, does the Golden Rule capital level remain the same, or, on the contrary, does the endogeneity of lifetime modify the Golden Rule?

Despite the increasing body of recent literature on the relation between economic growth and survival conditions, that question has not been discussed so far, as the literature focused mainly on purely *descriptive* issues (e.g. multiplicity of equilibria), and did not consider the normative question of the optimal capital accumulation in that context.[1]

Undoubtedly, studying the optimal capital accumulation in an economy where lifetime is endogenous consists of a most ambitious task, as the treatment of death, in welfare terms, remains problematic. Actually, the major difficulty concerns the definition of the utility level that should be assigned to death. However, given the growing body of recent literature with endogenous longevity, it is important, despite that difficulty, to study also the normative side of the growth/longevity relationship. This note, which aims at determining the Golden Rule capital level in the context of an economy with endogenous longevity, constitutes a first step in that direction. By focusing on consumption rather than utility, the present note will allow us to start the normative study of capital accumulation under endogenous longevity *without* having to make fragile postulates on the utility assigned to the death state.

In order to characterize the Golden Rule of capital accumulation, we use a two-period OLG model with physical capital based on Chakraborty (2004), where the probability of survival to the second period of life depends positively on the agent's health status, which is itself determined by some health expenditures. We then explore optimal accumulation policies in that context.[2]

Health spending obviously increase with capital per worker. Just like the two consumption levels of young and old individuals, health spending are not decided by the "planner" who determines the level of capital.[3] As a consequence, the capital accumulation rules we are going to derive here are no longer "first-best" as the original Golden Rule, but describe instead optimal accumulation policy in the second-best sense.

At this early stage of this study, it should be stressed that the relevancy of optimal accumulation rules in the context of endogenous health and longevity may be questioned on two distinct grounds, which, as we shall see, can serve as a basis for developing alternative policy concepts.

First, it may be argued that, as soon as *health* is a variable rather than a constant, focusing on the capital per worker maximizing steady-state consumption per head becomes a narrow objective. That criticism emphasizes an important limitation of optimal accumulation policy in the present context. However, as we shall see, it is nonetheless possible to account for that intuition, by expressing the consumption goal not in raw terms, but in efficiency units, under the assumption that agents tend, if they are healthy, to enjoy consumption to a larger extent than if they are not healthy. Note, however, that maximizing consumption in efficiency units is a better objective only to the extent that health spending improve the quality of each period lived. If health spending make people live longer but have no impact on the enjoyment of consumption (as in Chakraborty (2004)), then maximizing consumption per head is an adequate goal.

Second, it may also be argued that the usual objective of maximizing consumption per period becomes irrelevant once *longevity* is a variable. Obviously, whether agents live a short or a long life is generally not regarded as unimportant, and the usual Golden Rule, by focusing on consumption

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1 Chakraborty (2004), Cervellati and Sunde (2005) and Chakraborty and Das (2005) are three highly cited examples. Other papers include Jones (2001), Tamura (2006) and de la Croix and Licandro (2007). A survey is in Boucekkine (2008).

2 Note that, in the present framework, we shall assume that individual productivity is fixed. A natural extension of the paper could consist of introducing productivity gains related to a better health.

3 Note that assuming that individual health expenditures are not optimally chosen constitutes an important assumption, which affects our results (see *infra*). However, assuming, alternatively, that the social planner could choose individual health spending but not individual consumptions at the two periods of life would be rather hard to justify.