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Efficiency in overlapping generations economies with longevity choices and fair annuities [☆]

Julio Dávila ^{a,*}, Marie-Louise Leroux ^{b,c,d,a}^a CORE, Université c. de Louvain, Belgium^b ESG – Université du Québec à Montréal, Canada^c CESifo, Germany^d CIRPÉE, Canada

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ABSTRACT

When individuals can influence their life-expectancies and save in annuities, suboptimal savings result from the lack of incentives to choose the optimal longevity, even when annuity returns can be made contingent to longevity-related choices. Specifically, the golden rule steady state maximizing the representative agent utility cannot be attained as a competitive equilibrium under laissez-faire, even with actuarially fair annuities contingent to longevity-enhancing choices. In order to decentralize through markets the golden rule, longevity-enhancing expenditures need to be taxed if the steady state old-age consumption exceeds the annuitized capital return, and subsidized otherwise—the government budget being balanced through lump-sum transfers or taxes. Interestingly, with positive population growth the *expected* net contribution is negative when longevity-enhancing expenditures are taxed, and positive when subsidized.

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1. Introduction

Individuals decide not only what and when to consume (given their resources and the available financial contracts), but also about how long to expect to live. Indeed, individuals do influence their life expectancy in various ways by undertaking or avoiding actions and behaviors that may increase or decrease it.¹ Off course, increasing one's life expectancy can typically be done only at a cost, either in terms of resources (e.g. healthcare undertaken at the expense of lost consumption), or in terms of disutility (e.g. forgone unhealthy pleasures or a constraining way of life).² If that was it, the problem would not be different from

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* Corresponding author.

¹ For instance, agents can affect their life expectancy through their choice of preventive and palliative medical care, diet, lifestyle (see [Balia and Jones, 2008](#)), [Poikolainen and Escola \(1986\)](#) study in particular the impact of health expenditures on life expectancy. Several other studies document the impact of physical activity ([Kaplan et al., 1987](#); [Okamoto, 2006](#)), overweight (see [Solomon and Manson, 1997](#); [Bender et al., 1998](#)) and smoking ([Doll and Hill, 1950](#)) on life expectancy.

² While the most obvious way to increase life expectancy is to increase medical treatment, which requires the actual spending of income, individuals can also make behavioral choices to that end (e.g. exercising, abstaining from smoking, eating a healthy diet, driving safely) that do not necessarily require an additional spending, but may inflict nonetheless some disutility.

any other implying a trade-off between competing goals, namely between quantity and quality of life here. Nevertheless, things are in this case (unsurprisingly) more complicated: our choice of an expected life-span is intermingled with the problem of how to deal with the risk of outliving our resources. In effect, for most people, most consumption is financed out of labor income, which stops at retirement for legal reasons, or earlier for physiological ones, so that the most straightforward way to guarantee an income at retirement is to save. Still, individual savings do not eliminate this risk entirely, since miscalculation may lead to either running short of savings before dying or to leaving accidental bequests.³

To address in particular the risk of individuals saving insufficiently for old age, mandatory pension schemes force the inter- and intra-generational transfers necessary to guarantee adequate old-age living standards. Moreover, these mandatory public pension schemes are increasingly supplemented by private market-based schemes, such as annuities providing a life-long income after retirement in exchange of previous contributions. Nevertheless, once insured against the risk of running out of income, anyone has obvious incentives to take measures to increase his or her life-expectancy.⁴ Mandatory public pension schemes in which the pension received is not contingent to the individuals' life-enhancing choices are clearly unable to deal with this incentives problem, and are likely to induce excessive longevity, compared to the optimal one. Indeed, annuities that are independent of the individuals' choices make them invest in the quantity of life without internalizing the subsequent negative impact on its quality (through lower annuity returns). Instead, private annuity markets should have more chances of solving this incentives problem, by being able to make returns contingent to observable individual choices and behavior.⁵ This conjecture is precisely what this paper explores. To do so, we use a [Diamond \(1965\)](#) overlapping-generations economy of agents living up to two periods in which longevity—i.e. the probability of survival into the second period—is assumed to be endogenous (in Section 6, we extend the analysis to an overlapping-generations model akin to a “perpetual youth” model à la [Blanchard \(1985\)](#) without constant survival probability: households can live any number of periods, but face at any time a probability of survival into the next period that depends on their longevity-enhancing expenditures).

Specifically, can perfect annuity markets—which can price longevity-enhancing observable behavior into annuity returns—overcome alone the problem of inefficient investment in longevity? We show here, first, that in a laissez-faire, dynamic setup the answer to this question is negative. More specifically, we establish that typically the golden rule steady state maximizing the expected utility of the representative agent is not an equilibrium outcome under laissez-faire, even with actuarially fair, longevity-contingent competitive annuity markets. Moreover, in order to lay bare the fact that longevity choices are the root of the problem, we show that for an exogenous survival probability the golden rule is attainable through annuities and money. We show next that, in this set-up, life-expectancy is actually not necessarily higher at the competitive equilibrium steady state than at the golden rule: there may as well be, at equilibrium, a problem of under-investment in longevity as one of over-investment. In other words, depending on their preferences, the agents may uncoordinatedly choose to live shorter and richer lives, as well as longer and poorer lives, than the optimal lives the resources allow for if they coordinated their choices. Finally, we identify a policy of taxes and transfers that decentralizes the golden rule as a competitive outcome.

This paper is related to the literature on endogenous longevity in overlapping generations setups. In [Chakraborty \(2004\)](#) and [De la Croix and Ponthière \(2010\)](#) survival chances are a function of a constant fraction of, respectively, the marginal productivity of labor and the output per worker. [Chakraborty \(2004\)](#) argue for the positive impact on growth of publicly funded health care through the subsequent increase in the returns to investment in human capital, while [De la Croix and Ponthière \(2010\)](#) study how the golden rule is modified when longevity depends on per capita income. At any rate, longevity is not in these two papers the result of any deliberate choice by the agents of setting aside resources devoted specifically to modify it.⁶ To the contrary, in our paper, longevity is actually a direct private choice as it depends on the agent's private healthcare expenditures, like in [Pestieau et al. \(2008\)](#) and [Jouvet et al. \(2010\)](#).⁷ Nevertheless, [Jouvet et al. \(2010\)](#) explicitly avoid addressing any risk aspect of the problem assuming deterministic life-spans that are function of health expenditures, while [Pestieau et al. \(2008\)](#) restrict the analysis to the case in which there exists a pay-as-you-go pension system with an exogenously given replacement ratio of benefits to wages.

The papers above focus on either the competitive equilibrium steady state, as in [Chakraborty \(2004\)](#), or on the golden rule steady state, as in [De la Croix and Ponthière \(2010\)](#), or on the solution of a planner constrained by an exogenously given replacement ratio of an existing pay-as-you-go pension scheme, as in [Jouvet et al. \(2010\)](#). We show here instead that the golden rule cannot typically be attained under laissez-faire as a competitive equilibrium with annuitized savings when the agents can influence their longevity, *even if the annuities contracts are devised to cope with the incentives to over-invest in longevity when insured*. Notwithstanding, we show that an active fiscal policy allows to implement the golden rule as an equilibrium outcome. Specifically, whether longevity-enhancing expenditures need to be taxed or

³ Another primitive way to address this risk is to have children, although it is clearly not entirely free of risk either, in spite of the premeditated attempts by most cultures to instill in children devotion towards their parents.

⁴ This point was developed in [Davies and Kuhn \(1992\)](#) and [Phillipson and Becker \(1998\)](#).

⁵ [Phillipson and Becker \(1998\)](#) note that this externality can also arise with private annuity markets, if it is too costly to control longevity-enhancing behavior through insurance premia. Yet, the authors argue that public schemes are more subject to this moral-hazard problem, given their lack of a profit-maximization motive.

⁶ It is indirectly a consequence of their saving decisions, but for that reason the agents cannot disentangle the two choices.

⁷ [Jouvet et al. \(2010\)](#) also study the impact of a production externality (such as pollution) on longevity.

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