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The dynamics of capital accumulation in an overlapping generations model

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Abstract

This paper studies capital accumulation in a slightly altered, explicit OLG model. The fundamental difference with the standard model lies in the initial conditions. If a portion of the initial allocation of the capital stock is not assigned to retirees, the framework allowing for a genuine accumulation of capital is provided. Dynamic aspects of the resulting model are analyzed, including dynamics of the quotas of capital stock, shares of total output, partial influences of parameters, the connection between the depreciation rate and capital's contribution to production, and the relation of the latter to saddle-node bifurcations and the existence of real-valued equilibria. It is demonstrated that the model is able to describe the initial phase of accumulation. © 2001 Elsevier Science B.V. All rights reserved.

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1. Introduction

Standard OLG models are described by first order difference equations for which the capital intensity (capital per capita or the capital–labor ratio) in the next period depends exclusively on the savings habits of the generation working in the current period. Any increase in the capital stock from one generation to the next is accomplished through a reproduction rather than an accumulation mechanism (more capital begets more capital). Any *genuine* accumulation requires an equation

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of motion expressing next period's capital as a sum of current capital and the difference between current production and consumption, the latter of which includes retirees' consumption out of wages from the previous period. The accumulation process is thus described by a second order relation. Of course, in the standard model, retirees consume all of their previous savings and all of capital's share of the national product, which they receive as interest payments. The result is that capital formation is due entirely to the savings of young workers, who must replace the entire past capital stock and then some, if they are to see growth in capital intensity.

There are behavioral assumptions that could lead to accumulation from one period to the next, even if retirees hold all assets. One possibility is that retirees refrain from spending all of savings and interest, as a consequence of either altruistic bequests or uncertainty regarding lifespan, then at least some of capital could remain in the economy as unconsumed capital (e.g. as savings of the young out of bequests). OLG models with altruism have received much attention in the literature. For an overview see Smetters (1999). Other recent models include Michel and Pestieau (1998), Pecchenino and Pollard (1997), Hori (1997). A recent study of the effects of uncertain lifespan are in Fuster (1999). All of these references assume, however, that next period's capital stock depends entirely on current savings (an exception is Lines, 1999).

A second assumption, that retirees are not endowed with the entire capital stock, could also lead to capital accumulation. The following is a study of the dynamics of capital accumulation under the latter hypothesis. In Section 2 an OLG model is developed. Existence and stability of steady states, and the dynamics in general, are studied in Section 3. Concluding remarks are provided in Section 4.

2. Basic model

2.1. Worker-capitalists

The problem facing the representative agent is:

$$\begin{aligned}
 & \max_{c_{1t}} \mathcal{U} = u(c_{1t}) + (1 + \theta)^{-1} u(c_{2t+1}) \\
 & \text{subject to} \\
 & c_{1t} + s_t \leq w_t \\
 & c_{2t+1} \leq (1 + E_t(r_{t+1}))s_t \\
 & c(\cdot), w(\cdot), u(\cdot), r(\cdot) \in \mathbb{R}^+, \quad s(\cdot) \in \mathbb{R}_0^+ \\
 & 0 \leq \theta \leq \infty \\
 & E_t(r_{t+1}) = r_{t+1}
 \end{aligned} \tag{1}$$

and variables are defined as follows: c_{1t} is consumption in the working period at time t , c_{2t+1} is consumption in the retired period at time $(t + 1)$, w_t is the wage in

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