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Learning-by-doing and aggregate fluctuations: Does the form of the accumulation technology matter?

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Abstract

Several authors have identified learning-by-doing as a mechanism capable of generating the endogenous propagation of shocks in RBC models. It is shown that this endogenous propagation mechanism depends upon the dynamic structure associated with learning, rather than any functional form assumptions on the accumulation technology.

Keywords: Business cycles; Propagation; Learning-by-doing

JEL classification: E32; E23

1. Introduction

It is well known that the internal propagation mechanism in the standard real business cycle model is extremely weak. Cooper and Johri (2002) show that a structural model that allows for the accumulation of organizational capital might be capable of generating an endogenous propagation mechanism that exhibits persistence in output consistent with the data. They augment an otherwise standard representative agent stochastic growth model by introducing a new state variable labelled ‘organizational capital’ which is an input to the production technology. In the presence of learning-by-doing, firms create organizational capital as a by-product of production. The current stock of

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organizational capital is assumed to depend upon last period's level of production and the level of organizational capital available to the production unit.

Cooper and Johri (2002) consider a log–linear accumulation technology for organizational capital. This log–linear accumulation technology has the advantage that it allows estimation of the organizational capital parameters of interest without requiring data on the stock of organizational capital. It is this feature that has been exploited by both Johri and Letendre (2002) and Clarke (2006). However, this log–linear accumulation technology implies a non-constant marginal productivity of both the existing organizational capital stock and last period's output in the production of organizational capital. This is in contrast to several microeconomic studies of learning-by-doing, such as Argote et al. (1990) and Benkard (2000), which consider a linear accumulation technology that exhibits (global) constant marginal productivity. This paper investigates whether the endogenous propagation mechanism, identified by Cooper and Johri (2002), depends critically upon the (additional) curvature implied by the log–linear accumulation technology.

2. The model

In the model of Cooper and Johri (2002) aggregate output is produced according to a Cobb–Douglas production technology

$$Y_t = A_t K_t^{\theta} H_t^{\alpha} Z_t^{\varepsilon} \tag{1}$$

where A_t represents a shock to total factor productivity. Organizational capital Z_t is combined with physical capital K_t and labour H_t to produce output Y_t. The evolution of organizational capital is described by the following accumulation technology:

$$Z_{t+1} = Z_t^{\eta} Y_t^{\gamma} \tag{2}$$

Preferences over consumption and leisure are given by $U(C, L) = \ln C + \Phi L$. The first order conditions associated with the planner's problem of maximizing the utility of a representative agent, subject to the accumulation equation for physical capital, the log–linear accumulation technology for organizational capital, and the aggregate resource constraint are given by:

$$E_t\left\{\beta \frac{C_t}{C_{t+1}}\left[\frac{\theta}{\alpha}\Phi\frac{H_{t+1}C_{t+1}}{K_{t+1}} + (1-\delta)\right] - 1\right\} = 0 \tag{3}$$

and

$$E_t\left\{-\Phi + \alpha\frac{Y_t}{C_t H_t} + \beta\Phi(\eta + \varepsilon\gamma)\frac{H_{t+1}}{H_t} - \beta\eta\alpha\frac{Y_{t+1}}{H_t C_{t+1}}\right\}. \tag{4}$$

It is clear from (3) and (4) that, with some identifying restrictions, the organizational capital parameters η, γ and ε might be estimated without requiring data on the stock of organizational capital Z_t. In contrast, Argote et al. (1990) and Benkard (2000) consider an accumulation technology of the general form:

$$Z_{t+1} = \phi_1 Z_t + \phi_2 T_t \tag{5}$$