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A note on work–leisure choice, human capital accumulation, and endogenous growth

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Abstract

The growth model of Lucas [Lucas Jr., R.E., 1988. On the mechanics of economic development. Journal of Monetary Economics 22 (1), 3–42] is enriched with people having the opportunity to optimally allocate a fraction of their time to non-productive activities ('leisure'). It is found that the chosen amount of leisure reduces the steady-state *rate of growth* of per capita output. This implies that the association between income and welfare may not be as strong as it is usually assumed to be. The optimal allocation of time among activities depends on some of the parameters and the marginal product of physical capital per capita.

Keywords: Human capital; Time allocation; Endogenous growth; Welfare

1. Introduction

A standard assumption in growth models is that people devote inelastically their whole time endowment to some productive activity: individuals do not have the option to optimally allocate total time between employment and leisure (Romer, 1990; Aghion and Howitt, 1992; Jones and Manuelli, 1997). Thus, while it is always assumed that people try to maximize their discounted lifetime utility, the latter depends only on the level of consumption. This contrasts with standard analysis of labor supply where people value both income and 'leisure' or 'free time'. The omission of leisure from the representative agent's utility function provides considerable analytical simplification. However, if consumption is the sole argument in the maximization of utility, then higher levels of income – or higher rates of income growth – are necessarily associated with increased welfare. This may not be the case if people value elements besides income in their welfare calculations. Hence, one might ask whether the inclusion of some of these elements can provide a more complete perspective for discussing issues regarding growth and welfare. In any case, since in this model the growth effect of the stock of human capital depends on how many units are offered to the market, it is of great interest to analyze a setting in which the number of hours worked is endogenously chosen.

The present paper explores the effect of including leisure as an argument in consumers' optimization problem. The focus is on a steady state where labor supply is constant. Thus, no distinction is made among various components of labor supply such as work effort and labor force participation. Two versions of the model of Lucas (1988) are

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examined. In both versions, the economy reaches a steady state with positive growth. However, in the first version, human capital has only an *internal* effect that is taken into account by optimizing individuals. As a result, the optimal equilibrium is identical to the competitive one. In the second version, the *average* level of human capital creates an *external* effect (positive externality) in the production of human capital that private agents disregard in their optimizing calculations. This leads the market economy to a suboptimal rate of growth.

The model with no externalities is described in the next section. Section 3 presents the Pareto optimal solution provided by a social planner who maximizes the present value of the representative agent's infinite flow of instantaneous utilities. In Section 4 the aforementioned external effect is added to the production function. Then the optimal equilibrium is presented first, and the competitive equilibrium follows. Section 5 presents some conclusions and questions for further research.

2. The model

The economy has a population of N persons that increases at a constant exogenous rate $n > 0$, that is,

$$\gamma_{\{N\}} \equiv \frac{\dot{N}}{N} = n \tag{1}$$

where a dot over some variable denotes the first derivative of this variable with respect to time, and $\gamma_{\{\mathcal{Z}\}}$ denotes the growth rate of any variable $\mathcal{Z}$. Each person is endowed with one unit of time which can be allocated to (a) the production of a final (consumption) good, (b) 'education and training' which increases this person's stock of human capital, and (c) leisure. Further, each person possesses h units of skilled labor or human capital that can be applied to either productive activity, that is, (a) or (b).

The final good is produced according to

$$y = f(h, k) = (u_1 h)^\alpha k^{1-\alpha} \quad 0 < \alpha < 1 \tag{2}$$

where y is per capita output, u_1 is the fraction of time devoted to production, and k denotes per capita physical capital.[1] Physical capital accumulates as the difference between per capita savings and the allowance for new workers, that is,

$$\dot{k} = y - c - nk \tag{3}$$

where c is per capita consumption. Human capital grows in proportion to the existing stock of human capital, h, the fraction of time devoted to education and training, u_2, and a technological parameter $\vartheta > 0$, that indicates the efficiency in human capital production[2]

$$\dot{h} = \vartheta u_2 h. \tag{4}$$

Clearly, if ℓ is the fraction of time an individual devotes to leisure, it must be

$$u_1 + u_2 + \ell = 1. \tag{5}$$

Finally, people derive utility from consumption and leisure and, facing the usual income and wealth constraints, choose a level of leisure and a path of consumption expenditures so as to maximize their total discounted utility over an infinite time horizon.

The introduction of leisure in preferences merits some additional consideration. The steady state in models like the one at hand requires that all variables grow at constant rates. However, since the time that can be devoted to leisure is bounded above by the time endowment, the only admissible growth rate for ℓ is zero. To ensure that this feature is compatible with a long-run equilibrium characterized by continuous increases in labor productivity and output, we must impose two restrictions on preferences: (a) the elasticity of intertemporal substitution in consumption must be constant and independent of the level of consumption and, (b) the income and substitution effects associated with

[1] The production function can also be written as $y = A(u_1 h)^\alpha k^{1-\alpha}$ where $A > 0$ is a constant technological parameter. For simplification the value of A is normalized to 1.

[2] There is no depreciation in either type of capital.