

# A Spatial-Temporal Model of Human Capital Accumulation<sup>1</sup>

Venkatesh Bala

*Department of Economics, McGill University, Montreal, Canada*  
vbala2001@yahoo.com

and

Gerhard Sorger

*Department of Economics, Queen Mary and Westfield College, London, United Kingdom*  
g.sorger@qmw.ac.uk

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We develop an overlapping generations model of human capital accumulation and analyze its spatial and temporal properties. The interplay between local spillovers of human capital and global market participation partitions the society into socio-economic classes. We focus upon stationary equilibria and show that a large class of them are locally stable. Stationary equilibria can be homogeneous (where the human capital distribution is degenerate) or stratified (with a distinct spatial pattern of human capital distribution). We provide several examples and specify conditions under which equilibria are sensitive to the spatial structure of the society. We illustrate our results by numerical simulations. *Journal of Economic Literature* Classification Numbers: D90, I21, J24, O15. © 2001 Academic Press

*Key Words:* human capital; local interaction models; social networks; spatial stratification.

## 1. INTRODUCTION

We study an overlapping generations model of human capital formation, where agents are indexed both by time and by family. The family specifies a fixed spatial location in relation to other families. All agents participate in a common credit market to finance their education: the marginal productivity of the investment in human capital depends upon spillover effects from agents in the same neighborhood, i.e.; from nearby families. In

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this setting we investigate existence, uniqueness, local stability, and spatial attributes of equilibria.

Our framework combines common markets for labor and educational credit with local externalities which affect the incentives of market participants. The rationale for the latter arises from empirical studies in different contexts (see, e.g., [7–10, 14, 15, 19, 21]) which indicate that human capital formation is qualitatively very different from the accumulation of physical capital. Specifically, the manner in which an agent acquires skills, education, and training is influenced by complex patterns of interaction with other agents in the society. Such influences are often collectively referred to as “social spillovers” and include role model effects, the benefits provided by social networks, as well as externalities due to activities which adversely affect the quality of education (such as crime).

For a parametric class of CES utility functions we show that, given any spatial configuration of human capital, there is a unique interest rate which clears the credit market (Proposition 1). The equilibrium rate of interest creates multiple socio-economic classes. Those agents who received high levels of local spillovers in their youth become “managers”: they borrow to finance their education, and have high levels of human capital and income when old. A second class is comprised of “workers,” who receive small spillover benefits when young. Such agents prefer to work throughout their lives and lend some of what they earn while young to the aspiring members of the managerial class to finance their (i.e., the managers’) education. Last, there may also be a group of agents who are indifferent between working and studying when young, and who have intermediate levels of human capital when old. Thus, we obtain an endogenous explanation of social classes, where agents self-select the classes they will belong to subsequently. The self-selection is based upon market incentives and upon the agents’ initial “type,” which is determined by the spillover benefits received when young.

Much of our subsequent analysis is focused upon stationary equilibria, where the interest rate on intertemporal borrowing and the spatial patterns of human capital and educational investment are reproduced in each generation. An important class of such equilibria are referred to as regular. In a regular equilibrium, no agent is indifferent between working and studying when young, so that agents either become managers or workers. We construct several examples of such equilibria. One is a poverty trap: if all families have low levels of human capital and the spillover effects are sufficiently small, each agent prefers not to invest in education when young. This maintains the low level of human capital and leads to a self-perpetuating outcome. We also construct examples of regular stationary equilibria which are spatially stratified under different specifications of the neighborhood structure of the society. An interesting point to note is that stratification

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