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Journal of Economic Dynamics & Control 28 (2003) 307–329
JOURNAL OF Economic Dynamics & Control
www.elsevier.com/locate/econbase

# Equipment prices, human capital and economic growth

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**Abstract**

This paper presents a multisectoral model of economic growth in which endogenous technological progress is embodied in new equipment capital. The difference in the intensity of use of human capital across sectors creates aggregate dynamic non-convexities, and hence the model may generate multiple balanced growth paths. Under standard parameter values, our model can explain the observed correlations, found for a pool of countries, between investment rates in equipment capital and income growth, on the one hand, and between the rate of decline in equipment prices and income growth, on the other. The model is then used to study the effectiveness of two public policies that have been widely implemented to promote economic growth: An equipment investment tax credit, and a tax incentive to human capital accumulation. Our results indicate that both policies have positive effects on equipment investment and on long-run growth.


*JEL classification:* C68; E13; E22

*Keywords:* Equipment prices; Equipment investment; Non-convexities; Multiple long-run equilibria

## 1. Introduction

It has long been recognized that the ability to produce better and cheaper machines provoked the economic takeoff in the West. The idea that technology embodied in machines is one of the most important factors in the process of economic growth dates back to the Industrial Revolution. Support for this view has been recently provided in a series of papers. De Long and Summers (1991), using data from 1960 to 1985 for a sample of 25 nations, find a strong, positive statistical relationship between national rates of equipment investment (electrical and non electrical machinery), and

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doi:10.1016/S0165-1889(02)00166-5

productivity growth. Moreover, they also conclude that this association is causal, that is, higher equipment investment drives a faster economic growth. Structures investment has, however, an insignificant effect on growth. These authors show that the pattern for equipment prices across countries also seems to maintain an unambiguous relation with economic growth. Countries with lower equipment prices invest more in equipment capital, and then enjoy a more rapid growth. Furthermore, countries with faster economic growth are those that underwent sharper declines in equipment prices. Jones (1994), using data for 65 countries for the same period, 1960–1985, reaches similar conclusions. He includes the relative price of equipment in a growth regression, and finds a strong, negative relationship between growth and equipment prices.

In postwar U.S. economy, the most striking observations on equipment investment, as pointed out by Greenwood et al. (1997), are the decline of the relative price of equipment at an average annual rate of more than 3 percent, and the increase of the equipment-to-GNP ratio. The decline in the relative price of equipment has been interpreted as an improvement in the supply conditions of equipment goods, relative to final output. In other words, the production of equipment goods has experienced a faster technological change than the production of final output. Following this line, Greenwood et al. (1997) propose a model featuring exogenous technological change in the production of new equipment. More specifically, the amount of equipment that can be purchased for one unit of output increases at an exogenous rate. The model is then calibrated for the U.S. economy, and used to study the role of investment-specific technological change as an engine of growth. In their model, however, the relative price of equipment and its rate of change are exogenously set. Thus, since this price is not determined by equilibrium conditions, the long-run equipment investment rate, and the growth rate are trivially pinned down.

The main aim in this paper is to show that the endogenization of investment-specific technological change may have important consequences on the equilibrium dynamics. Indeed, when the relative price of equipment is endogenized, it depends on a ratio of marginal productivities, which in turn depends on the stock of wealth in the economy, and on the allocation of inputs across production sectors. The decision on how much to invest in equipment goods depends crucially on its relative price. When this latter price is high, it is optimal to produce final output with relatively more labor and less equipment. The low demand for equipment restrains technological change in the equipment-goods sector, thus preventing equipment prices from falling. The equilibrium dynamics then leads the economy to a long-run equilibrium with high equipment prices and no growth. On the contrary, when the price of equipment is low, the high demand for equipment goods fosters technical change. The equilibrium dynamics then leads to a long-run equilibrium with falling equipment prices and sustained growth in per capita income. As follows from these arguments, the composition of the initial stock of wealth, through its effects on the initial price of equipment goods, is an important determinant of the process of growth. Thus, having access to a technology that enables the production of cheaper equipment goods does not guarantee that it will be used in equilibrium, and hence it is not a sufficient condition for sustained growth.

This idea is presented in a standard endogenous growth model based on the Uzawa (1965)–Lucas (1988) framework. The new ingredient in this paper is that physical