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Reexamining the interaction between innovation and capital accumulation

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Abstract

In endogenous growth models with innovation and capital accumulation Arnold [J. Macro-economics 20 (1998) 189] and Blackburn et al. [J. Macroeconomics 22 (2000) 81] show that long-run growth of per capita income is independent of innovation activities; it is solely determined by preferences and the human capital accumulation technology. As a result, government policies do not affect long-run growth. This paper develops an endogenous growth model with innovation and (physical and human) capital accumulation to show that long-run growth depends on both innovation and capital accumulation technologies as well as on preferences and that government taxes and subsidies can have effects on the long-run growth rate.
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1. Introduction

In the endogenous growth literature, numerous studies have been devoted to understanding the determinants of long-run economic growth. There are basically two alternative approaches to the study of endogenous economic growth: capital accumulation approach and innovation approach. The first approach focuses on endogenous accumulation of physical or human capital and thus stresses the importance of investment in physical or human capital (e.g., Romer, 1986; Lucas, 1988; Rebelo, 1991). The second approach takes intentional innovation as the source of growth

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and thus emphasizes the role of investment in innovation activities (e.g., Segerstrom et al., 1990; Aghion and Howitt, 1992; Grossman and Helpman, 1991). Both approaches capture an important aspect of the growth process.

As pointed out in Aghion and Howitt (1998, Chapter 3), capital accumulation and innovation should not be treated as distinct causal factors, they are two aspects of the same process. On the one hand, physical and human capital are essential inputs in innovation activities and in the application of the new technologies resulting from innovation activities. On the other hand, the new technologies open up new economic opportunities for investment in physical and human capital to take place. Therefore, theoretically it is very important to integrate innovation and capital accumulation into a single framework and explore the policy implications. Along this line, many attempts have been made. [1] Howitt and Aghion (1998) develops an integrated model with innovation and physical capital accumulation. In their model, long-run growth depends on both innovation and physical capital accumulation technologies; and government policies that affect these two activities have permanent effects on growth. [2] Arnold (1998) and Blackburn et al. (2000) (hereafter BHP 2000) develop models with innovation and human capital accumulation. The two papers show that long-run growth depends only on preferences and human capital accumulation technologies. Furthermore, they show that government tax and subsidy policies have no effects on long-run growth. [3]

The objective of this paper is to examine the robustness of the results in Arnold (1998) and BHP (2000). The basic framework is due to Howitt (1999). We incorporate endogenous human capital accumulation into Howitt's (1999) model and correspondingly replace the labor input in intermediate good production with human capital. [4] As a result, we have two key assumptions that differentiate our model from Howitt (1999) as well as Arnold (1998) and BHP (2000). First, unlike Howitt (1999) where physical capital and labor are two inputs in intermediate good production, intermediate goods in our model are produced using physical and human capital. Second, different from Arnold (1998) and BHP (2000), human capital is not the only input in its own production; in addition to human capital, physical inputs are also required for producing human capital. [5] The extended version of Howitt (1999) still

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[1] Other than those papers cited below, quite a number of other papers (e.g., Eicher, 1996; Redding, 1996; Zeng, 1997) also study the interaction between innovation and capital accumulation. But these studies have focuses different from ours.

[2] Our model differs from Howitt and Aghion (1998) in two aspects: First, unlike the Howitt and Aghion model, our model does not exhibit scale effects; second, in addition to physical capital accumulation as in the Howitt and Aghion model, we also have human capital accumulation in our model.

[3] It should be noted that Arnold (1998, 100) is fully aware that the policy-ineffectiveness results obtained in his paper are not robust. The main objective of Arnold (1998) is to show that theoretically the link between long-run growth and policies is fragile.

[4] We believe that incorporating human capital accumulation into Howitt (1999) itself is a contribution of this paper.

[5] In endogenous growth models with capital accumulation as the *only* source of long-run growth, Pecorino (1994, 1995) examines how introducing physical inputs into human capital production affects the effectiveness of monetary and fiscal policies in influencing long-run growth.