# Human capital investment and economic growth: exploring the cross-country evidence

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## Abstract

The paper investigates three models on the role of education in economic growth: human capital theory, a threshold effect, and interaction effects between education and technological activity. Data for 24 OECD countries on GDP, employment, and investment from the Penn World Tables over the period 1950 to 1990 was used. Five sources are used for educational data. The descriptive statistics suggest that the convergence in labor productivity levels among these nations appears to correspond to their convergence in schooling levels. However, econometric results showing a positive and significant effect of formal education on productivity growth among OECD countries are spotty at best. With only one or two exceptions, educational levels, the growth in educational attainment, and interaction effects between schooling and R&D were not found to be significant determinants of country labor productivity growth. © 2000 Elsevier Science B.V. All rights reserved.

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## 1. Introduction

There are three paradigms which appear to dominate current discussions of the role of education in economic growth: the first has stemmed from human capital theory; the second could be classified as catch-up models; and the third important approach has stressed the interactions between education and technological innovation and change.

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## 1.1. The human capital approach

Human capital theory views schooling as an investment in skills and hence as a way of augmenting worker productivity (see, for example, Schultz, 1960, 1961, 1971; Becker, 1975).[1] This line of reasoning leads to growth accounting models in which productivity or output *growth* is derived as a function of the *change* in educational attainment.

The early studies on this subject showed very powerful effects of educational change on economic growth. Griliches (1970) estimated that the increased educational attainment of the U.S. labor force accounted for one-third of the Solow residual, the portion of the growth of output that could not be attributed to the growth in (unadjusted) labor hours or capital stock, between 1940 and 1967. Denison (1979) estimated that about one-fifth of the growth in U.S. national income per person employed between 1948 and 1973 could be attributed to increases in educational levels of the labor force.[2] Jorgenson and Fraumeni (1993) calculated that improvements in labor quality accounted for one fourth of U.S. economic growth between 1948 and 1986. Maddison (1987), in a growth accounting study of six OECD countries, covering the years 1913–1984 generally found that increases in educational attainment explained a significant proportion of productivity growth, though the contributions varied by country and sub-period.

Yet, some anomalies have appeared in this line of inquiry. Denison (1983) in his analysis of the productivity slowdown in the U.S. between 1973 and 1981, reported that the growth in national income per person employed (NIPPE) fell by 0.2% points whereas increases in educational attainment contributed a *positive* 0.6 percentage points to the growth in NIPPE. In other words, whereas educational attainment was increasing, labor productivity growth was falling. Maddison (1982) reported similar results for other OECD countries for the 1970–1979 period. Benhabib and Spiegel (1992), using the Kyriacou series on educational attainment (see below), found no statistically significant effect of the growth in mean years of schooling on the growth in GDP per capita among a sample of countries at all levels of economic development, when a 'catch-up' term is included.

## 1.2. Catch-up models

The second strand views the role of education in the context of a productivity 'catch-up' or 'convergence' model. Previous explanations of the productivity convergence process almost all involve the so-called 'advantages of backwardness', by which it is meant that much of the catch-up can be explained by the diffusion of technical knowledge from the leading economies to the more backward ones (see Gerschenkron, 1952; Kuznets, 1973, for example). Competitive pressures in the

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[1] Smith (1776), was, perhaps, the first to put forward this view.
[2] Denison (1962) appears to be the first work to provide detailed estimates of the contribution of education to economic growth.