Structural Change and Economic Dynamics 38 (2016) 55–68

Contents lists available at ScienceDirect

Structural Change and Economic Dynamics

journal homepage: www.elsevier.com/locate/sced

Education, structural change and economic development

Pier Paolo Saviotti[a,b,*], Andreas Pyka[c], Bogang Jun[c]

[a] Faculty of Geosciences, Cross- "Institutions" Program, Sub-Theme "Innovation", Utrecht University, Utrecht, The Netherlands
[b] GREDEG CNRS, 250 Rue Albert Einstein, Sophia Antipolis, France
[c] University of Hohenheim, Economics Institute, Wollgrasweg 23, D-70599 Stuttgart, Germany

ARTICLE INFO

Article history:
Received 4 March 2015
Received in revised form 2 April 2016
Accepted 4 April 2016
Available online 16 April 2016

Keywords:
Education
Development
Income distribution
Co-evolution

ABSTRACT

In this paper we explore the role that can be played by education in economic development using a model called TEVECON. Within the population of our economic system we distinguish two different social classes which differ for their level and quality of education and, as a consequence, for their human capital, wages and income per head. We vary the investment in education as a share of total investment, the share of investment in education allocated to each social class, and the quality of education each class receives. We show that while education can exert a positive effect on social mobility by increasing the population share of the upper social class it also leads to a tradeoff between income inequality and the rate of growth of income. These results are obtained based only on education and do not take into account any wealth effects.

1. Introduction

The objective of this paper is to study the role of education in economic development using our TEVECON model. The model explains growth and development predominantly based on the emergence of new sectors. Thus, structural change driven by innovation is a central mechanism according to which the emergence of new sectors is crucial to sustain long run economic development. In this paper, the role of education consists predominantly of improving the quality of human capital, thus contributing to increase labour productivity and output. In the paper we divide the population of our economic system into two classes, which we call H (high) and L (low). These two classes differ for their level and quality of education. Furthermore, we vary the investment in education in the whole economic system and study the impact it has on rates of growth of income and on the distribution of population and income between the two social classes.

2. Education and economic development

The progressive diffusion of education is one of the most important aspects of economic development, which occurred during the 20th century. The reasons for such an unprecedented development are in principle quite complex and not necessarily easy to understand. Education on the scale at which it is used today in advanced industrial and post-industrial societies requires a huge investment. Such an investment could have been carried out for non-strictly economic reasons. For example, a modern democracy could be expected to function properly only if its citizens are capable of understanding what their elected rulers do. If this was its only role then education could not have contributed directly to economic development but it would have been only a cost incurred to introduce justice and fairness into a system that otherwise would not spontaneously have produced them.

That the complex socioeconomic systems of modern democracies cannot be comprehended by uneducated people seems almost a truism. In this sense, it is quite likely that even a broadly conceived participation in social life requires a level of education superior to the one, which was required in the past. A general learning capability provides a basis for the learning of more specific knowledge leading to valuable competencies. Thus, a general usefulness of education, which extends beyond narrowly defined economic functions does not imply that education cannot play an important economic role. To explain the role played by education in the economic development of the 20th century we have to justify it as a form of investment. Participation in the education system involved withdrawing human resources from the labour market and from productive processes and allocating them to learning activities, which could improve their knowledge and competencies. The success of the investment can be judged either at the microeconomic

* Corresponding author at: Faculty of Geosciences, Cross-Faculty "Institutions" Program, Sub-Theme "Innovation", Utrecht University, Utrecht, The Netherlands. Fax: +33 476825455.
E-mail addresses: pier-paolo.saviotti@wanadoo.fr (P.P. Saviotti), a.pyka@uni-hohenheim.de (A. Pyka), bogang.jun@uni-hohenheim.de (B. Jun).

http://dx.doi.org/10.1016/j.strueco.2016.04.002
0954-349X/

or at the macroeconomic level by studying the impact of education on average income per capita or on rates of growth respectively.

The approach we will follow in this paper relies on the role of education in creating competencies and thus in affecting the human capital of workers. Human capital is obviously dependent on the education system and most of the existing empirical studies of human capital rely on education data, mostly but not only, years of schooling.

A possible mechanism through which education could have contributed to economic development consists of raising the income per capita, and thus the purchasing power, of consumers while simultaneously increasing the value of the output produced using better educated workers. The investment in education would be successful in a microeconomic sense if it could give consumers a positive return. This implies that if future workers invest in education, thus reducing their present income, they expect their future income, eventually diminished by the repayments of the loan incurred, to be higher than the one they would have perceived without education. Many empirical studies show that the income that the average worker can expect during his/her working life increases with his/her level of educational qualifications (e.g. Hall and Jones, 1999). Thus, education led to a rise in income. The precise mechanism according to which this could occur needs to be explained. The increase in wages which has been observed to coincide with rising levels of education could not have happened if by raising wages firms had simply become less competitive. The possibility to combine rising wages and increasing firm output and competitiveness depends on the prevailing mechanisms of economic development.

Higher wages can coexist with higher competitiveness if (i) productive efficiency rises, although this could lead to reduced employment, (ii) the quality of the output produced increases due to the enhanced competencies following from higher education levels, thus justifying higher wages. The combined influence of these two mechanisms can have contributed to create a higher purchasing power, thus stimulating demand and growth of output. We will later show that when describing the TEVECON model how the two mechanisms (i) and (ii) fit nicely into the pattern of economic development we propose. Also, we will see that the predominant mechanism of economic development is more likely to have been a co-evolution of education and of other relevant variables rather than a cause effect relationship in which education was the cause and enhanced revenues or rates of growth the effect. Existing studies of the role of education, either for simplicity or for data limitations, have framed the problem as a cause effect relationship between education and income per capita or rates of growth. We will now briefly review some of these studies before passing to describe our analysis of the mechanism by means of which education affected and was affected by economic development.

At the beginning of a study of the role of education in economic development it is important to state that education did not play an important role in the first phase of the industrial revolution (Allen, 2003; Clark, 2005; Mitch, 1993; Mokyr, 1990; Sanderson, 1972; Schofield, 1973). However, it would be very difficult to explain the existence of the armies of engineers, scientists and technicians working in modern socioeconomic systems if it were not for their contribution to the conception and production of the increasingly sophisticated products, which emerged since the beginning of the 20th century. Thus, in highly developed countries the transition from a generally unskilled workforce to a highly educated one started occurring at the beginning of the 20th century. However, the diffusion of education started much later and proceeded to a more limited extent in less developed countries (LDCs).

Early studies of the relationship between education and growth were based on data about school attendance, such as the number of years of schooling in given countries and their evolution in the course of time (Mincer, 1974; Krueger and Lindahl, 2001). Such studies did not lead to very conclusive results due to data quality and to the non-comparability of different education systems (Miller, 2007; Cohen and Soto, 2007; Barro, 2001). The explanatory power of education as a factor affecting economic development improves when cognitive ability rather than years of schooling is used as an indicator of education (Hanushek and Wößmann, 2007). Data about this effect of education have become available through the various education tests, which are now currently carried out (Knack and Keefer, 1995; Hanushek and Kimko, 2000). Unfortunately the scores of such tests are available for very short and recent periods and do not allow us to explore the changing role of education over longer periods. A variable, which has been used as a potential factor contributing to economic growth is human capital (Glaeser et al., 2004; Nelson and Phelps, 1966). Human capital is obviously dependent on the education system, although it can also be considerably affected by on the job learning (Becker, 1962). We do not separate the effect of education from that of on the job learning. While this could be considered an important problem if we were investigating the effect of human capital on competitiveness or on growth on a short term basis, we do not expect the absence of this distinction to affect negatively our results. As pointed out before, we are interested in exploring economic development over a relatively long period, such as the one from the industrial revolution to the present. We could expect the role of human capital to have considerably increased from the industrial revolution, when most labour was unskilled, to the 20th century, when the increasing diffusion of education and the change in industrial processes required the use of human capital of ever-increasing quality. Since the beginning of the 20th century the average frequency and duration of schooling is likely to have increased much more than on the job learning. In a past paper we identified one of the reasons for this growing intensity of human capital in the transition of the economic system from the production of basic necessities to that of a growing variety of increasingly differentiated and higher quality goods and services, a transition which we called 'from necessities to imaginary worlds' (Saviotti and Pyka, 2013). In that paper we had found that human capital, wages and demand increase only if product quality does. A similar transition, although occurring at a much faster pace, is likely to occur now in successful developing countries.

The diffusion of education entailed not just a very large investment but also a considerable growth in educational institutions accompanied by a number of other institutional changes which, while formally independent of education could have been interacting with it. The greatest advances in education were generally made in nations which introduced many other institutional changes, related for example to human rights, pensions, health care etc. The importance of institutions and of institutional change have been brought back to economists' attention by the work of AJR (2001, 2002), according to whom the main difference between nations that succeed and nations that fail is the greater presence in the former of *inclusive* institutions, empowering people to contribute to the economic development of the nation and enhancing its growth prospects. Without entering into the merit of AJR analysis this means that the diffusion of education is one of the many institutional changes contributing to the growth of nations, but possibly correlated with other changes. Glaeser et al. (2004) challenge the AJR point of view and conclude that indicators of institutional quality are less closely associated with economic growth than human capital.

The virtuous circle according to which education contributed to economic growth and economic development reinforced the role of education lasted for most of the 20th century in highly developed countries but it cannot be expected to last indefinitely. For example, the positive feedback loop between education and development can cease to operate if the cost of education becomes so high that