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 **Foresight**

**Mental Capital and Wellbeing:  
Making the most of ourselves in the 21st century**

**State-of-Science Review: SR-A3  
The Skills Needed for Economic Growth**

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## Summary

In 1981, Richard A. Easterlin in his Presidential Address to the Economic History Association argued that the great differences in the growth rates of the countries around the world were mainly due to disparities in human capital. In this regard, he considers the 'transfer of technology as a person-to-person process' and he identifies a skilled and well-educated labour force as the key factor that allows technological transfer and enables countries to experience economic growth. An example of institutional commitment to this idea is the recent human capital policy of the European Union. New strategic objectives were set during the Lisbon Summit in the year 2000 in order to make the European Union gain competitiveness with respect to the other knowledge-based world economies. The plan was broad and the goals related to every field of human capital policy, including 'turning schools into open learning centres' as well as 'making lifelong learning generally available' and 'adopting an R&D policy by creating European networks for research'. Apart from the increased awareness of the significance of education and training among policymakers, it seems important to develop an understanding of what type of human capital fosters economic growth.

The aim of this report is to review the state-of-the-art of science of what are the skills needed for economic growth. The analysis proceeds as follows. It firstly provides a definition and a description of the role of human capital in the theoretical and empirical frameworks at micro- and macroeconomic levels. Then, it highlights some methodological issues. Next, the focus is on what is available in terms of evidence on the distribution of skills that matters for growth, and the review ends with some concluding remarks.

### 1. Human capital: a definition

A natural question that arises from the discussion above appears to be: what exactly is 'human capital'? What does the term mean and what does it represent? According to Becker (1964; 1993), human capital is 'what is embodied in one person in terms of knowledge, skills and health'. This concept of human capital is broad: it includes healthcare, formal education, vocational training, on-the-job learning, adult learning, general knowledge and also experience. This review adopts a narrower definition, one used by the Organisation for Economic Co-operation and Development (OECD, 1998, p.9) namely: 'human capital is the knowledge, skills, competences and other attributes embodied in individuals that are relevant to the economic activity'. This restricts the concept to what directly contributes to productive activity and provides a return to the individual and, indirectly, to society as a whole. For our present purposes, the definition will be further narrowed to a focus on formal education and vocational training.

At the microeconomic level, the formulation of participation in schooling as an investment has been one of the fundamental conceptualisations of the human capital theorists like Becker (1964) and later Mincer (1974)<sup>1</sup>. The rationale behind this is that a greater level of skills makes an individual more productive and increases his or her market value.

There has been an extensive amount of research done on calculating returns to formal education. The basic model from which all the empirical analysis has been derived owes its origins to Mincer (1974). According to this model, the individual logarithm of earnings is a linear function of the number of years of schooling, work experience and an error term. The crucial assumptions of this model are: linearity and homogeneity of the returns to education, as well as exogeneity of the schooling decision. That is, there are no variables that affect both the schooling decision and the level of earnings that are not included in the model.

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<sup>1</sup>A discussion of the concept of human capital is presented in section 3.

The empirical analyses that have made use of this model have estimated the returns to an additional year of schooling to vary from 6-10%<sup>2</sup>. In spite of the powerful simplicity of this model, the underlying assumptions are quite strong. Among these, the ability bias remains the main difficulty in estimating the returns to schooling, that is the endogeneity of the education decision. Some unobservable characteristics of individuals are correlated both with the education decision but also with wages which, it is generally assumed, bias the estimates upwards. One strategy that has been employed is to rely on so-called 'natural experiments' to identify the effect on earnings of exogenous changes in education. Such experiments consist of changes in the schooling participation of some individuals that are independent of their own characteristics. Institutional and policy changes can be seen as natural experiments where some cohorts of individuals see their education opportunity changed independently of their own abilities and motivation. According to these studies, returns to education are highest for low income and middle income countries.

In the macro-economic literature, human capital is considered in two ways: as a factor of production and as a factor that facilitates the accumulation of productive capabilities. This difference is very important because it has both theoretical and empirical implications, as briefly discussed in the following paragraphs which consider neoclassical growth theory and endogenous growth theory, and provide an overview of relevant empirical findings.

## **2. Key methodological issues**

Starting in the 1950s, neoclassical growth theory soon became the most influential theoretical framework. Its basis was the Solow (1956) model, which features a neoclassical production function explaining level of output in terms of two factors of production: capital and labour. The two inputs exhibit decreasing returns, and technological progress is considered to be exogenous.

In the 1980s, new ideas challenged the underlying hypotheses of the neoclassical growth theory. In particular, researchers found that the basic assumption of a steady state of the Solow model was no longer adequate to represent what was happening in reality. Moreover, scholars became more interested in the ultimate sources of growth. Among these, the role of institutions appeared to be central in order to understand the process of growth. This deterministic approach, in terms of the impact of institutions on growth, is central to endogenous growth theory, designed to address some of the unsolved issues left by the neoclassical theory. A complete survey of the role of human capital in this framework is provided by Jones (2002) and, at a more technical level, by Aghion and Howitt (1998). In the following paragraphs the focus will be limited to the different roles of human capital in the most representative models of the endogenous growth theory.

In the AK models<sup>3</sup>, the growth process is considered to be endogenous as there is no exogenous technological change. Belonging to this category, the model developed by Lucas (1988) for instance, shows that human capital has a double effect on growth. It has a direct impact in terms of skills that increase workers' productivity, but also an 'external effect' that contributes to a greater level of firms' output. In the Lucas model, human capital enters the production function as an input multiplied by the time individuals spend in production. The steady-state equilibrium depends on the productivity of schooling multiplied by the optimal allocation of time spent in education. The practical implications for growth are that higher rates of accumulation of skills provided by schooling and learning-by-doing have a positive and permanent impact on the growth rate. Therefore, what matters for long-term growth is the accumulation of human capital through investment in schooling at any level. The role of government is limited to the provision

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<sup>2</sup>See Psacharopoulos (1994), Card (1999) and Psacharopoulos and Patrinos (2004) for an overview of the estimates and the studies in the existing literature.

<sup>3</sup>These are the endogenous growth models with constant returns to capital. In this case, aggregate output is equal to the stock of capital ( $K$ ) multiplied by a constant ( $A$ ). This is why they are called 'AK' models.

of formal education and training. This is because the interaction between people is the fundamental source that generates the knowledge that can allow the economy to grow indefinitely. In the subsequent developments of the new growth theory<sup>4</sup>, human capital is considered as a factor that facilitates the accumulation of productive capabilities. In fact, growth is endogenously determined and is a consequence of specific policies and deterministic factors rather than exogenous technological change. In these models, human capital is the key determinant of long run growth; technological advance is generated by 'the accumulation of knowledge', 'ideas' and 'skills' (Romer 1986; 1990). Furthermore, long-run growth can be affected by governments through their incentive policies and by firms through their decisions related to investment in research activity. Moreover, guidelines in terms of educational and vocational training policies can affect workers' decisions on how to invest in education and training and, consequently, may have an impact on the accumulation of human capital at aggregate level.

In addition to this, an indirect effect of human capital accumulation is generated by the positive externalities that foster growth. Accordingly, in these models, the interaction between the factors of production can generate positive spillover, and government policies can have a permanent effect by affecting the rate of growth of production (Romer, 1986).

A further role attributed to human capital in the endogenous growth theory is to allow the adoption of new technologies. In the model presented by Nelson and Phelps (1966), human capital has a double effect: it increases an individual's capacity to innovate and to adapt to new technologies (Aghion and Howitt, 1998, p.338). What matters for growth in this model is the level of education. That is, an increase in the labour force with higher levels of education would have a positive impact on growth as it would lead to a faster adoption of new technologies.

Following on from this research, Benhabib and Spiegel (1994) adopt an alternative specification to the neoclassical approach and provide empirical evidence on how high human capital levels determine the innovation process and the adoption of new technologies. However, a shortcoming of their study is that, if the regression analysis is restricted to the OECD countries, education is not significant. This may be a consequence of measurement problems that will be described later<sup>5</sup>. Policy recommendations arising from these models concern investments at higher levels of education and in R&D as in Nelson and Phelps' specification, human capital is probably referring to the highly skilled (Aghion and Howitt, 1998, p.356). This is because this is the share of the labour force that makes use of more advanced technologies.

From a theoretical point of view, the fundamental role that human capital plays in the process of economic growth has been widely recognised in the economic literature. However, from an empirical perspective, in spite of some recent contributions demonstrating the positive impact of human capital on growth, it is still not possible to draw definitive conclusions<sup>6</sup>. This is not only because, as Sianesi and Van Reenen (2003, p.163) acknowledge, 'the evidence of the neoclassical versus endogenous growth models is still inconclusive' mainly because empirical work 'does not allow in general to distinguish between theories', but more importantly because technical difficulties associated with the approximation of human capital and problems with data have generated questionable results. In fact, contrary to what has been found in the micro literature, macro studies show that what matters for growth is the initial level of schooling and also that primary education has a lower effect on growth than secondary and higher education. Even if there is no conclusive evidence in support of these models (Jones, 1995), they are very important as endogenising economic growth gives a greater role to institutions. That is, endogenous growth theory really considers the importance of institutional and educational policies for growth.

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<sup>4</sup>Among the first who developed this theory are Romer (1986), Lucas (1988) and Rebelo (1991).

<sup>5</sup>More recent developments in this tradition are provided by Greenwood and Jovanovic (2001) and Scarpetta and Tressel (2004).

<sup>6</sup>These studies will be examined later in the section and they include the analyses by Krueger and Lindahl (2001); Acemoglu et al. (2003); Aghion and Howitt (2005); Vandenbussche et al. (2006).

### 3. Human capital and economic growth

Among the empirical analyses, Benhabib and Spiegel (1994; 2005), while estimating the augmented-Solow model for 42 countries including European, African and Latin American nations over the period 1974-77, find that human capital has an insignificant impact on growth *per capita*. Barro (1997) finds that only male secondary and higher levels of education have a positive and significant impact on growth, whereas male primary schooling and female education are not significant. This analysis of 114 countries over the period 1960-90 finds that an extra year of male upper-level schooling is estimated to raise the growth rate by 1.2 percentage points per year. The empirical tool used in these studies (and usually applied in the literature to estimate the impact of human capital on growth) is provided by regression analysis: the logarithm of the Gross Domestic Product is usually taken as the dependent variable and, among the explanatory variables, one can find proxies of human capital, initial level of GDP, physical investment variables, government variables, geographical dummies and other economic indicators.

A recent paper by Krueger and Lindahl (2001) is recognised as an important contribution to the literature because, by considering the measurement errors and by removing the assumptions of linearity between human capital and schooling, the authors find empirical evidence of the positive impact of human capital on growth that confirms the results obtained at microeconomic level for a panel of 110 countries. Their panel includes European countries and developing countries, as well as the United States. They find that both the initial level and schooling growth have a positive impact on growth. They estimate that an extra year of schooling raises the growth rate by 10%, although they acknowledge the existence of differences across countries<sup>7</sup>. What they do in practice is an empirical exercise. They try to correct some misleading assumptions in the existing literature, then try to fit their analysis in some theoretical model. The 'Macro-Mincer' wage equation as specified in this work is obtained by aggregating the function across the individuals of a country by taking the mean of the variables of the model. The 'experience' variable is omitted from most of the analyses for simplicity. In spite of some criticism<sup>8</sup>, the Mincerian wage equation is now considered to be one of the fundamental tools of labour economics. The importance of the contribution of Krueger and Lindahl (2001) relies on the fact that their findings confirm the positive returns to education found at microeconomic level and therefore they remove what Psacharopoulos and Patrinos (2004) define as 'a major research gap'<sup>9</sup>. In spite of this important finding, when Krueger and Lindahl divide their sample into three sub-samples according to the initial level of education of the countries (low, medium and high), they find that this positive relation holds only for those countries that start at the lowest levels. According to their results, the relation does not hold for the OECD countries. Therefore, these results represent an improvement with respect to the previous literature as they remove the uncertainty surrounding the positive impact of human capital on growth. However, this analysis does not allow definitive conclusions to be drawn as it cannot explain the connection between these two variables in the more advanced countries.

In this regard, an innovative contribution is provided by Vandebussche, Aghion and Meghir (2006). In this paper, the authors argue that what needs to be considered is 'the distance of a country with respect to the technological frontier and the composition of its human capital'<sup>10</sup>. They argue that, when the distance from the technological frontier is great, a country is likely to be an adopter of technology so that primary and secondary education could have a positive impact on growth. On the other hand, when a country reaches a more advanced stage of development and becomes an innovator of technology, then higher education will have

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<sup>7</sup>Krueger & Lindahl (2001, p.1101).

<sup>8</sup>In particular, many scholars have found unsatisfactory the underlying assumption of no connection between the number of years of schooling and the length and profitability of on-the-job training. See for example Psacharopoulos and Layard (1979) for an alternative specification of the model.

<sup>9</sup>Psacharopoulos and Patrinos (2004, p118).

<sup>10</sup>Vandebussche et al. (2006, p98).

a positive impact on growth, whereas primary and secondary education will no longer foster growth. Their theoretical specification draws heavily on the notion of 'appropriate institutions' introduced by Acemoglu et al. (2003) that refers to Gerschenkron's emphasis on the fact that, for countries that industrialise at a later stage, policies different from those adopted by the early industrialising countries may be more adequate.

Vandebussche et al. (2006) test their hypothesis empirically and find that higher education has a growth-enhancing effect in a panel of 19 OECD countries over the period 1960-2000. The dataset they have constructed is drawn from the 15 Western European countries, Australia, Canada, New Zealand and the United States. These results show how, by adopting the right specification of the type of technology and educational composition, the puzzles previously found in the literature can be solved.

Moreover, the impact of human capital on growth may well be much greater than the estimation of private returns suggests as a result of the externalities. Recent investigations have shown the positive impact of education and training on health, social cohesion, crime reduction and voting behaviour. Among these studies, see Acemoglu and Angrist (1999), Moretti (2004), Chevalier and Feinstein (2006) and Venniker (2000) for a review of the literature. However, much less is known about how these non-monetary factors arising from an expansion of human capital may affect economic growth. In spite of these results confirming the positive impact of education on economic growth, there are still issues about the accuracy of the datasets, the suitability of the proxies and the production function used that all seem to characterise the results obtained. Furthermore, issues related to the quality of education and the problem of reverse causation have been raised and animate the current debate. In this regard, the recent paper by de la Fuente and Doménech (2006) provides evidence of the positive impact of education on economic growth by addressing some of these issues.

Even less satisfactory is the evidence related to the type of distribution of human capital that fosters growth. The studies reviewed so far and the majority of the existing analyses focus on the 'average distribution of schooling' due to the scarcity of data related to the distribution of human capital. Thus, at a theoretical level Saint-Paul and Verdier (1993) and Galor and Tsiddon (1997) identify a causal relationship that goes in both directions: on the one hand the distribution of human capital is determined by income inequality, but also the distribution of income affects the accumulation of human capital. On the other hand, Galor and Zeira (1993) find that a more equal income distribution, and therefore a more equal investment in human capital, does not always generate greater growth.

The empirical literature is less broad, and existing studies can be divided into three categories: those that provide human capital inequality measures; those that focus on wage dispersion across groups of people who have different skills and education levels; and finally those that focus on the intergenerational issue: how the initial income distribution affects the aggregate accumulation of human capital and how this affects the variation of the aggregate output overtime. In this regard, Castello and Doménech (2002) find that there is a negative effect of human capital inequality on economic growth, and these findings are robust to different specifications of the explanatory variables.

#### **4. Conclusions**

This report has examined the literature on human capital and growth by drawing attention to the key findings and their limitations. Institutional intervention in the areas of education and training has varied across countries, and this heterogeneity needs to be analysed. In fact, it may well be true that the production of human capital, 'the distribution of earnings', and the aggregate level of GDP, are 'a race between technology and education'<sup>11</sup>, as the events of the 20th century have shown. However, institutions seem to have a key role to play in this race, especially in recent times.

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<sup>11</sup> *The phrase "the distribution of earnings is a race between technology and institutions" comes from Goldin and Katz (2000, p782), quoting Tinbergen (1975).*

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