PRIME MINISTER'S OFFICE
ECONOMIC COUNCIL OF FINLAND

eu2006.fi

20 September 2006

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Education and economic growth: a quick review of the evidence and some policy guidelines

This paper is a contribution to the project *Globalisation Challenges for Europe and Finland* organised by the Secretariat of the Economic Council. The project is a part of Finland's EU Presidency programme and its objective is to add momentum to the discussion in the European Union on globalisation, Europe's competitiveness policy and the Lisbon strategy.

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SUMMARY

Recent cross-country research on the determinants of economic growth finds large social returns to education in European countries and suggests that investment in human capital should be accorded greater priority as part of a European strategy for promoting growth without sacrificing social cohesion.

The available evidence from the microeconomics of education provides some guidance for targetting efforts in this area efficiently. The literature suggests, first, that providing the right incentives for all participants in the education process is probably much more important than increasing resource inputs. And second, that returns are likely to be highest in the case of early interventions, particularly when they focus on youngsters from disadvantaged socioeconomic backgrounds because they can at least partially compensate for an unfavourable family environment at an age that is critical for the acquisition of basic skills.

Hence, priority should be given to pre-school education and to incentive-improving measures, such as the introduction of standardized examinations, the publication of school performance indicators, increased school autonomy in certain areas, performance pay for teachers, and greater school competition and parental choice.

1 INTRODUCTION

Human capital is a broad and multifaceted concept encompassing many different types of investment in people. Health and nutrition are certainly an important aspect of such investment, particularly in developing countries where deficiencies in these respects may severely limit the population's ability to engage in productive activities. In advanced countries, however, the key aspect of human capital has to do with the cognitive and non-cognitive abilities that are acquired at home, in the work place and in formal and informal training and are useful in the production of goods, services and further knowledge.

The first part of this paper briefly surveys the findings of a very large literature that provides evidence that skills are one of the primary determinants of wages and labor market outcomes at the individual level and of the level and growth rate of productivity at the country level. Hence, investment in people is both a crucial growth factor, particularly in the current context of rapid technological change, and a key instrument for enhancing social cohesion. As a result, educational policies and other public actions that influence the level and distribution of skills are potentially among the most effective levers that governments have at their disposal to promote economic progress and an equitable income distribution.

Recent estimates of the growth effects of human capital imply rather large social returns to educational investment in European countries and suggest that investment in education and training should be accorded greater priority as part of a European strategy for promoting growth without sacrificing social cohesion. These findings, however, provide very little guidance for the detailed design of human capital policies. To try to identify the key elements of an efficient strategy in this area, the second part of the paper draws on microeconometric evidence from the economics of education to advance two broad proposals that may help increase the efficiency of European educational systems.

2 HUMAN CAPITAL AND PRODUCTIVITY: A QUICK REVIEW OF THE EMPIRICAL EVIDENCE

There are good reasons to expect that human capital should be an important determinant of productivity, both at the individual and at the aggregate level, and that its role should be particularly crucial in today's globalized knowledge economy. Workers with greater problem-solving and communications abilities should perform better than their less skilled counterparts at any task that requires more than the routine application of physical labour and will also learn faster and adapt better to changing circumstances. Hence, skilled workers can

be expected to be more productive than unskilled ones for any given production process, and should be able to operate more sophisticated technologies that place greater demands on their capacities. If skill does carry with it a greater ability to learn, produce new knowledge and adapt to change, moreover, a more educated labour force will also be able to achieve faster productivity growth, both through gradual improvements in existing production processes and through the adoption and development of more advanced technologies, and should be in a better position to respond flexibly to rising worldwide competition.

These considerations suggest that the importance of human capital as an input has grown over time as production processes have become increasingly knowledge intensive and footloose. Today, relatively few occupations involve only mechanical physical tasks, and a large and growing fraction of jobs either reduce to the processing of information or require the application of specialized knowledge and skills to the production of increasingly sophisticated goods and services.[2] This is also true in relation to the production of the applied knowledge that underlies technical progress, which has gradually become more reliant on explicit R&D activities, more closely intertwined with formal science and, as a result, increasingly skill intensive. In addition, falling transportation and communication costs have opened up more and more activities to foreign competition, increasing the pace of structural change and putting a growing premium on the innovative capacity and adaptability of firms and workers.

There is a lot of academic work that broadly supports the hypotheses I have just set out. At the microeconomic level, the very large literature that has analyzed the impact of educational attainment on individual wages and other labour market outcomes leaves very little doubt that schooling has significant and quantitatively large positive effects on earnings, labour force participation rates and employment probabilities.[3] Recent research suggests that an additional year of schooling increases wages at the individual level by around 6.5% across European countries and that this effect can be as high as 9% in EU members with less regulated labour markets where pay scales presumably reflect productivity more closely (Harmon et al, 2001). Taking into account the employment effects of education, these estimates imply private rates of return to schooling that cluster between 7.5% and 10% for most European countries

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2 A recent OECD (1999) study finds that over half of the combined output of its member countries is produced in knowledge-intensive industries. These include not only advanced-technology manufacturing sectors such as ICT, but also intensive users of new technologies and of skilled labour, such as finance, insurance and communications services.

3 Wage equation studies have generally adopted the specification proposed by Mincer (1974). Psacharopoulos and Patrinos (2002) collect the results of such studies for a large number of countries and Card (1999) surveys the relevant literature focusing on estimation issues. On the impact of education on unemployment, see among others Ashenfelter and Ham (1979), Nickell (1979) and Mincer (1991).

(de la Fuente and Jimeno, 2004). There is also evidence of large and significant wage and employment effects of basic literacy and numeracy skills, even controlling for school attainment.[4]

At the macroeconomic level, academic economists have traditionally been optimistic about the contribution of education to economic development and have often assigned to the accumulation of human capital a central role in formal models, particularly in the recent literature on endogenous growth. The results of empirical cross-country studies on the determinants of economic growth have been largely consistent with this view. Landau (1983), Barro (1991) and Mankiw, Romer and Weil (1992), among other authors, find that a variety of educational indicators have the expected positive effect on output levels. Some of the relevant papers find rather clear indications that the level of education is an important determinant of the rate of technological progress and that this positive rate effect seems to work at least in part through the role of education in facilitating the absorption of foreign technologies. (See for instance Engelbrecht, 1997).[5]

During the second half of the nineties, however, a new round of empirical papers produced rather disappointing results on the effects of schooling on aggregate productivity. Unlike most previous studies (which relied on cross-section data to analyze the determinants of growth over long periods), most of these papers used pooled data at relatively short frequencies and relied on either panel techniques or on the use of differenced specifications to control for unobserved country heterogeneity. In this setting, educational variables are often found to be insignificant or even enter with the "wrong" sign in growth regressions. (See for instance Benhabib and Spiegel (1994), Islam (1995), Caselli, Esquivel and Lefort (1996) and Pritchett (1999)).

While some researchers have been willing to take such counterintuitive results at face value and have even started to seriously consider the reasons why educational investment may not contribute to productivity growth (see in

[4] See among others Boissiere et al (1985) and McIntosh and Vignoles (2001).

[5] The literature suggests that a country's stock of human capital can be expected to have a positive effect both on its *level* of productivity and on its *rate* of technical progress. In practice, it has proved rather difficult to separate these two types of effects, with different studies reaching opposite conclusions about their relative significance. This may be partly an estimation problem, as the high correlation between schooling levels and growth rates and of these variables with other regressors can make it difficult to untangle their separate effects in a growth regression. But there are also plausible theoretical specifications in which the two effects may be difficult to identify separately. In particular the distinction between them tends to become blurred once we allow for technological diffusion. In this context, an increase in human capital does make for faster technological change, but this effect gradually exhausts itself as the country comes closer to the world technological frontier and total factor productivity growth stabilizes. As a result, the rate effect becomes a level effect over the medium or long run and, if convergence to the "technological equilibrium" is sufficiently fast, the two effects cannot be separated.

particular Pritchett, 1999), many others have been rather skeptical (see for instance Barro, 1997). These authors have tended to attribute negative results on schooling and growth to various econometric and specification problems and to poor data quality. Measurement error, in particular, has been widely recognized to be a potentially important problem for two reasons. First, because the series of average years of schooling commonly used in the literature are likely to contain a lot of noise and, second, because years of schooling can be expected to be a very imperfect measure of skills in any event. The first problem, in addition, is likely to be particularly important in a panel setting, where parameter estimates rely heavily on the time-series variation of the data, because measurement error arising from changes in classification and data collection criteria tends to generate a lot of spurious volatility in the schooling series that will make it difficult to identify the contribution of education to productivity growth.

The research carried out over the last few years strongly suggests that the negative results found in the previous literature can indeed be largely attributed to deficiencies in the human capital data used in earlier studies. Papers that make use of improved data sets on attainment or allow for measurement error find that increases in schooling do indeed have a substantial impact on productivity growth. Results are generally even stronger and sharper when direct measures of skill levels are used to proxy for human capital, suggesting that improvements in the quality of schooling can have an even larger effect on aggregate output than increases in its quantity.

Krueger and Lihdhal (2001) show that the amount of noise in the most widely used schooling data sets is large enough to explain some of the most widely cited negative findings on human capital and growth as the result of measurement error. De la Fuente and Doménech (D&D, 2001 and 2006) and Cohen and Soto (2001) draw on previously unexploited sources of information to construct new attainment series that appear to contain a considerably smaller amount of measurement error. Both sets of authors find that the use of these refined data leads to very significant improvements in the performance of schooling indicators in several standard growth specifications. De la Fuente and Doménech (D&D, 2006) use an extension of the classical errors-in-variables model to correct the bias induced by measurement error. Their corrected estimates of the coefficient of schooling in an aggregate production function are around twice the size of what may be considered the consensus value of this parameter in the earlier literature.

The results of these papers indicate that the contribution of schooling to aggregate productivity growth is at least of the size implied by microeconometric estimates of wage equations and may be considerably larger, suggesting that human capital accumulation may be the source of important positive

externalities at the aggregate level which are likely to be related to the role of education in promoting the development and absorption of new knowledge. There remains, however, considerable uncertainty regarding the size of these externalities, both because the existing range of estimates of the relevant parameter is broad, and because it is quite likely that some of these estimates may be biased upward due to a reverse causation problem that reflects the feedback effects of rising income on the demand for education (see for instance Bils and Klenow, 2000).

Another interesting development is the use of direct measures of skills which are likely to be better proxies for human capital than years of schooling. While such data are still rather scarce, some recent papers suggest that this is likely to be a rather fruitful line of research. Hanushek and Kimko (2000) construct an indicator of labour force quality using mean country scores in a number of international student achievement tests in mathematics and science, while Coulombe et al (2004) use data drawn from IALS, an international study on the skill level of the adult population conducted by the OECD and Statistics Canada.[6] In both cases, the results of growth regressions point to even larger output effects than those obtained using even revised attainment data. These estimates imply that the return to improvements in schooling quality could be extraordinarily high, for not only are their expected benefits large, but the relevant costs will generally be much lower than those of increasing attainment for they do not involve a further sacrifice of student time and output.

The social return to schooling investment

The recent studies I have briefly discussed point to strong growth effects from human capital which in turn imply rather respectable social rates of return to investment in schooling. Drawing on D&D's (2006) results, I estimate that an additional year of average school attainment raises productivity in the average EU country by 6.2% on impact and by a further 3.1% in the long run through its contribution to faster technological progress (de la Fuente, 2003).[7] The first of these effects is considerably higher in the cohesion countries and in Italy,

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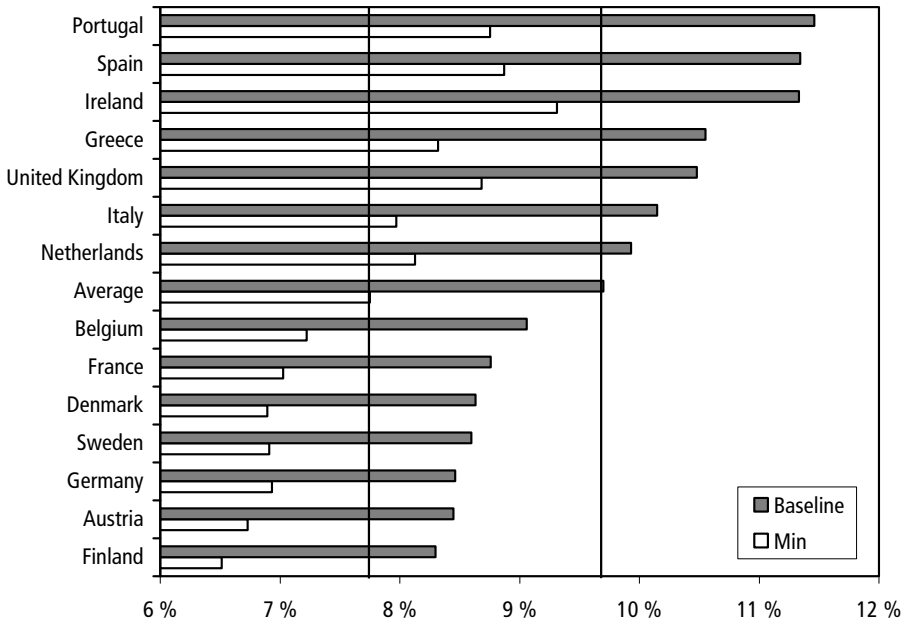
6 The IALS study is of great interest in itself because it provides what is probably the best available cross-country data on the skill level of the adult population. An important finding of this study, which points to a formidable policy challange, is that a considerable fraction of the adult population of advanced industrial countries lacks basic literacy and numeracy skills.

7 These estimates also imply that human capital accumulation accounts for 21% of observed productivity growth in the average OECD country over 1960-90 and that cross-country attainment differences within the same sample explain 42% of observed productivity disparities in 1990. Hence, human capital is relatively more important in accounting for remaining productivity differentials than in explaining past growth. The reason for this is that the stock of physical capital has grown more rapidly than average years of schooling and has converged at a faster pace across countries, thereby reducing the contribution of this factor to observed productivity differences.

reaching 9.2% in the case of Portugal, and drops to around 5% in the Scandinavian and German-speaking countries.

Figure 1 Social rate of return to schooling in the EU.



These figures are then combined with rough estimates of the relevant employment effects to obtain the baseline estimates of the social return[8] to a marginal increase in school attainment in EU member states that are shown in Figure 1. The figure also shows a conservative (min) estimate that is based on D&D's raw estimates of the human capital parameter, without correcting for measurement error.

According to my baseline estimates, the social rate of return to schooling in the EU ranges from 8.3% in Finland to 11.5% in Portugal, with an average value of 9.7%. Under the more pessimistic (min) assumption on the size of the growth effects of schooling, the average return drops to 7.75% and the lowest return to 6.5%. Under both assumptions, estimated returns to human capital are highest in the cohesion countries and the UK, and lowest in the Scandinavian and German-speaking countries.

[8] The social rate of return to schooling is defined as the discount rate that equates the present value of the increases in output induced by a marginal increase in average attainment to the present value of the explicit and opportunity costs of schooling. For further details, see de la Fuente (2003).

It is worth noting that the social return on human capital appears to be higher than the return on physical capital in all EU15 countries. This suggests that a marginal reallocation of investment resources in favour of education would be socially desirable. The social premium on human capital, defined as the difference between the estimated rates of return on human and physical capital, varies across member states reflecting the relative endowments of production factors and appears to be largest in Finland, Italy, Denmark, Greece, the Netherlands, Spain and Ireland, and smallest in the UK, Austria, France, Belgium and Portugal.

3 POLICY ISSUES AND RECOMMENDATIONS[9]

The figures I have just presented are estimates of the social return to marginal increases in the quantity of education, as measured by average years of schooling. They suggest that, provided this could be achieved without increasing the average cost or reducing the quality of schooling, practically all EU countries would benefit from an increase in the level of education of their population, even if it comes at the expense of a reduction in other types of investment. Other things equal, returns to improvements in the quality of education are likely to be significantly higher for they do not involve increases in the opportunity cost of schooling.

Hence, there is probably a good prima facie case for devoting additional resources to increasing both the quantity and the quality of education. There is still considerable room for improvement along the first of these dimensions, particularly in some of the poorer countries and regions of the Union, where enrollment in upper secondary training is still far from universal and tertiary accession rates remain relatively low. But there can be little doubt that in the long run the more relevant policy margin has to do with the quality of education as we must eventually run into sharply diminishing returns to futher increases in attainment.[10]

The formulation of policies that can increase student performance is, however, a difficult issue -- and one for which the cross-country aggregate studies I have focused on in the previous section offer very little guidance. There is, however,

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[9] This section draws heavily on Wössman and Schütz (2006). This paper is a report for the European Commission prepared by more micro-oriented colleagues at EENEE (European Expert Network on the Economics of Education).

[10] Econometric estimates of aggregate production functions do not suggest sharply decreasing returns to increases in average attainment at observed schooling levels. Even so, rates of return to schooling will fall as youngsters stay longer in school because their working lives will shorten. In addition, sharply diminishing returns are bound to set in once attainment reaches a certain level. It seems very unlikely, for instance, that the entire population will have the aptitudes required to benefit from advanced training.

a considerably body of microeconometric research in the economics of education that provides at least some general guidelines for setting policy priorities. Its main lessons can be summarized in two propositions. First, providing the right incentives for all participants in the education process is probably much more important than increasing resource inputs, at least in advanced countries where expenditure levels are already quite high. And second, returns are likely to be highest in the case of early interventions, particularly when they focus on youngsters from disadvantaged socioeconomic backgrounds.

The determinants of the quality of schooling

Economists tend to think of education as a standard production process in which different types of inputs (teacher and parent time, school facilities, learning materials...) are combined in a mechanical way to produce an output that may be measured by test scores or some other achievement measure. Once this perspective is adopted, it becomes rather tempting to think that any desired increase in achievement can be obtained by putting enough money into the system. Indeed, many discussions about educational policies implicitly accept this principle and focus on the need for additional resources in order to reduce class sizes, buy more computers, reduce university tuition fees or increase the volume of student grants.

Unfortunately, things do not seem to be that simple. A considerable amount of work in the recent literature suggests that increasing resource inputs does not necessarily translate into improved student performance. In spite of large increases in expenditure per student and falling class sizes, student achievement shows no discernible improvement in the US or other OECD countries, and actually falls significantly in many cases over the last few decades (Hanushek, 2003 and Gundlach et al, 2001). There is also no clear correlation across countries between average student performance in standardized achievement tests and expenditure levels.[11] Finally, microeconometric estimates of educational production functions with different student samples show mixed results at best, with a preponderance of insignificant or "wrong-signed" estimates of resource coefficients (see Hanushek 2003 for a meta-analysis of such studies and Wöessmann 2003 and 2005 for two careful studies of the subject using two large international student samples). While the issue is not entirely settled because the likely endogeneity of resource allocation within and across schools makes it difficult to isolate the causal impact of class size and

[11] Hanushek (2003) and Hanushek and Kimko (H&K 2000) conclude that standard measures of school resources do not have a perceptible effect on the quality of schooling as measured by achievement tests. Lee and Barro (2001), on the other hand, find a positive correlation between test results and some expenditure variables.

other measures of resource input on student performance,[12] Heckman (2000) argues that, even if we accept the most optimistic estimates of the effects of student/tearcher ratios on future earnings that can be found in the literature, reducing class size would be an inefficient policy with negative expected net returns.

On the whole, then, it seems unlikely that indiscriminated increases in resource inputs will be of much help in raising academic standards in Europe.[13] A number of authors have argued that a more promising alternative would be to focus on providing the right incentives for students, teachers and school administrators and on increasing parental choice and competition among schools. One measure which seems to have a substantial positive effect on the incentives of educational agents is the introduction of standardized curriculum-based exit examinations, coupled with the publication of mean scores and value added measures for each school. Bishop (1997) finds that centralized exams have substantial positive effects on student performance both across countries and across Canadian provinces. Hanushek and Raymond (2003) also report positive results in connection with the introduction of school accountability systems by different US states. Wöessmann (2003) confirms these findings using a large student sample drawn from 39 countries. This author also finds that, particularly in countries that administer centralized exit examinations, school autonomy in certain areas but not in others appears to have a positive effect on student performance. He finds, in particular, that school autonomy in personnel and process decisions, and teacher autonomy in the selection of teaching methods appear to have positive effects by allowing schools to draw on their superior local knowledge. On the other hand, he argues that centralized control over budgetary and curricular matters should be maintained in order to prevent opportunistic behaviour aiming to reduce workloads or extract rents.

Other measures that have been found to have positive effects on academic performance presumably through an incentives channel include performance pay for teachers, increased competition by privately managed (but not necessarily privately funded) schools and increased choice by parents in the selection of schools through vouchers and similar schemes (see Hanushek 2003, Heckman, 2000, Wöessmann and Schütz, 2006, and the references therein). Different authors, however, also warn that designing incentives correctly is

[12] For conflicting results and points of view, see among others Hanushek (1986 and 2003), Card and Krueger (1996) and Krueger (2002).

[13] One exception of sorts to this pattern of findings has to do with teacher quality. Hanushek (2003) and Wöessman and Schütz (2006) review some evidence that suggests that this factor has an extremely large effect on student performance. They also note, however, that measured teacher performance is extremely hard to relate to observable characteristics such as level of education or experience.

difficult and that schemes that are not well thought out may have adverse side effects (see for instance Hanushek 2003 and Ladd and Walsh, 2002).

A lifecycle perspective on skill formation

The acquisition of cognitive and non-cognitive abilities is an ongoing process in which skills acquired early on become a crucial input in further learning. In a number of papers, Heckman and various coauthors (see among others Cunha et al, 2005, and Heckman, 2000) have developed a lifecycle model of skill formation that incorporates the available evidence about the characteristics of the learning process available from economics and other disciplines and about the returns to investment in human capital at various stages in life and for different socioeconomic strata. They emphasize that the process of learning begins very early and is heavily influenced by family environment, that there are critical periods for the acquisition of certain basic skills, and that certain abilities crystallize rather early and are difficult to modify later on.

Heckman's model and his review of the empirical evidence provide some useful guidelines for the allocation of educational resources across age and income groups. One important prediction of the model, which appears to be born out by the available evidence, is that the return to investment in human capital will decrease with the individual's age in a way that can be expected to vary systematically across socioeconomic strata. Returns will fall in all cases because early learning will facilitate the acquisition of futher skills and because the time period over which the investment will produce a flow of returns will shrink as the individual gets older. Returns to very early (pre-school) investment can be expected to be very high for children of disadvantaged familes because intensive interventions early on can at least partially compensate for an unfavourable family environment at an age that is critical for the acquisition of basic skills.[14] In the absence of such compensatory interventions, however, the return to further investment on disadvantaged children falls sharply with age as ability deficits build up, and drops below those on investment on better-off children at realtively young ages. As a result, there is a clear trade-off between equity and efficiency at later ages, but not for young children.

[14] There is considerable evidence that intensive early interventions have substantial and long-lasting effects. In addition to Cunha et al and the references therein, see for instance Barnett (1990 and 1995) and Goodman and Sianesi (2005).

Heckman and coathors make a persuasive case for energic early interventions targeted at disadvantaged groups as a way to promote both efficiency and equality of opportunity.[15] Some of the evidence they present suggests that attempts to remedy early educational deficits later in life is both ineffective and expensive, and that such deficits, rather than short-term borrowing constraints, are the main obstacle to university attendance by children of low-income families. All this suggests that getting children from disadvantaged families very early into a comprehensive pre-school system that goes beyond day care may be essential for preventing the early build up of ability deficits that are likely to have important long-term consequences. By contrast, some of the measures that are frequently advocated to facilitate university attendance by low-income students, such as heavily subsidized tuition fees, may be of only limited effectiveness.

[15] Schuetz et al (2005) reach similar conclusions in an interesting paper where they construct an index of (in-) equality of opportunity for over 50 countries using the estimated influence of family background on student performance. They then explore the determinants of such index across countries and conclude that countries with high enrollment in long pre-school cycles tend to provide greater equality of opportunities. They also find that early tracking (i.e. the early separation of students into different types of schools on the basis of their performance) has a negative effect on equality of opportunity.

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