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Trade, Education and Skills: A Theoretical Survey

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TRADE, EDUCATION AND SKILLS: A THEORETICAL SURVEY

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Resumen

El documento revisa la literatura que relaciona comercio, educación y formación de recursos humanos, intentando ofrecer un marco teórico a la discusión de políticas en materia de educación. El trabajo se organiza de la manera siguiente. La sección 1 presenta la literatura que vincula educación y capital humano en modelos de comercio. La sección 2 se centra en la educación como inversión y el proceso de formación del capital humano. La sección 3 analiza los retornos de la educación. La sección 4 discute la literatura sobre funciones de producción de la educación además de la consideración de aspectos de eficiencia, eficacia y calidad de la educación. La sección 5 analiza la provisión publica de educación. La sección 6 presenta algunos comentarios finales.

Palabras clave: educación publica, economía de la educación, comercio

JEL: I21, I28, F16

Abstract

This paper reviews the literature that relates trade, education and skills formation, intending to provide a theoretical background to policy discussions in education matters. The paper is organised as follows. Section 1 summarises the literature on education and human capital in trade models. Section 2 focuses on education as an investment and the process of human capital accumulation. Section 3 deals with the returns to education. Section 4 analyses the economic literature on the education production function and on issues of effectiveness, efficiency and quality. Section 5 discusses the public provision of education. Section 6 presents some concluding remarks.

Key words: public education, economics of education, trade

JEL: I21, I28, F16

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INTRODUCTION

Schooling affects individuals' opportunities to access the labour market (and their probabilities of being successful), as well as the rate at which a country experiences economic growth. This fact is widely recognised in both academic and non-academic circles. For instance, the International Labour Organisation report "Learning and training for work in the knowledge society" (2003) states in its concluding remarks: "The knowledge and skills endowment of a country's labour force, rather than its physical capital, determines its economic and social progress, and its ability to compete in the world economy. Promoting innovation, productivity and competitiveness of individuals, enterprises and countries is therefore the first pillar that underlies contemporary learning and training policies and provision. Similarly, individuals' possession of knowledge and skills increasingly determines their employment outcomes and lifetime."

UNESCO has set the goal of "Education For All by 2015". The report from the Dakar Conference (2000) states: "… it is unacceptable in the year 2000 that more than 113 million children have no access to primary education, 880 million adults are illiterate, gender discrimination continues to permeate education systems, and the quality of learning and the acquisition of human values and skills fall far short of the aspirations and needs of individuals and societies. Youths and adults are denied access to the skills and knowledge necessary for gainful employment and full participation in their societies. Without accelerated progress towards education for all, national and internationally agreed targets for poverty reduction will be missed, and inequalities between countries and within societies will widen."

In particular, Tyler et al (2000) present evidence for the US suggesting that cognitive skills at the age of leaving compulsory education are positively and significantly correlated with earnings, and an OECD (1995) study suggests that poor command of basic skills is highly associated with unemployment. More recent work, such McIntosh and Vignoles (2001) and Chiswick et al (2003), stresses the value of basic skills (numeracy and literacy) for labour market success, as the empirical evidence suggests that basic skills are associated with higher wages, higher quality jobs, higher employment rates, etc.

Similarly, a recent study of Northern Ireland schools by McVicar and Anyadike-Danes (2002) helps to identity risk factors for labour market success. It is reported that poor qualifications at the age of sixteen (when compulsory education finishes) as well as context variables (e.g. socio-economic status of a student's family and regional prosperity) are significant factors in predicting an unsuccessful transition from school to work. Such students match the type that ends in long-term unemployment, so at this early stage they can be identified as the group at risk. Thus, according to the authors, "policy makers could target resources according to the predicted probabilities of young people following each transition type (successful or unsuccessful)".

The links between human capital accumulation and education are discussed extensively in the literature. As Judson (1998) defines it, human capital is the value of education embodied in the labour force. Human capital is an input to productive activities, and for individuals education is an investment. The literature also suggests that there is a link between education, trade and growth: growth is positively affected by trade and

education, as argued for instance by Lucas (1988) in the endogenous growth context, and Findlay and Kierzkowski (1983) in an open economy setting.

However important, educational systems, in particular in developing middle income countries such as those in Latin American, often shown several weaknesses, especially in quality and coverage. In the case of Uruguay the expenditure on public education per student is far behind that in the developed world, as also is the performance of students at all levels of the system. In recent years significant improvements have been made, but there are still high repetition and dropout rates that adversely affect the cost-effectiveness ratio.

Leaving aside other important factors, the size and the efficiency of the allocation of the public funds for education are relevant to improving overall performance. Indeed, public policies towards education directly affect the educational output, thus affecting the qualifications of those entering the labour market. So enhancing the provision of public education in a developing country like Uruguay may be expected to have economy-wide repercussions. In this case educational system shows persistent problems and several reforms have been attempted to improve the poor performance of the sector.

This paper reviews the literature that provides a review of the literature that relates trade, education and skills, intending to provide a theoretical background to policy discussions in education matters. The paper is organised as follows. Section 1 summarises the literature on education and human capital in trade models. Section 2 focuses on education as an investment and the process of human capital accumulation. Section 3 deals with the returns to education. Section 4 analyses the economic literature on the education

production function and on issues of effectiveness, efficiency and quality. Section 5 discusses the public provision of education. Section 6 presents some concluding remarks.

1: EDUCATION, HUMAN CAPITAL AND TRADE

The role of education and skills in the determination of comparative advantage can be traced to the pioneering papers by Leontief (1953, 1956). He found the famous paradox that in the US, a capital-abundant country, imports were (physically) capital intensive in contradiction with the Heckscher-Ohlin (HO) theorem. He resolved the paradox by arguing that the exports of the US were intensive in skilled labour (human capital), of which it had an abundance.

Differences in the quality of the labour force have since then been seen as crucial in determining the patterns of comparative advantage. In the subsequent theoretical and empirical literature it has become common practice to reinterpret the traditional HO 2×2 model (where the factors are specified as capital and labour, or as land and labour) by re-labelling the factors as skilled and unskilled labour.

This literature usually assumes that the distinction between categories, as well as their relative endowments, is exogenously determined. However there are trade models that have endogenised skills formation mainly following the model presented by Findlay and Kierzkowski (1983). This latter literature is discussed below, as well as other aspects of the relationship between skill formation and trade.

1.1: Trade skills and wages

The distinction between skilled and unskilled labour has become more and more important over the last decades as a consequence of increases in the 'skill premium'[1] in high-income countries, which affects both the distribution of income and unemployment and growth. The increasing gap between the returns to skilled and unskilled labour has drawn attention to the roles played by education (as supplier of skills), trade and technological change in its determination.

The theoretical literature and the empirical evidence are divided on which is the main factor influencing wage inequality. Among trade theorists, Leamer (1995) identifies trade as the main factor (through increased competition of unskilled-intensive goods from low-income countries), while Krugman (1996) suggests that skill-biased technical change (through increased demand of skills due to new skill-intensive technologies) is the main cause.

In the empirical literature contrasting results have been reported. For instance, Owen (1999) provides evidence that trade has an important role to play in determining the disparity between skilled and unskilled wages in lower income countries, but finds less conclusive evidence for higher income countries (which are relatively abundant in human capital), and Taylor (2002) provides empirical evidence for Great Britain that technology has stronger effects than does trade on returns to education.

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[1] The 'skill premium' is defined as the ratio between the skilled wage and the unskilled wage.

Other authors, for instance Turrini (1998) and Janeba (2000), have focused on the role of the government in addressing the wage gap, and thus reducing inequality. It is suggested that this aim can be realised by generating incentives to invest in human capital, for example by tax exemptions or subsidies.

1.2: Education, trade and growth

Several channels through which trade affects human capital accumulation have been identified, in Manning (1982), Findlay and Kierzkowski (1983), Davies and Reeve (1997), Owen, (1999), and Bond et al. (2003).

In Manning's model education is introduced in an extended version of the standard HO model that allows for factor accumulation. The two factors are identified as skilled and unskilled labour, and a non-tradable sector produces skilled workers. In terms of the economy, education has two effects: in the short run it uses some of the resources available for traded activities (so shrinking the production possibilities frontier), in the long run it produces additional resources (expanding the production possibilities frontier). So, in his model education policies shape the production possibilities frontiers of the economy over time.

Distinctive features of Manning's model include some leakage from the education system, a form of implicit inefficiency, by assuming that only a fraction of those entering the system graduate, this fraction being determined by an exogenous parameter. It is shown that the growth rate of the skill level (defined as the ratio of skill to unskilled workers) is a positive function of: 1) the proportion of skilled workers employed by the education sector, 2) the student/staff ratio and 3) the exogenous graduation rate.

Findlay and Kierzkowski (henceforth F&K)'s (1983) model is also an extension of the HO model of a small open economy. The model introduces into a standard HO 2×2 setting the endogenous formation of human capital. Education is a non-traded activity that uses specific resources to process students and transforms them into skilled workers after a period of time, and is a standard non-tradable sector with a sector-specific factor. The F&K model deals only with a single type of educational 'establishment', which provides the same level of training (and hence gain in human capital) to each and every student, with students choosing (rationally) whether to become educated or not. Education increases the efficiency of labour for those who pass through the system in relation to those who choose not to. In the basic model all students, having entered education, complete the full 'course'.

In F&K education is produced by one specific factor ('educational capital' as a composite of teachers and school resources) and is a competitive privately-provided activity, with individuals not being credit-constrained. Education needs time to produce its output, so the model is formulated as a simultaneous equilibrium problem. All individuals that enter are transformed into equally skilled workers; those who do not remain unskilled.

A distinctive feature of F&K's model is that the country's relative endowments are endogenously determined and thus so is the pattern of comparative advantage. The ratio of skilled to unskilled workers is determined as the result of the conditions of a competitive inter-temporal equilibrium. International prices will affect the relative endowments by affecting individuals' incentives to invest in education.

In F&K's model the production of education is given by a function yielding the educational output by using students and resources, as follows:

$$Q = F(K, E, \Theta) \tag{2.1}$$

where K corresponds to the amount of 'educational capital'; E is the number of students to be educated; Θ is the time that an individual (student) invests in education; and Q measures the output of skills in efficiency units that results when E students spend a period Θ studying using K units of educational resources.

As Q is assumed to be a constant returns to scale function, for a fixed Θ, (2.1) can be rewritten as:

$$q = f(k) \tag{2.2}$$

where $q = Q/E$ and $k = K/E$. Thus q represents the amount of efficiency units of skills that a student acquires after receiving an education of resource intensity k for a period of time Θ. It is assumed that:

$$f'(k) > 0, \quad f''(k) < 0 \tag{2.3}$$

Individuals 'once born' have to decide whether to go to work immediately as unskilled workers or go to school to become skilled workers. Inter-temporal optimisation determines individuals' decisions on how much to invest in education, taking into account the trade-off between the cost of studies (both direct as fees and the opportunity cost of studying and not working) and the expected gains from schooling. The lifetime incomes of the two alternatives are compared and decisions are made accordingly.

The benefits from education will be:

$$\pi = \int_{\Theta}^{T} w_1 f(k) k e^{-rt} dt - \int_{\Theta}^{T} w_1 f'(k) k e^{-rt} dt - \int_{0}^{T} w_2 e^{-rt} dt \qquad (2.4)$$

where w_1, and w_2 are the wages received by skilled and unskilled workers respectively , T is the individual's lifetime and r is the market interest rate.

The first term on the right hand side of (2.4) is the individual's income after finishing his/her studies. The second and third terms represent the costs (direct and indirect) of the education. The second term is the direct cost of the fees paid by the student; since education is a competitive activity the fees are set equal to the value of the marginal product of capital multiplied by the amount of capital used per student. The third term is the opportunity cost of the income as an unskilled worker foregone while studying plus the foregone income as an unskilled worker that he/she would have received anyway in the rest of his/her lifetime.

Equation (2.4) yields:

$$\pi = \frac{1}{r}\left[w_1\left(f(k) - f'(k)k\right)\left(e^{-r\Theta} - e^{-rt}\right) - w_2(1 - e^{-rt})\right] \qquad (2.5)$$

Using (2.2) and (2.3):

$$\frac{\partial \pi}{\partial E} = A\frac{\partial^2 Q}{\partial E} = -Af''(k)k < 0 \qquad (2.6)$$

where $A > 0$.

Expression (2.6) shows that, given a fixed amount of resources, the benefits reaped by the individual from education are decreasing with the number of students. As long as π is positive there is an incentive to invest in education. In the long-run equilibrium $\pi = 0$.

From (2.5) the long-run equilibrium condition implies:

$$\frac{\partial Q}{\partial E} = g\left(\frac{w_2}{w_1}\right) \tag{2.7}$$

where g is a function increasing in w_2/w_1.

Using (2.6) and (2.7), the equilibrium value of E is determined given good and factor prices and the specific resources in education. Since the specific resources are fixed, the ratio of skilled to unskilled workers will be directly affected by price changes due to trade.

From (2.5) the long-run equilibrium condition may be written as:

$$\int_{\Theta}^{T} w_1\left(f(k) - f'(k)k\right)e^{-rt}dt = \int_{0}^{T} w_2 e^{-rt}dt \tag{2.8}$$

That is, in the long-run equilibrium the lifetime income of skilled workers (left-hand side) is equal to the lifetime of unskilled workers (right-hand side).

Summarising, in F&K's model individuals make their decisions based on the lifetime incomes of both alternatives. With wages determined by the domestic prices of the traded goods, it follows that changes in the trade regime affect the incentives to invest in education. The model shows that given a fixed amount of resources the benefits reaped by the individual from education are decreasing with the number of students enrolled. As

long as there are net benefits to education in the short run there is an incentive to invest in education. In the long run equilibrium there is no net benefit, and the long run equilibrium condition determines the equilibrium number of students to be educated, given prices and resources. The distinctive feature of the model is that the intensity of resources per student (k) is endogenous, and that intensity determines the individual's endowment of skills (q) and thus wages (w), and also endogenises the ratio of skilled to unskilled workers.

Flug and Galor (1986) use F&K's model to show the impact of factor market distortions on factor accumulation. The imposition of minimum wages as a form of distortion will, by modifying the relative return between type workers and generating unemployment, affect the incentives to study and thus the factor accumulation process. Accordingly, in computing their benefits from study individuals now have to take into account the *probability* of employment (assuming perfect foresight). Thus the number of students in equilibrium, and hence the accumulation process, will also depend on the relative probabilities across skills of being employed.

The Davies and Reeve (1997) model endogenises skills formation following F&K, but a richer framework is introduced along the lines of Flug and Galor (1986) to allow for explanations of inter-country differences in observed trends in wages. The model considers differences between trading countries in the institutional arrangements in factor markets, particularly in the form of flexible or minimum wage regimes. Thus, the model allows for the endogenous determination of relative skill endowments, relative wages and unemployment.

In this model different institutional arrangement can be shown to play an important role in the differential effects of trade and technological change across countries (i.e. they may or may not cause unemployment or widen the wage gap between skill groups). Further, the difference in the quality (i.e. level) of skills across countries (endogenously determined in different country settings) can be an alternative explanation of differences in the evolution of wages (where wages are paid in efficiency units of skills, and thus workers' quality determines their total income).

Finally, Owen (1999) follows the 'spirit' of F&K's model, but modifies it to facilitate analysis of the effects of credit market constraints and of distributive issues in the process of factor accumulation. The accumulation process depends on both the incentives given by wages but also on the parents' capacity to finance their children's education. The two effects may have opposite signs, so that the direction of the change in the accumulation of factors may be ambiguous. For instance, trade between countries with different levels of human capital affects individuals in opposite ways. That is, individuals in the relatively human-capital abundant country will see the return to skills to rise and so there will be an incentive to invest in education; however, unskilled workers will face a decline in their income and will be less able to finance their children's education. Hence, whether trade will enhance the accumulation of human capital will depend on the balance of the two effects. As noted by the author, an interesting feature of the model is that it shows that trade can produce: 1) a decline in human capital accumulation in the relatively human-capital-abundant country if the effects from credit constraints are dominant, 2) a rise in human capital accumulation in the human-capital-scarce country if the income effect for

unskilled workers dominates. Since the model gives ambiguous predictions, it needs to be tested empirically.

In a different vein, the links between education, trade and growth in outward-oriented developing economies has been the focus of research by Kim and Kim (2000), McNab and Moore (1998), and Saarenheimo (1993).

Kim and Kim's model is designed to be representative of fast-growing East Asian countries. The novel feature of the model in linking education, trade and growth is the effect on the mobility of workers gained through the process of schooling. 'General'education increases the inter-sectoral mobility of workers, allowing them to move to sectors with higher productivity and higher rates of technological progress, thus the long run growth rate depends on the technical progress of the fastest growing sector.[2]

However, the empirical evidence presented by McNab and Moore (1998) is rather mixed. These authors, while finding evidence in cross-country comparisons of the effect of trade on growth, fail to find conclusive evidence of the contribution of education, where a proxy for human capital accumulation is constructed from primary and secondary

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[2] A model more focused on the labour market effects of education is presented by Groot and van Den Brinks (2000) and analyses the role of education on workers' job mobility. Two types of market flexibility are distinguished: internal (within the firm) and external (across firms). The empirical evidence reported on the effects of investing in education and internal and/or external flexibility is mixed; however their results seem to be a useful step forward. Their analysis shows that education and training increase internal mobility (e.g. the likelihood of being promoted) and problem solving skills (i.e. so that there is less need of supervised work).

enrolment rates. A completely different outcome has been suggested by Saarenheimo (1993), whose model shows that trade may provide a disincentive to invest in human capital, but who argues that this may be beneficial anyway to less developed countries, which would grow at higher rates than under autarky.

2: EDUCATION AND HUMAN CAPITAL

For Mincer (1984), human capital is both a condition and a consequence of economic growth. This is so as education activities consist of both the embodiment in individuals of available knowledge and the production of new knowledge.

According to Lucas (1988), human capital is knowledge embodied in workers, as opposed to 'pure knowledge' or 'technology' or 'ideas' which are disembodied, while Judson (1998) defines the human capital stock as the 'value of education embodied in the labour force'. Dowrick (2003) argues that human capital 'lives and dies with particular people' while knowledge and ideas 'do not live and die with their inventors'. All agree that the production of human capital is a consequence of education activities, whether formal or informal.

Barro and Sala-i-Martin (1995) categorised human capital as a rival good since its use in one activity excludes it from other uses. It is also an excludable good because individuals have property rights over their skills. As such it is distinguishable from pure knowledge or ideas that may be non-rivalrous and non-excludable. Both types of knowledge (embodied and disembodied) may cause externalities, which have been extensively

analysed in the literature; here the review concentrates on the *internal* effects of human capital as a productive factor.

In particular, Barro and Sala-i-Martin (1995) and Glewwe (2000) analyse human capital as an input to productive activities. For the individual, human capital depends on the quantity and quality of knowledge achieved. More formally, total human capital (H) can be expressed as $H = hL$, where L is the amount of workers and h is the human capital embodied in a typical worker. Hence, the quantity of workers (L) and quality of workers (h) are perfect substitutes in the sense that it is only the combination of them (H) that matters for determining the corresponding output of productive activities.

2.1: Investment in education

According to the approach of Becker (1962, 1964) and Mincer (1984), whether to undergo education can be seen as an investment decision. In Mincer the costly acquisition of human skills is an act of investment; in Becker the investment in human capital refers to activities that influence future real income through the imbedding of resources in people. Several ways of building human capital besides schooling are usually recognised, such as on-the-job training, learning by doing or experience, and home learning (e.g. through media).

The decision process can be analysed in a way similar to that of investment in physical capital, where individuals take into account both present costs and future benefits. The human capital literature analyses the accumulation of skills as an outcome of individuals' decisions, which are based on incentives, i.e. their expected rate of return to the investment. In making their decisions individuals take into consideration the cost (time

measured by its opportunity cost plus direct costs such as tuition fees) and the present value of the future stream of increments in wages due to additional schooling during their working life.

Optimality conditions similar to those for investment in physical capital determine that individuals will decide to invest in education up to the point where the cost equals the present value of the future stream of increments in wages due to additional schooling during working life. The rate for which this equality holds is the internal rate of return of the investment.

The relevant costs and benefits are not always monetary (see below). Accordingly, the efficient level of investment private and public is given by the total rate of return (i.e. monetary and non-monetary returns) that equals the interest rate. It is essential that individuals have all the information on monetary as well non-monetary returns when making the decision to invest in education. Similarly, society needs to know the social benefits from an individual's education in order to be able to decide how much of it is to be publicly financed. However, as there may be imperfect information on non-monetary returns this simple rule may not be straightforwardly applicable by decision makers.

The approach to education as an investment decision has also been used to define the output of the sector itself. In particular, Bowles (1967) and Jorgenson and Fraumeni (1992) measure the output of the education sector as the lifetime increment in the benefits the individuals receive (monetary and non-monetary) due to the effects of formal schooling.

Finally, for society as a whole education is a multi-product activity where the production of different types of skills are alternative options. For instance, Chiswick's model (1984) endogenises the level of qualification of each type of skill, instead of taking it as fixed and exogenously given as is common in the literature. Her model results in an endogenous trade-off between the quality and the quantity of each type of skill. This comes from the demonstration that the optimal investment decision requires that rates of returns on the extensive (i.e. return to an additional student/worker) and intensive (i.e. return to upgrading qualification) margins be equal. So, the condition determines the skill structure of the labour force as well as the amount of each type level of educational attainment. In Chiswick's model the resulting skewness of the earning distribution in the labour market will show either that the education system is of the 'elitist' type (intense in the education of one of a few skill types, so high productivity and earnings clearly differentiated from the rest) or is 'egalitarian' (more even intensity across the types of skills, hence less earnings differentiation).

2.2: Human capital and growth

The production of human capital generates long term growth as stated by the endogenous growth theory, and may be an alternative to improvements in technology, as in, for instance, Barro and Sala-i-Martin (1995) and Metha (2000).

However, the empirical evidence on this point is mixed. On the one hand, the reviews of the empirical literature by Sianesi and Van Reenen (2002) and Hanushek and Kim (1995) report significant positive effect of human capital on growth. On the other hand, Bils and

Klenow (2000), for instance, find weak effects of schooling (measured by enrolment rates) on growth.

Finally, it is also argued that the composition of the educational system is a key factor in determining growth. For instance, Sianesi and Van Reenen (2002) suggest that the impact of increases of different levels of the education systems varies across countries according to each country's stage of development. These authors report that increments in primary, secondary and tertiary education are mainly related to growth in poor, middle income and OCDE countries respectively.

3: RETURNS TO EDUCATION

Mincer (1984) argues that the measurement of labour as a factor of production in man-hours is inadequate, as labour is heterogeneous. He states: "…wages of a worker are proportionate to the size of his human capital stock. Thus wage differentials among workers are due primarily to differences in the sizes of human capital stocks, not in the 'rental price' employers pay per unit of the stock".

Welch (1966) highlights the difference between the concepts of 'education' and 'quality schooling' in accounting for individuals' qualifications. 'Quality schooling' refers to heterogeneous situations (e.g. over time or across districts or countries) while 'education' is homogenous, and 'quantity times the quality of schooling is defined as education'. Hence individuals who have attended school for the same number of years by definition have the same amount of schooling, but may differ in the amount of education received.

The returns to education are not solely private. There may be spillovers from education to other individuals, in which case the social benefits would be higher than the sum of private returns to educated individuals.

The investment in education brings returns, social and private, but the timing of investment is also important. As Heckman, quoted by Björklund, states: "Early learning begets later learning and early success breeds later success just as early failure breeds later failure".

3.1: Private and social returns to education

Schooling is an investment that generates higher future income for individuals who receive it. A simple link between wages (w) and skills (H) could be formulated as $w = w(H)$, where H depends on quantity and quality of schooling as well as personal attributes.

This point is theoretical and empirically analysed by Welch (1966), who expresses the return to an individual schooling as:

$$w_i - w_0 = \beta_i C$$

where w_i is the wage of an individual who has attended school for i years, w_0 the return for those without schooling, β_i represents the units of schooling possessed by a person who have gone to school for i years (with $i > 0$ then $\beta_i > 1$), and C is the return of one unit of schooling (set for convenience as basic education).

Thus the stock of schooling is measured by $\sum \beta_i N_i$, where N_i is the employment of individuals with i years of schooling, and the quantity of education as an input to any productive activity is measured by $Q\sum \beta_i N_i$, where Q is the quality of schooling. For estimation purposes Welch uses teacher quality (measured by salaries) and the size of schools as proxies of 'quality schooling'. However, no agreed measure for school quality is available, as will be discussed below.

But, as Sianesi and Van Reenen (2002) argue, private returns 'may underestimate the full return of society if education has the characteristics of a public good'. Social benefits identified as accruing from education externalities are reviewed in McMahon (1998), Sianesi and Van Reenen (2002) and Moretti (2003).

Returns to education may be monetary and non-monetary as well as private and social, as McMahon (1998) categorises them. Wages are the direct private and monetary returns from education. Non-monetary private returns are: health effects, human capital produced at home (children's education enhanced), more efficient household management, lifelong adaptation and continued learning at home (use of new technologies as Internet as well as educational reading, radio and television, etc.), motivational attributes, non monetary job satisfaction, etc.

Other monetary social benefits analysed by McMahon are effects on GDP growth and effects on the earnings of others (by making them more productive). Non-monetary social benefits are, for example, the gains from living in an educated society (better citizenship, democracy stability, poverty reduction and lower crime rates) and community services

from education (dissemination of knowledge through articles, books, media and also informally).

3.2: Timing of investment

Early learning enables further trainability, so that they are in a way complementary (Mincer, 1984, McMahon, 1998, Björklund, 2000, and Blundell et al., 1996, reported by Harmon, 2003), or as Heckman and Masterov (2004) put it, skills begets skills. Also, the importance of lifelong learning has been stressed (for instance OECD 2004) as a means of 'learning to learn' throughout the lifetime span and adjusting to a fast changing socio-economic environment.

As such, investment in education have different effects whether resources are devoted to the education of children or adults, or for the individual, if the investment takes place earlier or later in life.

For instance, Björklund (2000) and Harmon (2003) argue that adult and youth education have different returns: the return is higher the earlier the investment takes place on the grounds of a longer working life span, hence higher (present value of) lifetime earnings. Similarly, if for the individuals the investment in education has decreasing marginal returns, as suggested by Mincer (1984), Chiswick (1984), and Judson (1998), this implies that the return that an individual obtains from primary education is higher than that from higher education.

Gupta et al. (1999) report evidence that the social rate of return is decreasing over education levels. McMahon (1997) and Green et al. (1999) suggest that investment in

basic rather than higher education is a more effective strategy to promote skill growth, based on the experience of South Asian countries.

3.3: Returns to scale

The economies of scale in education can be considered in two different ways: economies of scale in the provision of educational services, or economies of scale in the production of human capital as an individual's investment.

Trostel (2004) argues that while educational services may be subject to constant returns to scale, since resources can be replicable to double the output (i.e. twice the amount of services is required to teach twice the number of children), that is not the case for the individual, as the main input to producing human capital is his/her own time, and time is not replicable.

The empirical evidence leads Trostel to suggest that the relationship is complex, with human capital investment having increasing returns to scale at low levels but decreasing returns to scale at high levels of an individual's educational endowment (measuring human capital by years of schooling).

However, other assumptions are often found in the literature. For example, the endogenous growth literature (as in Lucas, 1988) assumes constant returns to scale in the investment in human capital, i.e. a constant level of effort produces a constant growth rate of the human capital stock irrespective of its initial level. However, a different assumption is often found in the literature, for instance in Mincer (1984), Chiswick

(1984), and Judson (1998), who assume that education returns are decreasing with the level of skills already embodied by the individual.

The analysis of the returns to scale of the activity that provides educational services will be resumed below.

4: THE EDUCATION PRODUCTION FUNCTION

The literature on the production of education is extensive, and will be only briefly reported, and the debate focusing on methodological issues of the input-output approach will not be discussed.

4.1: Production of education

The education production function literature assumes a technology that transforms inputs in knowledge. It also assumes that there is substitutability of inputs to produce the same output. In support Jimenes (1986), Callan and Santerre (1990) and Nelson and Hevert (1992), for example, provide empirical evidence that there is at least limited substitutability between educational inputs, e.g. teachers, administrative and supporting staff, faculty facilities, etc.

A standard formulation for the education production function takes the form:

$$A = F(X)$$

where A represents the cognitive skills produced by the activity, and X is a set of inputs.

In general, the basic inputs identified in this literature are: teachers (classroom time, education and experience), parents (socio-economic-educational background, partnership with the school, etc.), schools (facilities, equipment, supporting staff) and others, such as students' innate abilities and peer group effects. Resources applied to the education activity are usually proxied by expenditure per pupil, class size, or teacher qualifications.

The production of cognitive skills is usually proxied by educational outcomes (e.g. measured by test scores or percentage of student reaching certain grade) or labour market outcomes (e.g. measured by wages).

Empirical research using this type of specification includes that by Hanushek (1979, 1986, 2003), Dewey et al. (2000), Glewwe (2000), Vignoles et al. (2000), Krueger (2003), Hansen et al. (2003) and Todd and Wolpin (2003) amongst many. In these works various aspects related to methodology (contemporaneous or cumulative formulations) and estimation issues (such as potential biases due to measurement errors, selection of variables -omitted or unobservable variables, aggregation or data availability, etc.) of such functions are extensively discussed.

There has been discussion of the applicability of this type of functions to different types of education activities. For instance, Hanushek (1986) argues that the evaluation of the education product as cognitive knowledge measured by test scores would be mostly applicable for primary and secondary school, and that it would be very dubious to measure the output of higher education in the same way. For similar reasons, Belfield and Fielding (2001) use as the dependent variable in higher education the wages earned by graduates. Also for the case of higher education, Cohn et al. (1989), Nelson and Hevert

(1992) and King (1997) analyse the provision of education as a multi-output activity, e.g. undergraduate education, graduate education and research, as will be discussed later below.

Finally, the entire education production function approach has also received criticism. For instance, Levačić and Vignoles (2002) emphasise the relevance of the omitted attention to internal school processes such as teaching techniques in the explanation of students' performance. According to them, the production function literature, by omitting process variables, is *'treating the school as a black box'*.

4.2: Quality of education

Wilson (2001), in reviewing the literature on education production functions, reports that about two thirds of the studies measure the output of education by students' performance (i.e. test scores) while the other third does it by quantity of schooling achieved (i.e. years of education).

The distinction between quantity and quality of education is commonly found in the literature. For instance, Glewwe (2002) suggests as a general formulation for the education production function where quantity and quality of schools are both inputs to the production of cognitive skills

$$A = \alpha\ f(Q)g(S)$$

where A represents student's cognitive skills, α is the learning efficiency of the student, Q is school quality and S is years of schooling, f and g being increasing in Q and S

respectively. The school quality is measured by Q as an index composed of school characteristics favourable to students learning, and α is an index of student's characteristics, such as innate ability and motivation, family background etc.

However, there is no agreed measure of school quality (Q). In some studies, school quality is measured by the resources applied in the educational process, as in Dearden et al. (2002), Dustmann et al. (2003), Ishikawa and Ryan (2002), Wilson (2002) and Bedi et al. (2002), where quality is proxied by teacher-student ratios, expenditure per pupil, class size, teacher's qualifications, school facilities, classroom hours, etc. However, the opposite view, mainly led by Hanushek (1979, etc.), suggests that it is students' acquired knowledge which defines school quality, in his own words 'cognitive skill measures appear to be the best available indicators of quality'.

Besides the issue of the definition of school quality, the distinction between school quantity and quality seems to be relevant. It is argued that years of schooling is a quantitative measure of individual schooling that, while being important, is not enough to measure adequately differences across individuals in skills and earnings as for instance in Hanushek and Kim (1995), Glewwe (1996), and Wößman (2003).

Firstly, as pointed out by Wößman (2003), measuring human capital by years of schooling would imply that the differences in productivity across individuals are proportional to the years of schooling, contrary to most of the empirical and theoretical literature on the returns to schooling.

Secondly, quality differs both through time and across countries. On this point, a few quotes are illustrative. Hanushek (1986) states: "Teachers and schools differ dramatically in their effectiveness"; Hanushek (2002) states: "Issues about what students know when they graduate from high school are specifically ones of quality, not quantity of schooling"; Wöβman (2003) objects that "a year of schooling in, say, Papua New Guinea is assumed to create the same increase in human capital as a year of schooling in, say, Japan".

Thirdly, measuring returns to years of schooling is a sort of *'sheepskin effect'* (Glewwe 2002, Harmon et al. 2003). Sheepskin effects as defined by Glewwe are 'the increasing of income solely due to possession of a diploma or other certificate, as distinct from any effect of skills acquired from the education that the diploma or certificate represents'. In particular he argues that the difference would be particularly important in developing countries where educational systems are very ineffective in producing cognitive skills. He states as a tentative conclusion on the empirical research on developing countries reported in his paper: '... cognitive skills directly affect wages, and may be the most important determinant of worker productivity'.

The relevance of this distinction between quantity and quality of schooling for empirical analysis seems clear. Behrman and Birdsall (1983) stress that quality varies substantially between schools and countries, showing important biases in any wage-schooling empirical work that relies only on quantitative measures. In terms of policy implications there appears to be a trade-off between a mere expansion of enrolment (quantity) and a more efficient use of resource to improve quality.

The relationship between quality of education and returns has been extensively tested empirically, using the concepts of quality associated to resources or to students' performance.

On the one hand, empirical work by Hanushek and Kim (1995) measures the labour force quality by cognitive skills (mathematics and science) through test scores instead years of schooling, finding much stronger effects on growth of an improvement in the former indicator than in the latter. Glewwe (1996, 2002) suggests that cognitive skills rather than years of schooling are the determinant of earnings.

On the other hand, evidence of returns to quality in education, where quality is measured by resources, can be found in, for instance, Dearden et al. (2002), Dustmann et al. (2003), Ishikawa and Ryan (2002), Wilson (2002) and Bedi et al. (2002). Wilson, Ishikawa and Ryan, and Bedi report on empirical analyses that find a significant relationship between schooling quality and wages; however, Dearden's analysis finds mixed evidence on school resourcing and wages.

Besides the effect of quality on wages, the effects of quality on students' decision to continue education has been tested. Dustmann el al.'s work suggests that for UK schools class size (proxy of resources) has an important impact on the decision on whether to continue education after the age of 16, as well as on wages when in the labour market. School quality measured by test scores also seems to be associated with continuation in school as well as school attendance, as reported by Hanushek (2003, 2004).

4.3: Efficiency and effectiveness of education activities

The usual treatment of education activities in the education production function literature also receives criticism on efficiency and effectiveness grounds. For instance, Hanushek (1996) states: '…one must believe that inputs are converted efficiently to outputs and that measured school inputs comprise the bulk of all inputs into human capital – two assumptions that appear far from true'.

The concept of effectiveness is usually associated with the cognitive knowledge attainable at a certain level (measured by test scores) by use of the *best practice*. The concept of effectiveness of schooling differs from those of technical and allocative efficiency. On the one hand, technical efficiency implies that for a given technology and resources the activity is operating on its production possibilities frontier. On the other hand, allocative efficiency requires the choice of the optimal place on the production possibilities frontier for given prices and budget constraints. However the concept of effectiveness is directly related to students' performance, irrespective of technical or resource constraint considerations.

However, satisfactory measures of effectiveness are difficult to obtain, as students' attainments are closely tied to many unobservable characteristics of the students themselves (e.g. their innate ability), of their teachers (e.g. motivation or interpersonal skills), or parents (e.g. involvement in student and school activities), and the general environment in both school and neighbourhood (e.g. bullying or violence), as well as teaching techniques and/or the leadership of the head of school. For example, Levačić

and Vignoles (2002) argue that an appropriate framework for analysing school effectiveness should refer to the *context-input-process-outcome* paradigm.

Moreover, as noted by Ladd et al. (2002), measuring effectiveness is intrinsically difficult as it is closely tied to what the public or the policy makers think that the 'mission' of the schools should be. For example, a school might serve a disadvantaged community and regard itself as increasing social mobility by reducing inequality and improving children's prospects of employment. Alternatively, schools might be seen as better serving the community by obtaining high educational outcomes (usually measured by test scores) which also favours children by fostering future income growth.

Both parametric (basically using the education production function approach) and non-parametric methods (based on efficiency frontiers constructed from the data) have been used to analyse efficiency in education. A review of the literature on efficiency of the education sector can be found in, for instance, Worthington (2001) and Chakraborty et al. (2001). More generally, Barnett et al. (2002) have argued that schools' performance should be evaluated by combining output effectiveness and input efficiency measures. For this, best practice cost-constrained performance will require that no school will be able to produce a higher output without having to increase expenditure (the 'pragmatic' approach).

An important point in assessing efficiency or effectiveness in the provision of education rests on whether a failure to embody knowledge in a student is a failure by the student, the teacher(s), the school/system or is shared, discussed in Thanssoulis and Portela (2002). These authors argue that responsibility for school effectiveness rests not only in

the schools themselves but also in their students. Their analysis of British schools leads them to suggest that 'pupil's own application accounts for the major part of any under-attainment, though schools also have scope to improve their effectiveness'. Some contextual variables are included in the analysis affecting student attainment, although they are not controllable by the school or the student, such as a student's attainment on entry and socio-economic background. Related works reported by the authors use these contextual variables to estimate the expected student attainment on exiting the school.

4.4: Education as a multiple output activity

Further criticism of the education production function approach comes from the fact that education may be regarded as a multi-product activity. For instance, Wenger (2000) suggests that low test-scored schools may have chosen to pursue other outputs, such as high completion rates, instead of high test scores. Discussions of school allocation rules across alternative outcomes are analysed in Levačić and Vignoles (2002).

Education as a multi-product activity has been widely considered in the literature, e.g. by Glewwe (2002) Levačić and Vignoles (2002), Bertola and Cecchi (2003). Glewwe (2002) distinguishes as educational outputs both cognitive skills (measured by the standard test scores) and social skills, values and, at some levels, prestige. Levačić and Vignoles (2002) identify as students' outcomes: cognitive skills (measured by examinations and test scores); affective outcomes (behaviour, personal and interpersonal skills, social attitudes); post-school outcomes (qualifications and vocational skills, employment). Bertola and Cecchi (2003) consider individual and social educational output. In the first group, the individual's outcome is related to educational variables (years of schooling,

exam marks, score tests, probability of transition to further education) or to labour market related variables (wages, quality of jobs, access to further training); in the second group, educational outcome is related to social skills and employability of individuals.

In Wenger's (2000) analysis, schools produce multiple competing outputs, e.g. test scores and school completion. There is a trade-off between the results obtained in test scores and the rate of school completion, so a school would only be able to increase graduation rates by accepting lower average test scores. This would be a counter-intuitive concept of what constitutes a good quality school if education is considered as a single product activity, i.e. cognitive skills measured by test scores.

In a different approach, studies that apply multi-output production function, such Jimenez (1986) and Callan and Santerre (1990), consider primary and secondary education as differentiated outputs in the educational process, while Chiswick (1984) categorises primary education as producing workers as well as inputs to further education.

4.5: Economies of scale:

A common assumption in the education production function literature is that the provision of educational services is subject to constant returns to scale. However, it seems likely that the addition of a marginal student to a class, say, of 20 students will have negligible costs while still producing the same quality of output (student qualifications).

The empirical evidence of the presence of economies of scale in the provision of education is far from conclusive, as shown, for example, by the review by Andrews et al.

(2002) of the empirical evidence on the presence of economies of scale in the provision of education in the US.

However, there is empirical evidence in favour of the presence of economies of scale. For instance, Chacraborty et al. (2000) review and provide new evidence of the presence of economies of scales in US schools, and Dodson and Garret (2003) and Callan and Santerre (1990) suggest large economies of scale in US schools, making a case for school consolidation; Kumar (1983) finds evidence of economies of scale in Canadian schools; Taylor and Bradley (2000) and Barnet et al. (2002) provide evidence of economies of scale in UK secondary schools; Jimenes (1986) finds evidence of the presence of economies of scale in Latin American countries at secondary school. But, in a different approach, Ferris (2002), without attempting to assess the presence of economies of scales, stresses that there are external costs associated with larger schools (e.g. violence.) that may offset any savings from larger schools and may also diminish the effectiveness of school learning.

5: PUBLIC PROVISION OF EDUCATION

The role of the government as the main provider of education is common in both developed and developing countries. The reasons cited for the public provision of education are its characteristic as a public good, the presence of externalities or market failures, and redistribution. Taking as given the existence of public provision, a brief review of motives follows.

5.1: The government as a supplier of education services

One of the most commonly cited features of education is its having some of the characteristics of a public good; however, this results in some peculiarities that have been widely discussed in the literature.

First of all, education is an appropriable good, and the benefits of education are private to the individuals educated. However, there are also returns that benefit the whole society (e.g. externalities) as well as those who have been educated.

Externalities are often cited as a justification for government intervention in the provision of education. Among such externalities are better citizenship, better parenting, better health and longer life expectation, better household management and crime reduction (cited for instance by Weisbrod 1962, Mincer 1984, Hanushek 2002b, and Dee 2003). Gradstein and Justman (2000) emphasise the role of public education in building 'social capital', i.e. social cohesion. Both social capital and human capital accumulation promote growth: by learning civic values future enforcement costs are reduced; by sharing language and customs transaction costs are reduced; ethnic or religious tensions may be lessened by schooling. These gains from education, at least at the basic levels, are generally accepted and are the foundation of the compulsory basic education schemes in place in almost all countries.

Secondly, Hanushek (2002b) has argued that education is not entirely a public good because it is partially produced by the government in interaction with other factors (characteristics of students, families, peers, etc.). Bertola and Cecchi (2003) suggest that the public good characteristics are more appropriate to primary education due to the

nature of the basic skills acquired at this level, while for higher levels of education the private returns tend to dominate the social ones.

Taking a different perspective, Poterba (1994) considers the "choice of instrument" issue in the provision of education, distinguishing public funding from direct public "production". It is suggested that e.g. in the presence of externalities, market failures or re-distributional goals, appropriate alternatives to direct public provision may be student loans or subsidies.

However, Trostel (2003) and Eckstein and Zilcha (1994) suggest that publicly provided education is the most efficient policy. In particular, Eckstein and Zilcha's theoretical model shows that compulsory education induces more investment in human capital as well as improving its distribution. The authors regard the compulsory education laws as a basic public service. They also show that a certain minimum level of compulsory schooling (financed by a proportional tax rate on wage income) increases aggregate output and reduces the range of the income distribution.

5.2: Public expenses in education.

Two main issues are explored in the empirical literature on the public provision of education: the level of public spending in the sector (e.g. its share of the total government budget or of GDP, spending per pupil, etc.), and the efficiency with which this expenditure is used.

There is no conclusive evidence in the literature that higher public spending has a positive effect on educational attainment. On the one hand, Hanushek (1996, 2003),

reviewing the empirical literature, concludes that there is not a significant systematic relationship between the budget allocated (resources) and students' performance, and similar results are reported by Dearden et al. (2002) and Häkkinen et al. (2003).

On the other hand, Dewey et al. (2000), Coates (2003), and Krueger (1999, 2003) have criticised Hanushek's conclusions. In particular, Wilson (2001) finds evidence of a positive effect of educational expenditure and attainment; for developing countries evidence of a positive relationship between resources and educational outcomes is reported in Glewwe (2000).

It is not only the level of public spending on education that is relevant to determining performance, but also the way in which resources are allocated within the sector, as for instance is shown by the empirical evidence reported by Gupta et al. (1999). The intra-sectoral allocation of the education budget is also analysed by Green et al. (1999), McMahon (1998b), Dabla-Norris and Matuvu (2002), and Jung and Thorbecke (2003).

For instance, McMahon (1998b) argues that the empirical evidence suggests that once universal coverage for primary education is obtained, the highest contribution to growth is made by an expansion in secondary education; he also suggest that a 'too early' expansion of higher education is not an effective policy for growth. Green et al. (1999) report the World Bank's suggestions that the emphasis on universal high-quality primary education has been a key factor in the economic success of East Asian economies. Dabla-Norris and Matuvu (2002) and Jung and Thorbecke (2003) also stress the long-term importance of the internal allocation of the educational budget for African countries.

Another problem usually identified in the literature on public provision of education is that it is argued that it is often plagued by inefficiencies, especially in less developed countries. For instance, Gupta and Verhoeven (2001) and Colclough and Al-Samarrai (2000) find evidence for African countries of inefficiencies in public spending on education. Clements (1999) analyses the situation of Portugal, which has a higher level of public education expenditure to GDP than other OECD countries but has lower educational outcomes, suggesting that in this case inefficiencies are a major determinant of the result.

For Levačić and Vignoles (2002) and Hanushek (1996, 2003) a basic problem causing inefficiency in the public provision of education is a lack of market incentives for school and teachers to improve performance; hence increasing expenditure on education as a policy to improve performance is ineffective. As argued by Hanushek (2003): 'Pay, promotion, retention in a job, and the like appear to be little different for high quality teachers and low quality teachers. Similarly jobs for school principals or other administrative and support personnel do not seem closely related to any student outcome'. Merit payment schemes or teacher bonuses related to student performance are suggested by Hanushek (2003, 2004) as an alternative.

Finally, the importance of the choice of instruments used to finance public education has been cited by, for instance, Blankeau and Simpson (2004). In their model the relationship between public expenditures on education and growth is closely dependent on the fiscal instruments used to finance education. According to whether taxes are distortionary or not, or whether taxes are on consumption or income, the relationship may be positive,

negative or even U-shaped. The authors conclude 'appropriate tax policies can help turn government education spending into a more efficient engine of growth'. Similarly, Matovu's (2000) analysis for Uganda suggests that the composition of the government expenditure and the instruments chosen to finance the public budget are the main determinants in the process of human capital accumulation.

A related issue on financing education is the treatment given to educational expenditure in the case of contractionary adjustments of public expenditure. This point in particular, is analysed by Noss (1991) and Quiggin (1999), who draw attention to the effects of such policies on the short and the long run.

Noss (1991) reviews the literature on education and adjustment, and suggests that adjusting economies that fail to recognise education as an investment (i.e. that treat it as any other current public spending) might reap in the long run the opposite effect to that originally sought by the reform. That is, current public policies such as budget containment might compromise future development if the education sector is not given special treatment. The author argues that when designing adjustment policies governments, as well as international lenders, should not overlook this inter-temporal trade-off. Whether the better policy for development is a reduction of public expenditure (including on education) or an expansion in the education budget, even if that increases the level of public expenses, is not clear from the empirical evidence reported. Due to the presence of lobbies, and other reasons, the evidence reported suggests that 'a common tendency is to cut back on social spending at basic levels'. Quiggin's (1999) analysis of educational policy in Australia concludes: '(T)he negative effects of recent cuts in

education spending will outweigh any benefits achieved through reductions in public debt'.

6 CONCLUDING REMARKS

The role of education and skills in trade models has long been discussed, particularly after Leontief's pioneering work, and in particular, those with endogenous skill formation have followed the discussion of the role played by education in the accumulation process in Findlay and Kierzkowski's paper.

The activity that provides educational services has been analysed extensively in the literature. The input-output analysis assumes that there is a relationship between resources applied to education and the production of knowledge, however there is no complete agreement with this assumption as efficiency and effectiveness issues may make the relationship between resources and educational output much more complex.

The presence of the government as provider of educational services is a commonplace in both developed and developing countries. It has been argued that inefficiency is an important problem in the public provision of education, in particular in less developed countries. While efficiency considerations and the level of spending on education are important, so also is the allocation of resources within the sector.

Leaving aside other important factors, the size and the efficiency of the allocation of the public funds for education seem relevant to improve results. Public policies towards education directly affect the educational system and indirectly the qualifications of those entering the labour market. The survey shows that there is room for policy intervention in

a developing country like Uruguay targeted at enhancing the educational system and the process of accumulation of skills; it also hints at the overall repercussions that these educational policies may have.

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