Conceptual Framework for the Analysis of the Social Benefits of Lifelong Learning

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ABSTRACT *This paper systematically identifies the market and non-market returns to education over the life cycle of graduates, as well as the social benefit externalities. It considers the most recent developments in the measurement and the valuation of these returns to additions to existing provisions for education and relates them to the costs. This is within the conceptual framework for lifelong learning defined by the graduate's life cycle, given that the capacity of graduates to learn later and to adapt is correlated with their prior schooling.*

The paper suggests that the capacity to finance lifelong learning depends on the capacity to identify and credibly measure these net social and private benefits, some of which are not well known and about which there is also misinformation. It also concludes that the capacity to finance education depends on political processes, which therefore are analyzed also, and on the capacity to build broad-based coalitions using knowledge about these marginal products.

Introduction

The important research under way in economics currently concerns identification and measurement of the returns to education, both monetary and non-monetary, private and social, and also on relating these returns to the investment made. This is because with respect to monetary returns, the new endogenous growth models and augmented Solow models combined with empirical tests give education a central role in the growth process. However, it is also because there have been recent advances in measuring and valuing not just these market returns, but also the non-monetary social benefits to education and lifelong learning using both micro and aggregate data.

The externalities and non-monetary private benefits are usually only vaguely understood, but there is general awareness that they are important to the quality of human life and to the broader aspects of economic development, or to society's overall well-being. Individual students need to have more specific information both about expected job-related earnings related to lifelong learning later in their life cycle, but also about the non-monetary returns to education if they are to make rational decisions about their investment in their own lifelong learning. The society

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also needs measures of the social benefits since this is relevant to the portion of lifelong learning costs that need to be publicly financed, and to finding the most cost effective ways of achieving broader economic development goals. Researchers need to build on what is known to get increasingly comprehensive measures of the total market and non-market returns to education.

It is possible to measure the net marginal products of education, as has been done in literally hundreds of studies, without placing an economic value on these outcomes. This involves a second step, using either cost-based valuations if one is concerned with efficiency and equity (see the following four sections) or the political decision process (see the sixth section). The latter focuses on the determination of actual lifelong learning budgets with a valuation of externality and intergenerational income distribution effects that are implicit in them.

This paper is basically a survey of recent advances in the conceptual framework and in empirical research relevant to the measurement and valuation of the benefits of lifelong learning. It seeks to be comprehensive in addressing the various types of non-monetary returns and impacts of the social benefits of education to the society available to all, and also in contrast to Behrman and Stacey (1997) tracing both their direct and their structural (or indirect) impacts. The capacity to measure the non-market returns is partly dependent on recent advances in measurement of the monetary returns net of innate ability and inherited motivation elements and on corrections for measurement error, as well as on empirical tests of endogenous growth models including externalities at the macro-level. Therefore, relevant aspects of these market-based measures also will be considered.

This paper seeks objective measures that neither overestimate nor underestimate the social benefits, and neither overestimate nor underestimate the precision with which these are measured. This is difficult, and requires patience in, for example, avoiding double counting of the non-market returns that often overlap the monetary returns to education. It is also necessary to face up to endogeneity problems, and to possible biases from unobserved variables; but it is just as easy to get carried away with hypothetical problems that do not exist, as to err in the other direction by ignoring effects that can disturb the results for which there is an empirical basis. It takes patience because the evidence is scattered in literally hundreds of articles, and most of the measures are not yet very comprehensive. It also must be anticipated that whatever level of precision in measurement is achieved, the world will still want even greater precision, and that there are those who, for whatever reason, will never be convinced by any amount of objective evidence.

With respect to the organization of what follows in implementing this objective, the next section develops the conceptual framework for distinguishing between the monetary and non-monetary returns to lifelong learning over the life cycle. However, this cannot only be at the micro-level, since the recent work by Lucas (1988), Barro and Sala-I-Martin (1995) and others on endogenous growth has implications for the market returns to lifelong learning. McMahon (1998) develops systematic measures of these direct and indirect market impacts as well as the non-monetary impacts as they relate to "knowledge for development" (World Bank, 1998).

The third section considers identification, measurement and valuation of the various 'non-monetary private' returns to lifelong learning. It is greatly aided by the work of Haveman and Wolfe (1984) as well as by more recent work by Wolfe and Zuvekas (1997). It looks separately at the private non-market returns since these are the portion of lifelong learning that it is more appropriate to finance privately.

The following section presents the conceptual framework for the externality-

type non-rivalrous benefits of lifelong learning, both monetary and non-monetary and both direct and structural (or indirect). Although these externality benefits are still efficiency based, they must be financed publicly. So a brief conceptual framework for the political decision-making process is presented later in the next section.

The fifth section first considers those aspects of lifelong learning that are more closely related to equity and distributive justice, as distinguished from purely efficiency considerations. They also must be financed publicly, so they become part of the political decision process in this penultimate section. They have their macro-economic implications for lifelong learning, suggested by the widening inequality in the distribution of income in all OECD nations (but especially in the US and UK). 'Growth with equity' has also been of major concern to international development agencies (World Bank, 1993a, 1995, 1998; UNDP, 1995) and to public policy in most OECD nations. The final section presents overall conclusions.

Monetary and Non-Monetary Returns to Lifelong Learning

The concept of lifelong learning to be used first needs to be defined, and then related to the life cycle. The distinction between monetary returns and non-monetary returns to lifelong learning, as well as between the direct returns and the structural (or indirect) returns to lifelong learning are then set out with their implications for measurement.

Lifelong Learning

The concept of lifelong learning to be used here will be one that includes all extensions to the existing provisions for education.[1] This has the advantage that it conforms to the way education budget requests are normally made, i.e. to finance increments to or changes in existing programmes.

However, for measuring and valuing the returns to these increments, most of the information available relates to the returns to existing programmes. This is a good guide if access to existing programmes is to be expanded, such as increasing secondary or 2-year post-secondary net enrollment rates. Here, the social benefit externalities may be relatively important, so the marginal returns to the incremental social benefits might actually be higher than the average returns, but then again, so might be the incremental costs. The average returns to existing programmes is not likely to be as accurate a guide if the quality of existing programmes is to be upgraded, such as Levin suggests in this special issue, to increase the propensity of graduates to continue to learn and adapt to change on their own throughout their life cycles. But this aspect of lifelong learning (i.e. learning through experience on the job and learning through experience in household production during hours not in the labor market) is well known to be highly correlated with prior formal schooling from work by Mincer (1974, 1984, 1993) and others. As such, the best measures may be to study the differences in the 'peakedness' of existing age–earnings profiles. Similarly, prior formal education heavily influences later access to and utilization of formal on-the-job training, non-market adult education, Internet distance learning and the capacity to choose stimulating work environments and thereby continue to learn (Mincer, 1974, 1993). The 'peakedness' of existing age–earnings profiles (and 'full income' profiles that include non-market returns) therefore tells a lot about the individual's capacity to adapt later to changes

brought about by globalization and technology in the knowledge-based information age. With greater attention to what happens later in the life cycle, and a little care, the returns to these aspects of lifelong learning programmes usually can be estimated from existing data.

The Life Cycle

The basic conceptual framework for the analysis and measurement of both the monetary and the non-monetary returns to lifelong education is the life cycle. The typical individual in OECD member nations is in the labor force for about 42 years, from graduation (G) in Figure 1 to retirement (R). Throughout this period there are monetary returns from education, shown as the area between $E_1(t)$ and $E_0(t)$ from G to R in Figure 1. However, there are also non-monetary returns, shown as $E_2(t) - E_1(t)$ both before and after retirement, including additions to longevity ($L_2 - L_1$ in Figure 1). Haveman and Wolfe (1984), in a pioneering article, estimated these non-market returns (including externalities) as approximately equal in value to the increments to earnings, and in their recent work, Wolfe and Zuvekas (1997) reconfirm this earlier estimate.

Lifelong learning programmes of the type that extend formal education at any level have monetary and non-monetary returns as illustrated in Figure 1 for each individual multiplied by the number of individuals involved.[2] This same figure illustrates the measurement of the net returns to education at any level (e.g. increasing secondary net enrollment rates) by merely reinterpreting graduation (G) and the net increments to returns ($E_2(t) - E_0(t)$) as referring to the education level of interest, net of the total returns to the next lower level.

Lifelong learning that occurs at later stages in the life cycle, if it is formal such as on-the-job training, Internet distance learning programmes or formal retraining, involves similar costs and similar before-and-after increments to returns. Lifelong

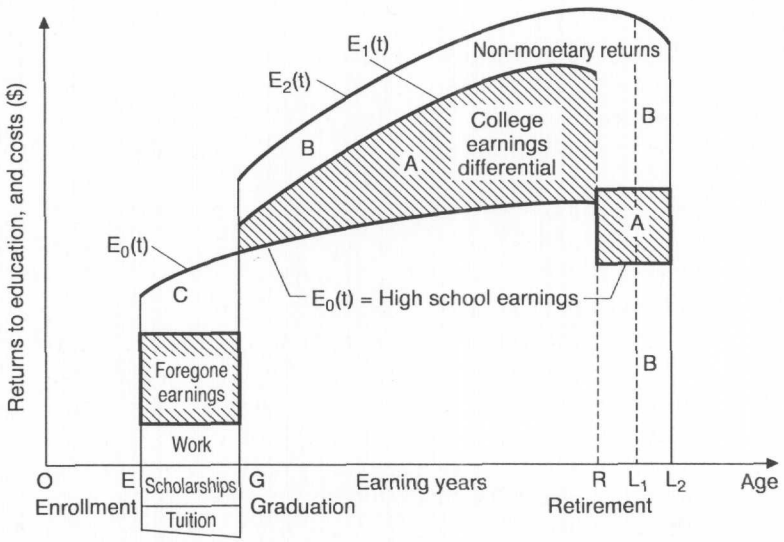

Figure 1. Investment in education, and returns, over the life cycle.

learning through experience can involve some foregone earnings costs but then it also influences the 'peakedness' of the age–earnings profile. Its connection to prior formal education can be measured, for example, by the interaction terms in Mincer earnings functions which could, in principle, be applied to non-market returns as well, or by examining visually the peakedness of the age–earnings profile for different programmes (e.g. general education versus VOTEC) or different groups.

The Conceptual Basis for Distinguishing Between Monetary and Non-monetary Returns to Lifelong Education

Over the life cycle there are two forms of household production which provide the conceptual basis for measuring the monetary and the non-monetary returns to lifelong learning. They are the household production of human capital and household production of final satisfactions.

- *Household production of human capital.* This uses the time of the individual, weighted by the household's prior human capital, and market-provided formal education as the key inputs in producing new skills and creative and problem-solving capacities that can be used either on the job or at home during leisure-time hours, as first developed by Ben Porath (1967).
- *Household production of final satisfactions.* This again uses household time but now largely during non-market hours, weighted by the prior human capital, and using other market goods (e.g. a book or a television set) as imputs to produce final satisfactions; i.e. human capital is not just used on the job, but it is also carried home and used during leisure time hours and after retirement. This second form of household production of final satisfactions provides the conceptual framework for identifying and measuring the non-monetary returns to lifelong learning.

Together, these define 'full income' (Becker, 1965). It is illustrated by the top line, $E_2(t)$, in Figure 1, but the momentary returns from financial assets must be subtracted to focus on total monetary and non-monetary returns to education. The net differential above the next lower level of education then must be divided between the monetary returns to education and the non-monetary returns in a way that the monetary returns to education are not double-counted. In the case of 'better health', for example, those with more education generally enjoy better health, in part because their higher earnings enable them to purchase better health care and a higher consumption–nutrition standard. But this is a part of the monetary returns to education, area C in Figure 1. These can be eliminated in several ways when seeking to measure non-market returns. Starting with Eisner's (1989, 1997) total income social accounts adapted for the OECD (Eisner, 1993), personal consumption expenditures which include the market returns must be subtracted from total consumption. They turn out to be about one-half of the total. Starting with either micro or aggregate data measuring specific non-market outcomes of education, the second and main approach either sorts the data by income level and examines it within each income strata, or uses regression methods. This control can be imposed by including income as one of the explanatory variables. This approach establishes the dividing line between monetary and non-monetary returns. When discussing net non-market returns to lifelong learning, this control for income will be referred to again occasionally because of its critical importance.

The Monetary Returns to Lifelong Learning

The monetary returns to lifelong learning in the OECD nations are considered elsewhere in this special issue in an excellent survey article by Cohn and Addison (1998). But it is necessary to comment on recent advances in measuring the monetary returns very briefly here, because the same kinds of 'controls' and most of the same kinds of 'measurement errors' to which these advances relate apply equally to the measurement of non-monetary returns. Furthermore, it is often necessary or convenient to convert the non-monetary returns, e.g. for adding up, in which case it must be done first, or by expressing them as a ratio to monetary returns for use in estimating them in situations where the specialized studies needed for estimating the non-monetary returns directly have not been conducted.

There are recent advances of three types that are relevant. First, rigorous controls to remove bias in estimating returns due to innate ability in studies of identical twins. Second, dynamic rates of return reflecting trends over time. Third, the new models of endogenous growth that give a major role to education-related externalities on the growth of 'market-based' gross domestic product (GDP). This section draws to some extent on the more extensive analysis of these developments in McMahon (1997b), but includes adaptations to lifelong learning.

Identical twins. Recent work with larger samples of identical twins by Ashenfelter and Rouse (1998a) and in their forthcoming book on *Cracks in the Bell Curve* (1998b) impose exceptionally strict controls that eliminate innate ability in the study of within-twin differences. Since the twins are genetically identical (monozygotic one-egg), there can be no question about differences in earnings due to innate ability, inherited personality traits or other genetic factors.

These studies build on earlier studies by Ashenfelter, the Editor of the *American Economic Review* (for example, Ashenfelter & Zimmerman, 1993; Ashenfelter & Krueger, 1994). They seek to control also for other factors in the family environment in cases where the twins were separated, as well as to estimate the bias due to measurement error. There are many other sources of possible omitted variable bias discussed by Behrman (1997), but in relation to the empirical evidence that is available, these would appear to be the relevant ones. With respect to 'family factors', even if Ashenfelter and Rouse's controls are not perfect, the education of the parents is part of the intergenerational contribution of education to human capital formation, which is the result of 'household' production as already indicated. These family factors do need to be controlled when measuring the return to a particular school or lifelong learning programme, but not when the objective is to measure the returns to education or all lifelong learning, part of which are intergenerational (Haveman & Wolfe, 1984; Greenwood, 1997). Omitted-variable bias due to 'community factors' will be discussed later, since these relate to externalities.

With respect to measurement error, research going back to Griliches and Mason (1988) and including Ashenfelter and Zimmerman (1993), Hauseman and Taylor (1981), Butcher and Case (1992), Kane and Rouse (1993), Card (1993, 1998) and Becker (1993) independently conclude that the upward bias in the returns to schooling due to omitted control variables (including ability) is roughly equal to the downward bias due to measurement error. Behrman (1997) does not agree, mentioning his study in Latin America where systematic self-reporting bias operated in the opposite direction. However, given the wide variation in quality of basic education in Brazil, this may be a special situation. Carnoy (1997), in his recent survey of

this issue, concludes that measurement error alone due to the usual failure to include the quality (of continuing education) and errors in self-reported education, if taken in isolation, leads to an understatement of the true returns to education.

The offset of ability bias by measurement error clearly also applies to the non-monetary and social benefits of lifelong learning. Here there is understatement of the true returns due to measurement of the quantity of education without adequate measures of quality differences and due to self-reporting errors, as well as overstatement of returns due to the effects of innate ability. The main finding of Ashenfelter and Rouse (1997) is that the true rate of return to education in real terms is about 10.8%. That is, the controls for innate ability and family background lower this "by about 31%" (Table 3, Cols. 6, 9, and 10) whereas the correction for measurement error raises the resulting rate of return by about 28%, so that the correction for family factors and measurement error lead to an overstatement of the time returns of only 12% (1.3 percentage points) if estimates are based only on the raw data are essentially equal and offsetting.

These findings are hard to ignore. If the non-market returns are then approximately equal to this (as discussed in detail later), then the 'total' rate of return in real terms to lifelong learning programmes is about 21.6% (i.e. 10.8% × 2), or 24.6% when the inflation rate is added to make it comparable to widely quoted rates of return on stock mutual funds or bonds found in any newspaper. This of course will be higher in some OECD countries and lower in others (see Cohn and Addison, 1998), and higher for some lifelong learning programmes than for others. But this estimate of the total rate of return to lifelong learning, if the various kinds of returns are measured and properly valued, means that it is well above the 10-year average return on all equities (or typical growth mutual funds) in any OECD nation, a very impressive return indeed.

Dynamic rates of return to education. The trends over time in the rates of return to education, but more importantly, dynamic rates of return which take into account percentage rates of change in earnings of those persons at older ages in their life cycle, have been changing drastically since 1980. The methodology set out by Arias and McMahon (1998) could be employed using successive annual cross-section data on earnings by education level within each OECD nation. For the US, it reveals that the dynamic rates of return are about the same in 1996 as in 1980 for high-school graduates. Private rates of return to lifelong learning extensions at this level are less likely, therefore, to have changed much since 1980. However, there may be additional social-benefit returns at the high-school level given the rising inequality and displacements due to globalization that must be publicly financed. Dynamic rates of return for college graduates, however, are 3% higher for males and 5% higher for females since 1980 than the rates of return based on standard methods of calculation using cross-section data (Arias & McMahon, 1998, Table 3).[3] In other words, the premiums to post-secondary 2-4 or 4-year degrees are significantly higher than previously supposed. Similar knowledge-based and globalization forces are impinging on the other OECD nations, with similar implications for lifelong learning policies contemplating expansion of access at these levels.

Implications for Measuring Non-monetary Returns to Lifelong Learning

The measurement of the non-monetary returns to lifelong learning faces the same three issues already considered, i.e. excluding the impact of hereditary factors,

correcting for measurement error in the education variable and correctly accounting for dynamic trends over time in the net returns. Recent advances in these three areas in the measurement of monetary returns apply equally to the measurement of both private and social non-monetary returns discussed later. The only differences are that in measuring non-monetary returns, there must be a control for income to avoid double-counting as discussed, and potential measurement error in the dependent variable (e.g. self-reported own-health) must also be considered.

Since Ashenfelter and Rouse (1998), using rigorously controlled studies based on identical twins, and most others who have studied this as indicated, conclude that the upward bias in returns (about 31%) due to innate ability and motivation is almost precisely offset by the downward bias due to the two types of measurement error (about 28%), it is reasonable to assume that this offset also applies to the measurement of the non-monetary marginal products of education to be discussed extensively. There are, however, a few special situations where the measurement error may be partly systematic and therefore this offset is not precise (e.g. Behrman and Birdsall (1983) find systematic errors related to the quality of schools in Brazil). Therefore, the potential of the lack of a precise offset in extraordinary situations must be kept in mind.

This provides the basis for assuming that there will be little or no omitted ability/motivation variable bias when the non-market direct and structural returns to lifelong learning are estimated directly from aggregate data as well (for example, McMahon, 1998). In most practical situations, micro or macro, the capacity to control for ability and motivation using data on identical twins or to precisely correct for measurement error does not exist. So, in the social sciences as well it is necessary to rely on strategically controlled experiments such as those mentioned. Then, if special situations arise where either the ability factor or the sources of measurement error are extraordinary, an additional correction for the unusual circumstances is appropriate.

Non-monetary Returns to Lifelong Learning

This section turns to the measurement and valuation of the non-monetary returns to education, especially lifelong learning. Advances in the conceptual framework, as well as in the empirical measurement of a wide range of specific returns, will be considered, emphasizing first the private returns. The next section will emphasize the measurement and valuation of externalities, although many of the private benefits here include impacts from externalities that are very hard to sort out.

Conceptual Framework for Measuring Non-monetary Returns

The basic method for measuring the non-market returns to lifelong learning involves estimating the marginal product of the increment to education in producing the non-market outcomes using a household production function. (This is shown explicitly in the next section as equation (2).) For example, in the case of the product 'better own-health', Grossman's (1975) study of the Thorndike sample is the basis for computing that a 2-year increase in schooling, such as completing grades 11 and 12, or a 2-year post-secondary degree programme, lowers the probability of death in any given year by 0.88%, thereby increasing longevity (see Grossman & Kaestner, 1997). This marginal product is a non-monetary return to

education since it is estimated after controlling for income in order to avoid double-counting the monetary returns to education which also affect longevity.

To place a value on these non-monetary returns in terms of efficiency, the basic method is to ask how much it would cost to produce this same outcome using alternative means available in the market. For example, how much would it cost to produce this same increment to longevity on average by purchasing more doctors' visits and other health-care inputs? This then is assumed to be the value that the individual is placing on this non-market outcome at the margin. The derivation of the marginal products from the household production function, pricing the inputs in the relevant budget constraints, and this cost-based method of valuation is developed further by Wolfe and Zuvekas (1997) and summarized in Appendix A.

Non-monetary Private Benefits of Lifelong Learning

Although individuals take the following list of non-market returns to education into account when deciding about continuing in school or supporting their children, it is very doubtful that they are aware of the full scope or the marginal product of education in contributing to each of these outcomes. If governments were to undertake improvements in the measurements, cost-based valuation and dissemination of this information, this intervention would be justifiable on efficiency grounds since rational decision making by individuals would be improved.

The list that follows refers to the benefits of general education, not to specialized lifelong learning courses targeted on each outcome. Targeted courses may raise the specific outcome more, and other outcomes less, than it is raised by general education. Research summarized later has shown there to be the following kinds of effects of lifelong learning. The stages or aspects of the life cycle that are affected are identified in relation to Figure 1.

1. Health effects (Area B, Figure 1)
   - Reduced infant mortality
   - Lower illness rates
   - Greater longevity ($L_2 - L_1$)
2. Human capital produced in the home (Area B)
   - Children's education enhanced
3. More efficient household management (Area B)
   - Higher returns on financial assets
   - More efficient household purchasing
4. Labor-force participation rates (additions to Area A)
   - Higher female labor-force participation rates
   - Reduced unemployment rates
   - More part-time employment after retirement
5. Lifelong adaptation and continued learning (Areas B and C)
   - Use of new technologies within the household (e.g. the Internet)
   - Obsolescence: human capital replacement investment
   - Curiosity and educational reading; educational TV/radio
   - Utilization of adult education programmes
6. Motivational attributes (Areas B and C)
   - Productivity of non-cognitive skills
   - Selective mating effects
   - Divorce and remarriage (potentially negative returns)

7. Non-monetary job satisfactions (Area B)
8. Pure current consumption effects (Area C)
   - Enjoyment of classroom experiences
   - Leisure time enjoyments while in school
   - Child care benefits to the parents
   - Hot lunch and school-community activities

Shifts in personal tastes attributable to education are not included in this list of non-market returns. Although they can be measured, they displace other tastes and the net change to personal utility cannot be valued. For example, after a college education, some graduates may enjoy classical music or public TV rather than stock-car races. So although there are shifts in tastes of this type, these are shifts in personalized final outcomes that are hard to value.

Brief comments on the research measuring non-market benefits of lifelong learning while controlling for income follow.

1. *Individual and family health.* Grossman and Kaestner (1997) survey 132 pieces of research in professional journals concerned with the effects of education on health. They estimate that the purely non-monetary effects of education over the life cycle on better own-health, better spouse health and better child health after controlling for income, IQ and initial status, add up to 40% of the effect of education on earnings. By this estimate, effects on health alone would indicate that the true total return to new investments in lifelong learning is 4–5% higher than existing estimates based on monetary earnings such as those surveyed by Cohn and Addison (1998) for OECD nations in this issue.

"The importance of schooling as a determinant of the self-rated health and mortality experience of males of all ages is underscored in studies by Rosen and Taubman (1982), Taubman and Rosen (1982), and Sickles and Taubman (1986)" (Grossman & Kaestner, 1997, pp. 135–136). Dunleep (1986) finds that all groups with less than a college education have higher mortality than college graduates in her sample, which is limited to married men who have lower mortality rates (and higher education) to start with than those who are single.

- *Child health and infant mortality.* There is an enormous amount of research measuring the impact of female education on the health of the family. Grossman (1975), again holding income and other factors constant, finds that the children of more educated women have healthier teeth, are less likely to be anaemic and are less likely to be obese. Cochrane *et al.* (1980) find that one additional year of the mother's education (an extension of lifelong learning which could be priced out) is associated with a reduction of 9 per 1000 in the infant mortality rate, and an additional year of the father's education with one-half of that amount. Crouch *et al.* (1992, p. 16), controlling for per-capita income, find a highly significant relation of the secondary education of females to the reduction of infant mortality rates worldwide, but only after a lag of about 20 years.
- *Lower morbidity rates and greater longevity.* Lando (1975), again controlling for income, finds less work disability. Grossman (1975) finds that a wife's schooling has an even bigger effect on her husband's health than does his own schooling. Nobody, to the author's knowledge, has yet studied the effect of a man's education on his wife's health.

Cochrane *et al.* (1980) and Grossman (1975) both find that those with more education live longer. Crouch *et al.* (1992, p. 17) find the same thing worldwide.

2. *Lifelong learning within the family: children's learning.* Formal schooling is only one input to the household production of human capital; other inputs are pre-school and after-school contributions by the family to the child's education and motivation.

- *Children's education.* Leibowitz (1974) finds that a mother's education used for pre-school home investments in children very significantly raises the IQ of the child. During the school years, Benson (1982) finds that families of high socio-economic status tend to limit television viewing and pay more attention to whether the child does his/her homework, both of which are positively related to school achievement. The number of years of college planned by white males and by black males, after controlling for family income and many other factors, is positively related to the educational attainment of the parents, especially the education of the mother (McMahon, 1976, p. 322).

3. *Efficient Household Management.* Human capital employed in the home contributes to the productivity of non-market time by increasing returns on financial assets and the efficiency of household management of consumption budgets and time.

- *Returns on financial assets.* Solomon (1975) has found in a survey of members of the Consumers Union, after controlling for income and occupation, that the level of education has the strongest relation to choosing the best inflation hedge, including investment in equities, thereby achieving higher total returns on savings.
- *Efficient household purchasing.* Hettich (1972) measured the extent to which more educated women are more efficient in market search. The saving as the result of more efficient purchasing was estimated to raise the rate of return to a college education based only on money earnings by 1.5%.

Michael (1972, 1982) finds that consumers with higher levels of education shift their spending patterns among consumption items. They behave as though they have more real income than they actually do. He concludes that this effect of education on the production of non-monetary satisfactions has an elasticity of 0.5, or about 60% of the effect of education on money earnings. McMahon (1984a) finds that when students were asked to appraise the relative expected value of monetary and non-monetary returns to them, they placed a weight on the non-monetary returns of about 50% of the weight on the monetary returns. Only a limited set of non-monetary returns were included in the questionnaire, so this is a qualification; but students entering fields such as music placed the non-monetary returns above the monetary returns, while those entering medicine and business cited the monetary returns as much more important. There were controls for family income. Consistent with this, overall expected earnings had a considerably stronger influence on family (and student) decisions to invest in education than did these expected non-monetary returns on average for all students. This weaker effect of non-market returns might change somewhat if students had better information.

Education affects the shadow price of time within the household. This leads to the diversion of time away from time-intensive activities, such as dishwashing, toward human capital intensive activities, such as reading to the children and entry into the labor market, in the time budgets of French housewives as reported by Lemennicier (1978). He concludes that the overall shifts away from dishwashing, mending and having larger numbers of children by the more educated French

housewives means that education is counter-productive in these forms of household labor. This result is analogous to similar counter-productive effects of education for the more time-intensive less-skilled production-line tasks in the workplace found by Rumberger (1981).

4. *Labor-force participation rates.* In a similar vein, shifts toward more productive use of time are evident in labor-force participation rates.

- *Female labor-force participation.* Levy-Garboua and Jarousse (1978), Ferber and McMahon (1979), Psacharopoulos and Tazannatos (1994) and others document the time shifts of educated woman toward entry into the labor force in Sweden, France the UK, the US and Latin American countries. With the rising dynamic rates of return to college-educated females in the US through 1996 (Arias & McMahon, 1997) and similar trends in other OECD countries (Sullivan & Smeeding, 1997; Cohn and Addison, 1998, Table 3), increasing college-level female labor-force participation is likely to continue.
- *Reduced unemployment rates.* At any given level of aggregate demand, those with more education tend to have lower unemployment rates and lower under-employment rates. Education policies are sometimes unwise, such as over-expansion of free public higher education in some poor countries, leading to poorly trained and unemployed college graduates. But under-employment plus unemployment rates tend to be much higher among those with little or no formal schooling; 47% in urban areas and 61% in rural areas in Indonesia, for example, as shown in Boediono *et al.* (1992). They are much lower and fall steadily at each higher level of education, although one must control for age and make some allowance for job search time.
- *Part-time employment after retirement.* With increasingly liberal early-retirement arrangements, as, for example, in the military or in consulting, many people have second careers. The monetary returns from this were included in Area B in Figure 1, but the non-monetary returns after retirement in Area B are also positive. Empirical research on this controlling for money income is quite limited, but the economic research in the field of gerontology is increasingly active.

5. *Lifelong adaptation and continued learning.* Economists often regard most human capital as putty–clay; malleable putty during the early and formative years, but hard clay once this process ceases. It is hard to teach an old dog new tricks, but a very important exception is the positive correlation that exists between prior formal education and the amount of learning that occurs later. This has been extensively documented by Mincer (1974, 1984, 1993) and others in relation to learning on the job; but it clearly also applies to non-market household production and to the leisure-time adaptation to new technologies. This is a very important aspect of lifelong learning.

The author is not aware of research on the relation of prior education to the propensity to enrol in adult education courses that controls for money income, although Cohn and Addison (1998) do survey research on post-school training programmes. Rosen (1975), however, has found larger effects on the obsolescence of human capital in those fields where new technologies and new research findings are unfolding at a faster pace. As Mincer (1984, p. 198) points out, "this human capital stock grows over the life cycle by means of ... later in job choice, job training, work effort (experience), later job mobility, and in health."

As the person ages, a shorter number of years to realize returns by the individual

or by the society remains. So investments diminish and mobility is reduced, which explains the peaking in the age–earnings profile at about age 53 widely observed in the data. Opportunity costs of time for additional learning also rise. For these reasons, rates of return fall. So it is very difficult and less economically advantageous to get older people into continuing education programmes.

Lifelong learning as replacement investment in human capital to overcome obsolescence and to adapt to new technologies is a crucial aspect of the endogenous growth process economy-wide. We will return to this in the next section.

6. *Motivational attributes.* Wise (1975) has shown that non-cognitive attributes created by education contribute substantially (about 40%) to productivity on the job later, as measured by earnings and promotions. These non-cognitive attributes logically also contribute to production of non-monetary satisfactions. He finds experience in leadership, and particularly in organizing the work of others on extra-curricular committees, etc., to be particularly productive. He finds a strong security orientation, or risk aversion, to be unproductive later.

One type of non-monetary return impact from these affective attributes is in the selection of a desirable spouse. Michael (1982) develops the point that a person's own schooling and the schooling of his/her mate has a 0.4 positive correlation. Becker (1981, Chapter 4) develops this into a whole theory of assertive mating in marriage markets. Marriage to an educated spouse leads to better health and greater longevity (Sweet & Bumpas, 1987; Cherlin, 1992) and not just a better joint standard of living. The non-monetary return expected by those planning college is positively and significantly related to 'finding a spouse with college values', after controlling for expected money income (McMahon, 1984a). This coefficient was larger for male, than for female students. Benham (1974) and Welch (1974) find that a wife's schooling raises her husband's annual earnings by about 3.5%.

Women with more education are also more prone to divorce, generating disutility (Becker, 1981, p.231). However, divorced persons with more education are known to remarry more quickly. Also, this disutility of divorce for the husband and children must be offset in part by the greater earnings of educated women.

7. *Non-monetary job satisfactions.* There are non-monetary satisfactions in certain occupations while on the job. Where job markets are competitive, the value of these amenities can be measured by determining the extent that the jobs accompanied by these amenities have earnings below those for roughly comparable jobs that do not possess these amenities. Duncan (1976) has measured these non-pecuniary on-the-job benefits and Chambers (1995) measures locational differences in these amenities in teacher job markets which are correlated with the education of the teacher.

8. *Pure current consumption effects.* These are the current consumption satisfactions enjoyed during the years in school, or when the classes themselves are enjoyable. These are represented by Area C in Figure 1, although the instant gratification involved also could be connected to adult education (e.g. elder hostels) later in life.

During the time invested in learning at school, the parents bear most of the foregone earnings costs. But from the point of view of the participant in later lifelong learning, these current consumption satisfactions net out reducing the total real investment costs. There is a strong incentive to respond to feelings of immediate

satisfaction available from student-rating forms, as well as evaluation questionnaires that accompany most short courses. This information is very useful, but it can also be myopic.

Additional current consumption benefits to the family include child care, which is very important for the primary and secondary school years. There are also hot lunches, athletic events in the smaller towns, school bands, orchestras, plays and other school-centered community activities. Little has been done to measure, or value, these types of current immediate consumption benefits beyond an early study by Lazear (1977), and cost–benefit studies of day care services by Gustafson (1978).

Identifying, Measuring and Valuing the Social-benefit Externalities of Lifelong Learning

Externalities are the social benefits from education that spill over and benefit others, and society as a whole, as distinguished from directly benefiting those that made the investment. The social benefits can be monetary, raising GDP and the money income of others, or they can be the non-monetary satisfactions from living in an educated society.

The critical point is that they cannot be captured privately by the person who has made the decision to invest. He/she benefits privately from investments made by others. The net benefits of average education levels in the community are usually positive, as suggested by their net effects on poverty, lower average crime rates after controlling for other factors or even Jefferson's insistence that Americans must have education for democratic institutions to take root and prevail. However, they can also be negative, as illustrated by embezzlers or computer hackers that steal credit-card numbers and use their education in ways that injures others, so some negative returns must be subtracted.

These 'social' benefit externalities have significant implications for financing education, but are very different from the non-monetary 'private' benefits. With externalities there is no private incentive to invest. As Lucas (1988, p. 18) says, "no individual human capital decision can have an appreciable effect on the average level in the community, so no one will take the external benefits into account in deciding how to allocate his time." There will be under-investment unless there is public subsidy and/or sufficient support by eleemosynary benefactors. For economic efficiency (i.e. Pareto efficiency), these externalities must be publicly financed if they are to be produced at all to correct this under-investment.

Economists universally recognize that basic research, much of which is done at universities, generates major externalities. Most basic research is financed by governments worldwide because of this externality characteristic. In a similar vein, primary and secondary education also yield obvious social-benefit externalities as indicated in the form of lower welfare costs, reduced unemployment, and lower crime rates. It has to be highly subsidized for this reason, and because of imperfect capital markets for the financing of human capital (see Appendix B). This is also true for the post-secondary 2-year Associate Degree or polytechnic level. There is more dispute among economists about whether the externality-type benefits from college are relatively as large, since private earnings are substantial.

The Conceptual Basis for Externalities

As a central aspect of the new endogenous growth theory, Lucas (1988) specifies human capital in the production function for the typical firm. This point is so

important that the equation must be shown. Human capital yields internalized private benefits to the firm, as indicated by the term μH in equation (1). Critically important for our analysis here, are the separate externality effects from human capital and knowledge possessed by others on the productivity of the firm. These are shown by the term H_t^z outside the parentheses:

$$Y_t = F(\mu H N_t, K_t) H_t^z \tag{1}$$

where Y is the output, μ is the proportion of time each worker devotes to production, so that μH represents the education level of the employees within the firm, created by past investment in education, plus human capital formed after employment through learning by experience (Arrow's (1997) "learning-by-doing") and formal on-the-job training, N is the number of persons, K the physical capital, and H is the average level of education in the community, also created by acts of investment.

These effects from education and knowledge available from the community can include books and articles published by educated persons in universities, other firms or government agencies that raise productivity within this firm, knowledge of effective management methods gained through informal discussions, use of libraries and public television or even knowledge through the Internet and the World Wide Web (e.g. Chapter 1 in Eliasson *et al.*, 1990). In the new endogenous growth theory and empirical tests, these and other kinds of external benefits from education and knowledge lead to increasing returns and are not only central to the growth process, but also to the potential, in the case of the OECD economies, for growth without bounds (Uzawa, 1965; Romer, 1986; Lucas, 1988; Barro, 1992; Barro & Sala-I-Martin, 1995). The augmented Solow growth models with empirical tests by Mankiw *et al.* (1992), for example, are very closely related, since as they augment raw labor and physical capital imputs with human capital, growth is sustained and growth rates even increase so long as investment in human capital is sustained or increased. Kim and Lau (1996) show that it is not increases in total factor productivity that has been responsible for the phenomenal per-capita growth record in East Asia (apart from the recent, hopefully temporary, serious slowdown), but instead it is the high rate of investment in human capital since the 1950s and the sustained high rate of investment in physical capital that have been responsible. Studying the different roles of enrollment (quantity) versus investment (including an element of quality) at each education level in an education and growth model, McMahon (1997a) finds that expansion of enrollments at the secondary level, as well as investment at that and higher levels, more specifically played a central role in the level of development found in East Asia. These contributed to per-capita growth directly, but also through the stimulus that an educated labor force provides to sustaining high rates of investment in physical capital. It also is crucial in adapting to export opportunities (Wood, 1994).

East Asian governments induced much of these high rates of investment in human capital, and since there also were feedback effects on rates of investment in physical capital, these latter effects of education can be identified as externalities. This part of the externalities, however, are related to the growth of market-based GDP, or what we have been referring to as the monetary returns to education.

Turning to externalities arising from the non-monetary returns to lifelong learning, households who produce these non-monetary satisfactions during leisure-time hours also benefit from the average education level in the community. The

standard household production function for final satisfactions (Becker, 1965) can be extended to include externalities:

$$Z_t = Z((1-\mu)H_t, x_t)H_t^{\beta} \quad (2)$$

where Z is the final satisfaction, or 'Becker commodity', $(1-\mu)$ is the proportion of time used in household production, H is human capital created by education used within the household, x are market goods and H^{β} is the average level of education in the community, an externality effect.

This, then, becomes the conceptual framework both for measuring the contribution of education to the production of non-monetary returns (the marginal products of H via $(1-\mu)H_t$ and H_t^{β} in equation (2), but also for valuing these non-monetary returns to lifelong learning. A precise separation of the 'private' non-monetary benefits to education (from $(1-\mu)H_t$) and the externality benefits of education (from H_t^{β}) is difficult, as mentioned earlier. Nevertheless, the total private plus externality benefits can be measured by estimating the marginal product(s) of education using this production function, using either micro or aggregate data.

These marginal products can then be valued by two methods, by a cost-based valuation and by valuation in the political decision process as education budgets and lifelong learning increments to these budgets are determined. The cost-based method summarized in Appendix A is the same as that for valuing non-market private returns as mentioned above. It involves essentially asking how much it would cost to produce the same outcome (e.g. same increment to longevity) by non-education market-based means. The political decision process is discussed in the penultimate section.

Identification of the External Benefits of Lifelong Learning

The following presents externalities of education on which there has been empirical research. It draws on earlier work by Weisbrod (1962, 1964), McMahon (1985) and Wolfe (1994), with updates from recent research. It differs in that it seeks to relate to the conceptual framework for lifelong learning by, for example, not including the benefits of education to other family members. We have regarded the family as the basic decision unit from the point of view of financing and therefore have included these intra-household benefits with the private benefits already discussed.

Public good social benefits of lifelong learning.

1. Economic output and economic growth effects
   - 1.1 Economic growth externalities: direct effects
   - 1.2 Structural feedback effects on growth
2. Non-monetary social benefits
   - 2.1 Population and health effects (controlling for income)
     - Lower fertility rates
     - Lower net population growth rates
     - Public health
   - 2.2 Democratization (controlling for income effects)
     - Democratization
     - Human rights
     - Political stability

2.3 Poverty reduction and crime (controlling for income)
  Poverty reduction
  Homicide rates
  Property crime rates
2.4 Environmental effects (controlling for income)
  Deforestation (for cooking, and export, given low education)
  Water pollution
  Air pollution
2.5 Family structure and retirement (controlling for income) impacts
  Higher divorce rates
  Later retirement
  More work after retirement
2.6 Community service effects of education (controlling for income)
  Time volunteered to community service within income strata
  Generous financial giving within income strata
  Knowledge dissemination through articles, books, television, radio, computer software and informally
3. Income distribution effects of lifelong learning
3.1 Poverty reduction
  Reduction of rural poverty
  Reduction of structural unemployment
3.2 Geographic spillovers
  Migration to urban ghettoes
  Firm location decisions
3.3 Reduction of inequality
  'Growth with equity' effects over time (World Bank, 1993a)

Research Measuring External Efficiency-related Benefits

For there to be economic efficiency, the social-benefit externalities affecting economic growth and/or non-monetary aspects of human welfare depend on public provision (up to the point where marginal social benefits equal marginal social costs). The research related to the measurement of the marginal product of education and lifelong learning in generating these impacts will be considered first, i.e. points 2.1–2.6. Aspects relating to the distribution of the benefits of education among students and the impacts of this on the income distribution later raise separate issues, and therefore points 3.1–3.3 are considered later.

'Direct effects' of lifelong learning are measured in what follows as the regression coefficient or net marginal product of education after controlling for other relevant factors. We continue to assume here that the effects of random-measurement error approximately offsets the effects of ability and motivation on the average over larger groups. To measure non-market returns, however, either income (micro) or per-capita GDP (for aggregate data) is an empirically relevant and crucially important control.

'Structural or indirect effects' of lifelong learning are distinguished from these direct effects. These impacts are often ignored. These are measured by the cross-partial derivatives. For example, the impact on crime of poverty reduction ($\partial C/\partial Pov$) multiplied by the impact on poverty reduction of higher secondary gross enrollment rates ($\partial Pov/\partial Gersec$). Whether or not these indirect effects are also being picked up by the regression coefficient for education will depend primarily on whether the

intermediate community environment factor (poverty, in this case) is omitted from the regression. If it is not omitted, then there needs to be a separate regression of education on this 'community effect', and the net result of this structural impact added back in to get the total impact of the lifelong learning programme.

'A Common Cause?'; as income rises, each of the non-monetary aspects of development or human welfare listed, including education, improves. It could therefore be argued that both education and the externality benefit have a common cause, namely higher income, if care is not used. But first, to measure the non-monetary returns to education, in all research mentioned, including both direct and structural effects, per-capita income or GDP is included as a crucially important control to remove this part of the income effect.

Second, education expenditure itself, of course, also rises as per-capita income rises, since education is a 'normal good' with income elasticity of demand for basic education of about 1.0 (see McMahon, 1970, 1989; where other sources are also cited). However, most of the evidence is that this relationship is basically recursive. There are lags of 15 or 20 years or longer after education investment increases before most of the impacts from lifelong learning are felt since the average person is in the labor force 40–42 years after receiving his/her education. Therefore, lags of this magnitude are usually employed in the regressions reported.

To test for bias due to simultaneity, two stage least squares simultaneous equation estimating methods are frequently employed. Using them, a second equation expresses investment in education as a function of income. However, the lags are so long after this that it does not usually seriously bias the effect of education on its outcome. For example, with investment in education in Africa as endogenous, see the 2SLS and ordinary least squares estimates compared in McMahon (1987), or for health effects with endogeneity see Wheeler (1984a), and for physical capital/income/education endogeneity see McMahon (1997a, 1998). These and other such studies test whether or not the coefficient estimating education impacts on various outcomes is subject to a bias due to simultaneity that is empirically large. Joint two-way causation does exist in many other branches of economics, and there is nothing wrong with it *per se* (e.g. does quantity cause price or price cause quantity in market solutions?—usually both are true). In these cases, however, the lags are not as long as they are for education impacts over the life cycle. So in this specific case it is less necessary that simultaneous equation estimating techniques always be used.

Nevertheless, there are potential impacts of education that have not yet been adequately measured, the level of precision of measurement will never be perfect, and many things are not known. It would be a mistake to overestimate what is known, so caution is warranted. But it would also be a mistake to underestimate what in fact is known.

1.1 Economic growth externalities: direct effects. The average education level in the community as an externality is responsible for increasing returns to scale in the new endogenous growth theory of Lucas (1988) and in related empirical tests by Barro (1992) and Barro and Sala-I-Martin (1995, pp. 424–450). These externalities offset diminishing returns to investment in physical capital that would otherwise appear. The result is that there is not convergence of growth rates worldwide (Barro, 1992; Barro & Sala-I-Martin, 1995); i.e. the richer OECD countries are getting richer, and the Sub-Saharan Africa countries are getting poorer. It is human-resource development through education after controlling for investment

in physical capital that is found to be primarily responsible for this (see Mankiw *et al.* 1992; Kim & Lau, 1996; McMahon, 1997a), as well as responsible for 'conditional convergence'. That is, the poor countries within each region (e.g. Malaysia, Thailand, Indonesia) begin to catch up if they invest in human-resource development but not otherwise. The complementarities with investment in R&D with the many failed experiments that are involved may be more empirically relevant in the advanced OECD nations (for example, McMahon, 1984b), but it is education that appears to be critical to offsetting diminishing returns in the poor countries.

The public good aspect of education diffuses the technology (for example, Romer, 1990); i.e. education contributes to the availability of new information, capacity to access new ideas, willingness to experiment, capacity to understand the potential of new processes or outcomes, and so forth. Some of this is reflected in labor-market earnings. This willingness to adopt new research and to take risks with R&D brings benefits to society and to future generations beyond labor-market earnings (for example, Wozniak, 1987, p. 104). Wozniak estimates that an additional year of schooling increases the probability of being an innovator by about 3% (*op. cit.*). This is a new human capital emphasis in Schumpeterian innovation and diffusion of these capacities.

1.2 Structural feedback (indirect) effects on growth. There are feedback effects on growth as a result of a positive relation of education to the rate of investment in physical capital as a percentage of GDP, which then in turn contributes to growth. These are over and above the direct effects of education on growth since this investment ratio is controlled for in all of the regressions reported in McMahon (1998). This structural impact that Barro and Sala-I-Martin (1995, p. 451) also find on 'private' investment as a percentage of GDP is 0.034 times average secondary and higher-education enrollment rates. Multiplying this by the coefficient for the physical capital investment ratio in the per-capita growth equation, which also by coincidence averages 0.034 (Barro & Sala-I-Martin, 1995, p. 425, columns 1–6), this indirect structural externality effect adds 0.1% to the per-capita growth rate worldwide. By this same method of calculation, McMahon (1997a, Table 6, Model 21 times Table 1, Model 7) finds that in East Asia, this structural effect of education adds 0.7% to the average per-capita growth rate of nations that aggressively expanded secondary education in that region.

2.1 Fertility rates. Population and health effect. Lower fertility rates as the result of education are treated as primarily a social-benefit externality, although there also may be some private benefits within the family, especially in poor countries or neighborhoods where typical families are much larger than average. This is largely an external social benefit because lower fertility rates eventually lead to lower net population growth rates, which have positive implications for capital deepening and faster per-capita growth.

Much of the evidence for the relation of more female education to lower fertility controlling for income is at the micro-level. It is summarized by Michael (1982, Chapter 6, pp. 133–135) with more recent surveys by Dasgupta (1995) and by Greenwood (1997, pp. 4–6). There are several routes by which fertility rates are affected. First, there is a reduced demand for children when women find entry into the labor force more advantageous (Becker, 1981, pp. 93–112). Second, there is greater utilization of the technology, in this case contraception. Third, many find

that as females stay in school longer, the number of child-bearing years is diminished with negative effects on fertility (Cochrane, 1979, p. 146; Moore *et al.*, 1993; Schultz, 1993). For the theory which is the basis for the inference of causation, see Becker (1981, pp. 93–112), as well as Card (1998).

Lower population growth rates. After female education goes beyond about the 9th grade, net population growth rates begin to fall because these fertility effects outweigh the opposite child-health and longevity effects of education. This is a structural effect as total physical capital and human capital deepening and economic growth are aided. It is also an externality as less strain is put on school and welfare budgets.

Recently, an effort has been made by McMahon (1998, Chapter 6) to calculate these indirect structural effects of education via lower fertility rates on net population growth rates. The evidence for these more complex structural impacts as lower fertility offsets the positive effects on child health and longevity controlling for education is quite suggestive. It takes into account the offsetting effects mentioned but not measured by Dasgupta (1995, p. 1887). It will always be possible to refine the controls for income further and increase the precision in other ways. This evidence is also consistent with earlier work by Wheeler (1984b) and Crouch *et al.* (1992, p. 15) in finding a positive interaction between the education of women and the effectiveness of family-planning efforts, although Dasgupta (1995, p. 1889) points out age limitations to this interaction.

Starting from very large families, such as are typically found in the poorest countries and poorest sectors of all societies, reduced numbers of children per family raises per-capita income and also per-capita non-monetary satisfactions within the family. There are fewer children, but the children have better health and better education (referred to as better 'quality' children in the literature; see Becker, 1981, pp. 103–112). It has been argued by Simon (1981) that larger families generate larger aggregate utility, but this is an extreme position that assumes additive cardinal utilities, and one that is difficult to accept when one observes the large families and near-starvation conditions in Chad, Burundi, Mali, Bangladesh, Honduras or Haiti, or in urban ghettoes in some OECD nations.

Lifelong learning implications of this in the OECD nations are strongest for the extension of quality education to females in low-income neighborhoods who are most at risk of dropping out of secondary education or adjacent levels. Although not a panacea, the costs may be largely offset by the savings to welfare budgets, which is a financing suggestion discussed at length by Levin in this special issue.

Public health externalities. To the extent that lifelong learning of parents after controlling for income not only improves own-health and child health, but also reduces the spread of infectious diseases to others and leads to suggestions to others that benefit their health, it also generates externalities. From Grossman and Kaestner's (1997) very extensive survey, additional externality-type public health marginal products can be identified.

2.2 Democratization. There are net effects of education on democratization after controlling for income and after tests to verify a recursive relationship that suggest a marginal product of 1.8% for secondary-education gross enrollment rates. The lag used is 12 years in worldwide data ($t = 2.60$, $n = 75$ in McMahon, 1998, Chapter 7). This is a long-run kind of effect, noticeable in Latin America, for example. After over two centuries of dictatorships, rule by fiat and coups, all of

the larger 18 Latin American nations now have democracies, albeit fragile ones, partly due to rising income but after controlling for this, partly due to differences in education levels. All OECD nations have high education levels and also have democracy, whereas most of Sub-Saharan Africa is authoritarian and unstable. Rising income is very important, but there are net education effects on democratization that are not double-counting the monetary returns to education since they have been removed with controls. Those nations that have had higher secondary enrollment rates (like Costa Rica) are much further ahead with democratization than others who were also Spanish ex-colonies at the same per-capita income levels that have low secondary enrollments.

This hypothesis warrants further investigation, but it is consistent with recent independent work by Clague *et al.* (1996)—whenever 'literacy' is included, his ordinary least squares *t*-statistic for this measure of basic education is very high.

Human rights. Human rights as measured in the West is usually interpreted as civil rights, as defined and surveyed by Freedom House (1996). This includes freedom of the press, radio and TV, freedom of assembly, an independent judiciary, no imprisonment for political crimes, gender equity and absence of serious corruption.

Human rights improve significantly with democratization ($t = 11.89$ in McMahon, 1998, Chapter 7) after controlling for per-capita income. This is another structural effect, in this case measured by the cross-partial derivative of human rights with respect to democratization multiplied by democratization with respect to education, in both cases after first controlling for income. The relation to the human rights index (which runs from 1 to 7) is $0.588 \times 0.018 = 1\%$ times changes in the secondary gross enrollment rate! This is in addition to another 0.6% direct effect, both lagged 12 years. Both are after controls for per-capita income and for the adverse effects of high military expenditure (see McMahon, 1998, Chapter 7, Table 2, Model 1). These would appear to be interesting specific hypotheses for which there is preliminary evidence that justifies further investigation.

Political stability. Political stability similarly comes about over the long run worldwide after controlling for per-capita income as primary education levels improve (McMahon, 1998, Table 3). Neither Barro and Sala-I-Martin (1995, p. 426) nor McMahon (1998) find that democratization *per se* contributes significantly to economic growth, but both find that political stability does.

2.3 Poverty reduction and crime. The role of adult education and lifelong learning in reducing poverty among those who left school earlier is likely to increase in the OECD nations. Inequality is related to prior education levels, and is increasing in all of the OECD nations, but most especially in the US and UK (see Gottschalk and Smeeding (1997) and Sullivan and Smeeding (1997) for the recent research on trends under very controlled conditions). Controlling for overall average per-capita income (since poverty is reduced as growth occurs, a very robust relation), there is a net reduction in poverty rates in areas where primary and secondary gross enrollment rates are higher. This is an externality benefit to the community (e.g. lower social service expenditure, higher tax collections). It is also a traditional function of public-school systems. The opportunity costs of the poor are lower, so from this point of view it should be easier to get them into subsidized lifelong learning programmes; but their prior human capital tends to be lower, so new learning is likely to be slower as suggested by the second section of this article.

Very major efforts to get more high-school graduates from low- and middle-income families to complete high school and 2-year community college degrees are being pushed as a high-priority item by the Clinton administration in the US. Dynamic trends in rates of return as well as in rising inequality would seem to warrant similar action in other OECD nations on both efficiency and equity grounds. (For the trends, see Arias & McMahon, 1998; Gottschalk & Smeeding, 1997; Cohn & Addison, 1998.)

Homicide and property crime rates. Although those in prison in the US perform at very low educational levels, a survey of the crime literature by Witte (1997) finds that average educational attainment (of those prone to crime) has no relation to further criminal activity. Larger numbers of unsupervised teenagers on the streets in a community is very significantly related to crime rates. In updated regressions, McMahon (1998) finds after controlling for income a significant direct relation of higher secondary gross enrollment rates to both lower homicide and property crime rates. These are augmented by the structural effects of education in reducing inequality and/or poverty, since the latter in turn are significantly related to homicide (McMahon, 1998, Chapter 10, Table 1) and property crime (McMahon, 1998, Chapter 10, Table 2). This pattern emerges both in worldwide and US data after controls. This evidence is consistent with Witte's rationale regarding unsupervised teenagers, as well as with earlier micro-economic evidence by Spiegleman (1968) and Ehrlich (1975).

There is a large and sophisticated crime literature considered further in the sources cited. With respect to the role of the schools, much of it is not related to traditional academic functions but more to teenager supervision, and to peer group formation. Research on trends in the productivity in US schools (for example, Hanushek, 1994a, b, 1997) does not always take into account increased burdens being placed on the schools as a result of the need to include all teenagers, both for supervision and to allow healthy peer-group formation.

This evidence offers suggestive hypotheses that warrant further testing in other OECD countries. It is not clear that education systems not committed to getting involvement of 100% of teenage youth can do very much about the crime problem.

2.4 Environmental effects. The hypothesis here is that more education after controlling for income tends to create a demand for a clean environment (direct effect), and reduces both population growth rates and poverty (if policies are appropriate). Population growth and poverty in turn are well known to be related to deforestation rates (e.g. for agriculture and for cooking) as well as to higher water pollution in less-developed countries. Both are structural or indirect effects. (See the special issue of the *World Development Report*: *The Environment* by the World Bank, 1992.) Air-pollution and global-warming externalities must be analysed slightly differently. These direct and structural effects show up in re-estimated equations, as does the total marginal product of education, in McMahon (1988, Chapter 9). The importance of this issue warrants further efforts at measuring and testing direct and indirect structural impacts of education on environmental quality.

2.5 Family structure and retirement community impacts.

Divorce rates. The growth in the divorce rate cited by Becker (1981, p. 229) is due to a number of factors such as imperfect information, but may also be affected over time by the greater economic independence of women.

Later retirement age. Although corporate and military policies now encourage early retirement, lifelong learning encourages later retirement. It also makes part-time work possible after retirement, and reduces social-security fund costs which is a social benefit. However, to measure the net effect of education on social security systems, the effect of education in increasing longevity must be subtracted.

2.6 Community service: effects of education. Within income groups, a Gallup survey in the US reported by the National Center for Education Statistics (NCES, 1995, p. 98) reveals that those with some post-secondary education give voluntarily and generously of their time to community-service activities nearly twice as often as those with a high-school education (i.e. 22 versus 12% give time). The college-educated people also give 3% of their income or more to charity about twice as often as high-school graduates, both in lower income groups (24.7 versus 12.5%) as well as in higher income groups (19.1% versus 7.5% give generously). Although this is in fact a social benefit of higher education, McMahon (1984a) finds that students do not weigh these possibilities for community service significantly when making their private college investment decisions.

If public leadership is well educated, there can be external social benefits to many generations to come, a point cited by Bowen (1977) (e.g. Thomas Jefferson). There are also savings of social cost from the willingness to spend time and the capacity of citizens to assess their own income tax (Weisbrod, 1962).

Knowledge dissemination. Perhaps the single most important externality of lifelong learning is the knowledge disseminated, and acquired, through articles and books written by educated people, through television and radio, through health and other encyclopediae, through computer software and through informal communication. The capacity of people to learn later in the life cycle and to adapt to new technologies is an enormous externality. Without it, the cost to the public treasury (or the lost production) in making (or failing to make) the necessary transitions would be enormous.

Schultz (1975, p. 843) has addressed this issue in his analysis of the value of the 'ability to deal successfully with economic disequilibria, which is enhanced by education,' as has Eliasson *et al.* (1990). It shows up in the age–earnings profiles in all of the OECD nations that are more sharply peaked. There are not just private monetary returns; there are also more sharply peaked non-monetary returns and social-benefit externalities as new learning and adaptation persists throughout the life cycle.

Distributional Implications for Lifelong Learning

The conceptual framework for distinguishing between efficiency and equity or economic growth and distributional effects of education is provided by welfare theory in economics. If all 'Pareto moves' that are possible are made improving efficiency in ways that some are made better off, but no one is made worse off, the grand utility possibility frontier for the society is reached. These are the efficiency-related impacts of lifelong learning discussed in the third and fourth sections. After this, the only moves possible along this frontier involve conflict, since redistribution would occur that benefits some and takes away from others. However, starting at points below the frontier 'humane growth' (McMahon, 1982, pp. 22–25) or 'growth with equity' (World Bank, 1993a) that simultaneously improves efficiency

while also reducing poverty and inequality is normally possible, and reduces the intensity of the conflict.

Some human capital development policies have a primary targeted distributional objective (e.g. Project Head Start in the US, means-tested education grants, and lifelong learning programmes to achieve high-school equivalency learning for drop-outs in poor rural and urban areas). They are policies that fall into this 'growth with equity' classification, for they normally also have a major efficiency component—e.g. rates of return on these investments are likely to be high, and even higher if the efficiency-related externalities were included. Absolutely pure redistribution is largely non-existent in democracies, Rawls (1977) notwithstanding, because it involves so much conflict and opposition.

The conceptual framework for establishing how the society values these goods involves the concepts in political economy discussed in the next section for budget determination through voting.

Research Relevant to Distributional Impacts

It is known that increasing the average education level (while essentially preserving the inequality of access) does not reduce the inequality in the earnings distribution in the OECD nations, as shown by new research under controlled conditions by Sullivan and Smeeding (1997). Rising inequality in the earnings distribution is also known to be the major source of the trend toward greater inequality in the distribution of income within OECD nations (see Gottschalk & Smeeding, 1997). Regressive changes in the tax laws and benefits programmes in the US and UK have augmented the trend towards greater inequality in disposable incomes there (see *The Economist*, 1994, pp. 10–21).

The income distribution effects of education depend primarily on who gets the education, and on whether or not the education distributed within each group is of equal quality for all children (see Psacharopoulos, 1977; Harbison & Hanushek, 1992, pp. 192–199).

3.1 Poverty reduction and unemployment. Apart from the efficiency aspects of poverty reduction as evidenced by high rates of return already discussed, there are some purely distributional impacts. Ehrlich (1975) finds a strong relation between inequalities in schooling and the relative number at the poverty end of the income distribution. McMahon (1998) finds a significant relation between extending secondary education to poor rural areas and reduction of both poverty and inequality, an effect that is especially pronounced in East Asia, which has experienced fast growth with equity, in the World Bank's (1993a) terms. Stiglitz (1997) also stresses this effect.

At given levels of aggregate demand, continuing education can help to lower structural unemployment. The social benefits of this in OECD countries include lower unemployment compensation, Medicaid, welfare and public-health costs which can be measured (Webb, 1977). Garfinkel and Haveman (1977, p. 53) find a strong negative relation between the education of the head of the household and poverty status, with its associated welfare and Medicaid costs.

3.2 Geographic spillovers. The enormous cost of the migration from poor rural areas where the education has been inadequate to urban slums has never to the author's knowledge been estimated (e.g. from rural Mississippi to Chicago, or from rural

Pakistan or Brazil to the slums of Karachi or Rio de Janiero). This is largely the result of deficiencies in the education systems in the poorest rural areas, or in the regions from which OECD immigrants generally come. In the other direction, America benefited massively from the influx of immigrants from Europe bringing skills and knowledge, in this case an externality of the European education systems. This process and its continuation in recent years is extensively analysed by Ballendorf (1972), Bernard (1971), Chiswick (1974, 1992) and others.

Within each nation, lifelong learning programmes funded by the central government in those areas losing population help to compensate for the loss of skills and tax revenues to the community that financed the education. Otherwise there will be underfunding of schooling by the community experiencing net out-migration. This is the conceptual basis for the argument that federal governments and agencies such as the European Community should share the costs of education.

Firm and household location decisions. Firms and households enjoy lower costs in communities where there are better education levels generating externalities, and (for firms) where the labor force is already well educated and the local schools are attractive to the management personnel who come in. Firm location decisions that are influenced by local education, controlling for other factors, have been made by Heins (1976) and others. High-tech firms are obviously attracted to university towns and places like Silicon Valley largely because of local human capital endowments, a social benefit of education to these communities.

3.3 Reduced inequality. Inequality as measured by the GINI coefficient sometimes follows the pattern of the inverted 'Kuznets U', rising at first and then falling as economic development occurs. The inevitability of this is much disputed in recent years.

If policies expanding secondary education are pressed, inequality in the income distribution (as distinguished from absolute poverty, and after a 20-year lag) is found to be significantly lower (McMahon, 1998, Chapter 8). This hypothesis is consistent with the strong positive relation between inequality in access to education and inequality in the income distribution found by Psacharopoulos (1977). The cause of these inequalities in access to education are often the high effective price of education services for the poor as documented by the World Bank (1993b). Another major source is the failure to expand access to the next higher level of education after universal education at the next lower level is achieved. For example, delays in expanding junior-secondary education to the rural areas in Thailand and Indonesia (see McMahon, 1994), similar policies in Brazil, and potentially delays in expanding access of lower income groups to 2 years of post-secondary education in OECD nations could contribute to rising inequality.

Generally, therefore, appropriate education policies can contribute to achieving a path of endogenous growth with equity. This sustained growth in living standards accompanied by falling inequality in the distribution of income is the path largely achieved in all eight of the world's fastest growing countries in East Asia (World Bank, 1993a; McMahon, 1998, Chapter 8).

The Rationale for Valuing Externalities in Political Economy

There are two methods for valuing the net marginal products of education and lifelong learning discussed—use of a cost-based valuation and the political decision

process. The conceptual basis for cost-based, which is the efficiency-based, valuation of each of the 25 types of outcomes considered has been discussed and is set out in Appendix A. The political decision process, for valuation both of externalities and income distribution effects, will be considered here.

With respect to political valuation of lifelong learning outcomes, governments have and can be expected to continue sometimes to ignore cost-based valuations (Arrow, 1997), and hence ignore efficiency. We suggest that this is most likely where income-distribution impacts are involved. In this latter case, valuation involves questions of equity, which are outside the bounds of pure Pareto efficiency considerations, and can really be resolved empirically only by the political decision process. But cost-based valuations, including efficiency considerations, are also often ignored when special interest groups direct budget and tax decisions to their own ends, as they frequently do.

Although this process does result in an actual valuation being placed on these outcomes (and hence on these programmes), these values are not necessarily optimal, either in the sense of being efficient or in the sense of being both efficient and equitable. The conceptual framework for this distinction will be considered briefly next.

Optimal Efficiency: expenditure/taxation levels

The usual criterion for economic efficiency is that total private plus public investment in lifelong learning should be expanded up to the point where the total rate of return, including both monetary and the value of non-monetary returns as well as the value of externalities in the calculation, is just equal to the interest rate. The interest rate is taken as an overall average of the opportunity cost to the society of the funds involved, usually about 10% in developing countries and about 6% currently in OECD nations. The optimal solution explained in Appendix B and illustrated in Figure 2 is at point Ω where the total rate of return with the value of non-monetary returns and externalities included ($r^*_M + r^*_{NM} + r^*_{EXT}$) is just equal to the rate of interest (r).

However, there are imperfect capital markets for human capital, as Oosterbeek and others in this special issue have stressed. Those most in need of lifelong learning are unlikely to be able to provide the collateral that banks or other lenders require, even though the total private rate of return might be very high. So it is not just the growth-related externalities and the non-monetary social benefit externalities that governments must subsidize, it is also private investment in lifelong learning for those without collateral to borrow if there is not to be under-investment. Including a correction for imperfect capital markets, the optimal solution requires student loans of ΩA in Figure 2.

This solution for optimal efficiency as it relates to optimal expenditure levels (private plus public subsidy) often differs significantly from the actual rates of return estimated from the data (although the latter do not normally include non-market returns and externalities), and these differences can persist for very long periods. This can be because there is imperfect information about the non-market returns which causes them to be undervalued (Schultz, 1967), or at least imperfectly valued, or because of the political distortions mentioned, or because actual allocations take income distribution effects into account which optimal efficiency does not.

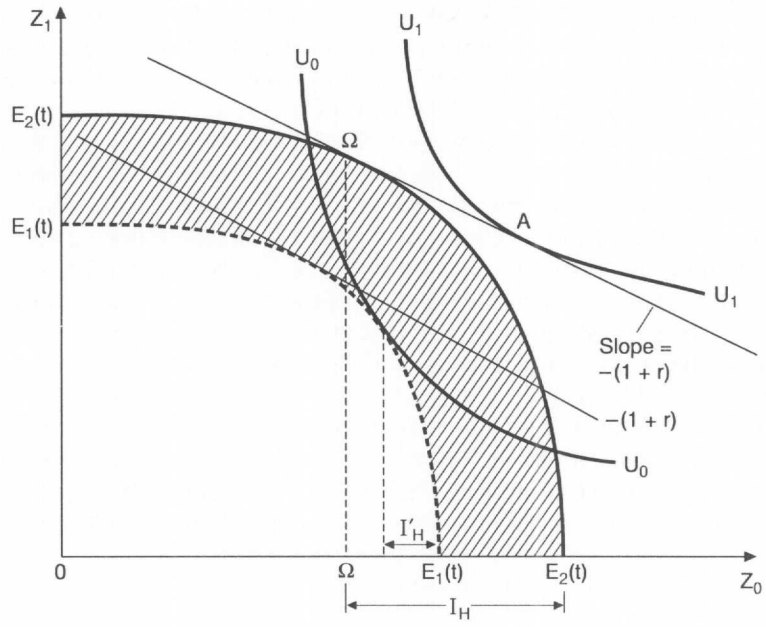

Figure 2. Imperfect capital markets: their significance for optimal investment at Ω, non-monetary returns to education included (area of difference between full income, $E_2(t)$, and money earnings, $E_1(t)$).

Equity and Optimal Distribution

Equity or distribution issues are often ignored by economists when focusing on efficiency (as already discussed), but they are inherently a part of the maximization of human welfare (for example, Samuelson, 1955, Chart 5, p.352). Income-distribution effects also need to be considered for a second important reason; if the analysis is to be relevant to policy and to actual outcomes, it must be recognized that education budget decisions allocate the capacities to earn incomes in the future. So income-distribution effects that relate the current distribution of income to the future distribution of income inevitably enter the debate and are a part of actual final budget outcomes.

With respect to financing lifelong learning, this means paying attention to vertical equity among students who are not equal largely because their household or families have widely different incomes and assets. Family wealth is the primary determinant of where children live, the quality of education they receive and how far they go in school (for example, McMahon, 1984a). Since this largely determines 'ability' test scores that inevitably measure achievement, probably more than innate ability, family wealth and ability measures are very highly correlated.

There is a literature in economic theory that deals with optimal taxation that takes income distribution and hence vertical equity into account (see Diamond & Mirrlees, 1971a, b), but this has not dealt with income redistribution through education policies other than Mirrlees (1974). Ulph (1977) advances a theoretical solution, but he rules out by assumption the central vertical equity issue, which is the connection of the parents' wealth to the expenditures on education that distribute earning power. He says "individuals are assumed to be equal in all respects other than innate ability" (p. 343).

The more empirically related education finance literature is dominated by this issue, however (see any issue of the *Journal of Education Finance* or the special issue of the University of Michigan *Journal of Law Reform*, Spring 1995, that focuses on this). Degrees of vertical equity[4] in the distribution of future real incomes (or utilities) among children range all the way from 'commutative equity', which holds that the 'market results should prevail' and hence any redistribution is evil (or should be ignored) to Rawlsian (Rawls, 1977) 'positivism' which advocates 'correcting the wrongs of society'. The latter is highly intergenerationally redistributive (see McMahon (1982, pp. 14–25) for other specific gradations of vertical equity). No nation among the OECD member countries goes to either of these ethical extremes in their education policies. More common is to aspire to 'equality of educational opportunity' which does not focus on raising the welfare of the least advantaged as Rawls (1977) would have it. Empirically, most nations achieve something less than equality of educational opportunity, however; especially in the US where the education system is highly decentralized in its financing and hence heavily dependent on differences in local parental wealth. At the higher education level, quality is protected by creating a hierarchy of institutions that cater to different sectors of the market, augmented by means-tested financial grants, an approximation to equality of opportunity that is relatively widely accepted, (see McMahon, 1974).

The degree of redistribution that is optimal still uses a welfare function given by the "omniscient ethical observer" to achieve a determinate solution (going back to Samuelson, 1955). This involves a normative value judgment. Such values have a religious basis (e.g. the New Testament or the Koran) or a philosophical basis (for example Rawls, 1977) outside of pure economics. There are ways of measuring conceptually the efficiency gain from a change in the income distribution. This was originally provided by Atkinson (1970) and is set out in relation to education in McMahon (1982, pp. 24–25). However, even here with a welfare function that is ordinal, the aspects of its location that specifies the initial optimal distribution is exogenous. The utilitarian 'value' of this redistribution involves interpersonal comparisons of utility.

Budget Determination Through Political Decisions

What is ethical or optimal in normative theory (which includes income distribution as well as efficiency) aside, actual lifelong learning budget decisions are made empirically through a political decision process. The results tend to reflect the economic interests of the stake holders. This occurs over time and in the cross-section. It is evidenced, for example, by the fact that as average income rises, parents want more and better education for their children, so the effective demand for both basic public education and higher education rises with an income elasticity of effective demand that averages about 1.0 (McMahon, 1970, 1984a, 1992). As technical change, globalization and lifelong learning capacities to adapt to these changes later give increasing advantages to those with a 2-year Associate or 4-year Bachelor's degree, the effective demand for these programmes, public and private, can be expected to continue to increase. (The dynamic trends in the US are documented by Arias and McMahon (1998).) Public education partially meets private household and employer demands, responding to these, but it simultaneously responds, and can be expected to respond in the future, to rising social

benefit externalities inherent in both endogenous growth and development that have been discussed in detail.

Arrow (1997) has recently expressed the considered opinion that this political decision process will reject on occasion cost-based valuations of these externalities. He says "although this comparative cost analysis has been made repeatedly, it often has not had much effect, I regret to say" (p.26). Pure income-distribution effects cannot be valued exclusively on a cost basis, as indicated above, so cost-based valuations become less relevant when there are large income-redistribution effects involved. Within the context of majority voting models, solving distributional issues becomes a matter of how the median voter is affected. This large literature, as it applies to education, goes back to Bowen (1943, 1948, pp. 180–181). A formal exposition of Arrow's impossibility theorem, how it is displaced under the (reasonable) assumption that preferences are usually single-peaked, appears in Musgrave (1959, Chapter 6) and is used in Downs (1957). Stiglitz (1974, pp. 362–366) later addresses the central issue of public education budgets where both abilities and wealth are differing. But apart from aspects of his analysis related to opting out of the public system for private schools, he essentially concludes that the income redistribution effects of education get largely washed out. He says, "the wealthier professionals often seem to be among those who are the most ardent supporters of (public higher) education; this is perhaps because the belief in a high private rate of return to education leads them to be relatively high demanders, (eliminating any) redistributive effects" (*op. cit.*, p. 362).

This majority voting literature still makes unrealistic assumptions, however, about one-man, one-vote and ignores the effects of differences in wealth among local school districts and closely related pressures to keep the financing localized. The result is that it arrives at very unrealistic conclusions suggesting that public education is more egalitarian than it really is, and that more inequality in wealth can lead to higher investment in public education (for example Stiglitz, 1974, pp. 361–362). Most of the majority voting literature is extremely abstract, not subject to empirical tests, and often without an empirical analogue (see, for example, the "Symposium on the Economics of Voting", (Shapiro, ed., 1995). The problem is that frequently the majority do not vote and, furthermore, that who votes, and how they vote, is heavily influenced by television advertising and in other ways by financial contributions to candidates and their 'soft money' supporters. The money under the control of legislative leaders is used to influence Congressional and state-level legislative votes that affect public budget levels, tax levels and allocations. Under these conditions this means equating money to votes, even endorsed recently by the Supreme Court in the US for example as 'free speech'. It results in outcomes that are not particularly egalitarian.

Some recent significant work by political scientists has addressed this issue. Huber *et al.* (1993, p. 75) conclude that "the economically dominant classes (and also the bourgeois) accept democracy only where their interests are effectively (provided for)." This is consistent with the empirical finding that in the worldwide data, democratization, which is measured by degrees, has no significant relation to reduced inequality in the income distribution (McMahon, 1998, Chapter 7). This is after controlling for per-capita income, and is based necessarily on the 64 countries for which data on GINI coefficients is available from the World Bank (1997, pp. 222–223). This is somewhat surprising given the popular view about 'democracy' and an interesting hypothesis that merits further exploration.

With the median relocated as a result of these influences, on one side of this

new qualified median, those who pay more taxes and receive less benefits, or who pay a higher 'tax price' generally want smaller education budgets. To consider the implications for lifelong learning programmes, these individuals and groups logically will be less favorable to public financing of provisions for externalities, even though cost-based valuation and efficiency within the economy would call for it. They have incentives to try to reduce their taxes (and hence public expenditure), and hence also reduce public support for the redistributive aspects. This is evidenced, for example, by the vigorous opposition from the higher income suburbs in states in the US within which there is enormous inequality in expenditure per child (e.g. Texas, Ohio and Illinois) to school finance reform that would raise the state-financed foundation levels. Reforms of this nature were defeated this year in Illinois, Texas, Ohio and elsewhere, but did pass in Mississippi, the latter being a remarkable exception.

Surveys of voters in local school elections find that most opposed to higher school district budgets are not generally parents with children in school, but tend to be those who are older and paying property taxes or, at the state level, income taxes. These older property tax payers are also not in the best position to benefit privately from adult lifelong learning programmes. With respect to externalities, some gated communities for high-income retired persons in southern Florida, Arizona and Southern California, for example, admit no children and refuse to pay any taxes in support of public education, irrespective of what the externalities or income-distribution implications might be for the larger society. On the other side of the qualified median voter are those who pay less taxes and/or receive larger benefits from lifelong learning programmes. They want larger budgets, and are also dissatisfied with the quality of their schools and education funding. The 'tax price' is lower for those who stand to benefit directly.

This means that if public lifelong learning programmes are to be successfully financed, they must benefit a large enough percentage of the politically active population to achieve a majority, or be packaged with other programmes to build the necessary coalition. The problem again is that many persons who potentially could benefit do not vote. The US Census Bureau reports, for example, that in the 1994 Congressional elections where turn-out was higher than in state-level or local school elections, 63.8% of those with Bachelor's degrees voted, but only 31.3% of those with 'some high school' voted. For those with less than 6th grade, it was even lower (21.9%), as reported by Mortinson (1997).

Conclusions

Lifelong learning occurs over the life cycle, but is highly correlated with prior formal education and with characteristics whose effects can be detected in the shape of the age–earnings profiles. However, there are also non-monetary returns that can be valued based on the costs of producing these outcomes in alternative ways. There are also externalities proxied by the average level of education in the community that contribute to productivity in firms and in households of both monetary and non-monetary aspects of human welfare. All these are part of economy-wide efficiency. Better knowledge about them and improvements in their measurement can only contribute to more rational private and public decision-making.

This does not apply to income redistribution impacts of education, however. These are not Pareto moves that require that no one is worse off. They must be

valued by a political decision process in which votes are influenced by the money-weightings behind them, and by the fact that most people (who are disproportionately poor and less well educated) do not vote. This redefines the location of the qualified median voter. It falls to this political decision process to decide not just about the value of intergenerational income redistribution through education, but also decide on the value for economic growth and development purposes of the social-benefit externalities of education. In this process, even the efficiency aspects as given by cost–benefit measures that presumably include the cost-based valuations of externalities will often be ignored, as Arrow (1997) indicates.

The opportunities for the finance of lifelong learning in the future include better articulation of the marginal products of education and of economy-wide efficiency gains. They also include looking more seriously at better measurement of these marginal products of education that produce social-benefit outcomes. These need to be compared to the current costs to society of addressing these problems in other ways (e.g. welfare costs) while seeking more cost-effective solutions that also take intergenerational vertical equity into account, as Levin essentially suggests in this issue. Finally, it is likely to be necessary to use knowledge about these marginal products to build broad-based coalitions of those for whom the 'tax price' is low, or at least reasonable. There would seem to be no realistic alternative.

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Notes

1. This is also the concept suggested by the OECD Secretariat (1997, p. 3) for the forthcoming country studies.
2. The non-additivity of utility is avoided by first expressing non-market returns as a function of monetary returns for each individual, and then adding up the total returns, all expressed in monetary terms as indicated.
3. All estimates of trends in rates of return over time suggest that the pay offs to higher education have risen substantially since 1980 for whites and blacks, men and women (see McMahon, 1991; Carnoy, 1997). Using longitudinal data, Murnane *et al.* (1995), for example, for high-school seniors graduating 8 years apart from the National Longitudinal Survey 1972 and High School and Beyond 1980 surveys (which is only a short period to move up the age–earnings profile and therefore produce a somewhat lower rate of return than if the entire life cycle returns were considered), find substantial increases in the college premium. They and others also find that these are most pronounced for those with high mathematics scores (Carnoy, 1997).
4. Horizontal equity, or equal treatment of equals, raises fewer basic distribution or distributive justice issues.

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Appendix A. Cost-based Valuation of Non-monetary Benefits of Lifelong Learning

Pioneering work on the valuation of non-monetary returns, both private and externalities, has been done by Haveman and Wolfe (1994), updated by Wolfe and Zuvekas (1997). Based on their work, a very brief summary of the technique follows.

First, estimate the marginal product of education of producing a given outcome (e.g. lower poverty followed by lower crime rates) using a household production function. Appropriate controls for income, ability and family factors, and measurement error are discussed in the text.

Second, assuming that households will equate the ratio of this marginal product to its price (MP_{Sch}/P_{Sch}) to a similar ratio of each other marginal product to its price (MP_X/P_X) across all inputs, P_{Sch}, the implicit value, or price, of a unit of schooling can be determined. Rearranging produces:

$$P_{Sch} = (MP_{Sch}/MP_X) \times P_X \tag{A1}$$

Third, the marginal product of other inputs that can be purchased on the market in producing this same outcome (i.e. MP_X) must be estimated. Since these marginal products are equal (same outcome), $MP_{Sch} = MP_X$, and the willingness to pay for education to accomplish this objective (P_{Sch})will be equal to the price of the other input. In the example chosen, if the expenditure on policing or alternatively the expenditure on poverty-reduction programmes necessary to accomplish a given reduction in the local crime rate can be estimated (i.e. P_X), then the local citizens should be willing to pay this same amount for increases in the local secondary enrollment rate that would accomplish this same result.

In this particular example, three marginal products must be estimated to get the cross-partial derivative of crime with respect to poverty reduction multiplied by poverty reduction with respect to education, plus the direct effect of reducing the number of unsupervised teenagers on the streets as a result of their involvement in the school.

Other aspects of the formal solution applicable to this situation, including the relation to the household production of human capital, the time constraint, the full income budget constraint and the formation of the Hamiltonian, are discussed by McMahon (1997b, pp. 26–27). The full formal solution is set out by Heckman (1976).

This illustrates cost-based valuation of the benefits of lifelong learning extensions that arise as externalities, including direct and structural impacts. The political process, however, is, and must be, the process that decides on how much is going to be paid for these externalities. For reasons discussed in the text, the political process will frequently arrive at a valuation that is different from this valuation based on costs.

Appendix B. Imperfect Capital Markets

Capital markets for financing investment in human capital by households are imperfect, given the lack of collateral or expected capacity to make monetary repayments, especially where the private benefits to education are non-monetary, or where there are external benefits available to all, some of which are non-monetary, $E_2(t) - E_1(t)$. The result is that the borrowing rate exceeds the lending rate, and investment is constrained by the household's money income, $E_1(t)$ on the axis Z_0 (Figure 2). Under these conditions, there is under-investment at I'_H (actual investment in human capital by households, given that capital markets are imperfect, if there is no subsidy), rather than the optimal level I_H (optimal investment in human capital, $E_2(t) - \Omega$) (for example Jacoby, 1994).

To achieve the optimal level of investment at point Ω, and the higher level of household satisfaction at A (optimal level of utility achievable, requires borrowing amount ΩA with a government-guaranteed student loan programme supporting this amount of borrowing. The credit guarantee equates the borrowing rate to the lending rate. This rationale is discussed further by Hartman (1973), written at the time the large US Student Loan Program was initiated.

Alternatively, there could be public subsidy of amount ΩA to achieve the optimal level of investment. This assumes that the subsidy is repayable by taxes later (just as are loans), and that there is no government failure.