

The External Benefits of Education

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Education externalities are the public benefits of education that spillover to benefit others in the society, including others in future generations. External benefits are distinguished from private market benefits to earnings and from the private nonmarket benefits beyond earnings such as those to own health, longevity, and the quality of life. Education externalities can be either positive or negative. But with a few exceptions the evidence is that they are overwhelmingly positive.

The external benefits of education include education's direct benefits to the development of civic institutions that contribute slowly over long periods of time to the rule of law, democracy, human rights, and political stability. Externalities also include direct benefits to longevity, reduced poverty, lower crime rates, lower public welfare and prison costs, environmental sustainability, contributions to happiness and social capital, and effects from new ideas and adaptation of the results of research.

External benefits of education also include indirect effects of education that are over and above these direct benefits. Indirect effects operate through other variables and feed back over time to increase the private market and nonmarket benefits. Examples include the contribution of education to better governance, political stability, and trade that then indirectly increases growth. Indirect effects aid productivity and set the stage for new rounds of growth in the future, benefiting others and future generations. The reverse side of the coin is that earnings and well-being today are larger due to external social benefits of education from prior generations. The analysis of the dynamic process involved provides a basis for their measurement. External social benefits today continue to set the stage for growth within families and within nations.

The social benefits of education are normally defined to include the total benefits of education, including the external benefits. Therefore, private market and private nonmarket benefits, which are part of this total, must be identified so that they can be distinguished from the externalities. That is, to arrive at the total value of the external social benefits the value of each must be estimated, including the indirect effects!

In what follows, each of these concepts will be further explained as will the method of estimating their value. This is followed by a review of the empirical evidence for each, and estimates of their monetary value. The method of valuing the indirect effects will be explained, followed by considering those studies that have sought to measure

the value of aggregate education externalities without identifying each.

Distinguishing Private Market, Private Nonmarket, and Social Benefits

The external social benefits of education are not the same as nonmarket benefits. Some nonmarket benefits are private benefits, such as better own health, and some public benefits raise market earnings, such as political stability. These concepts and the methods of measuring each need to be distinguished.

The Market Benefits of Education

The market benefits of education are the additions to earnings, or in the aggregate the additions to per capita economic growth, that are due to education. These are increments to earnings above the amount earned by those with less education, measured either by a Mincer earnings function or by the full method that computes a pure internal rate of return (see McMahon, 1991). Increments to aggregate per capita growth are measured using a growth equation based recently on Lucas' (1988: 18) endogenous growth theory. His production function, including investment in human and physical capital, is normally augmented to include trade, the rule of law or political stability, life expectancy, and shocks. The direct market benefits of education that this reveals are illustrated in Figure 1, panel A-1. The indirect effects in panel B-1 result from feedback effects as education contributes through trade openness, political stability, and longevity (see McMahon, 2009: ch. 3 and Appendix D). Difference equations that incorporate lagged effects reveal these feedback effects on per capita growth over time.

The Private Nonmarket Benefits of Education

The private nonmarket benefits of education are private benefits to the student and his or her family as shown in panel A-2. (The relevant decision-making unit is regarded here to be the household. Intrafamily benefits to children therefore are private benefits. When individual pupils are regarded as independent decision-making units, as in Haveman and Wolfe (1984), benefits to children are externalities and increase the size of the externalities

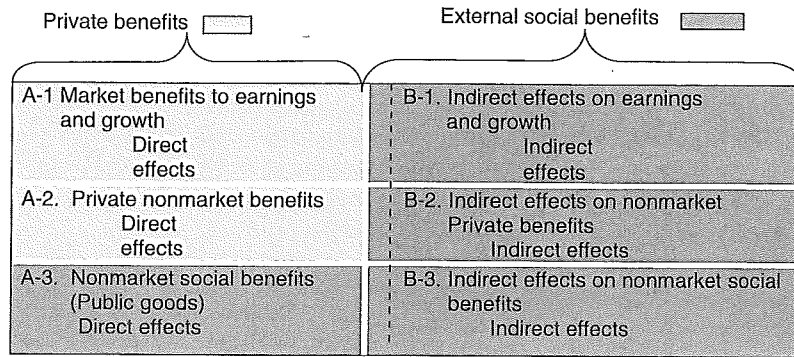


Figure 1 Total benefits of education. From McMahon, W. W. (2006). Education finance policy: Financing the non-market and social benefits. *Journal of Education Finance* 32(2), 264-284.

reported here. Similarly, the firm is regarded as the relevant decision-making unit so intrafirm spillovers are also private benefits.) They are not external benefits but instead private benefits to own health, spousal health, longevity, lower infant mortality, child health, child education, child cognitive development, lower fertility leading to smaller families, and happiness or well-being. The value of each of these nonmarket private education has a monetary value that is estimated in McMahon (2009) by methods explained below and estimates of their value are just as legitimate as estimates of the value of the earnings due to only education. The nonmarket private benefits are measured using a household production function attributable to Becker (1965). It includes per capita income since market goods are also needed to produce final outcomes. The income term in the regression controls for the market benefits of education, which permits the value of the nonmarket benefits in addition to income to be valued. There are many studies in the literature that do not include this important control, although there are hundreds of studies that do use the household production function rationale and, therefore, include per capita income. Students, families, and policymakers generally have very poor information about these nonmarket benefits and their value, leading to significant market failure (see McMahon, 2009: ch. 4).

Some of these private nonmarket benefits are indirect. For example, education contributes to own health, which in turn contributes to child education and child health (panel B-2).

The External Social Benefits of Education

The portion of direct social benefits that are public benefits are externalities because they benefit others in the society or in future generations. Public goods in public finance mean that consumption by one person does not reduce the consumption by others. Romer (1990) calls these public goods nonrivalrous. World events analysis offered by public broadcasting (PBS) is a public good,

for example, because consumption of it is not limited as others tune in. It is supported by donations but about 90% of all listeners do not contribute and are free riders. Hence, some contribution from these persons must be obtained through taxes or too little of the public service would be produced. Education is partly a public good, with external social benefits, and partly a private good, generating purely private benefits. Lucas (1988) proves analytically that with education externalities the growth rate is higher and that this is required for overall economic efficiency (the optimal solution). He suggests that the individual's investment in education is small relative to the average level in the community so the individual takes these community benefits for granted. The individual or family will not invest more in education to receive external social benefits because of this and because they spillover to benefit others and future generations. Therefore, insufficient investment in human capital formation through education is the outcome. (This discussion assumes that government failure is limited, which is sometimes challenged. However, government failure in the US and Organization for Economic Cooperation and Development (OECD) is relatively small in these democracies compared to massive government failure in providing basic education in authoritarian regimes, for example, in sub-Saharan Africa, Pakistan, Nepal, and Haiti.)

This has important public policy implications and is a second source of market failure. The value of the external benefits of education as a percent of the total benefits is a guide to the extent to which government must finance education through taxes if the system is to be economically efficient. However, efficiency is a term that is thrown around with wild abandon. Economic efficiency includes external efficiency, or how well education serves the needs and demands of society, as well as internal efficiency, and to achieve it requires providing for the production of the external social benefits of education. (Economic efficiency includes production efficiency and exchange efficiency. In the education literature, the former is usually referred to as internal efficiency, and the latter as external efficiency.

Overall economic efficiency requires both). A private for-profit college with no endowment and vocational offerings might be internally efficient, but not externally efficient, with few requirements in history, the humanities, or social sciences that encourage citizenship and public service. At the other extreme, government supported public universities with little tuition as in Europe may also not be very economically efficient. With lower resource recovery from parents and lower resources per student than in the US, either quality or access must be sacrificed. In the latter case, there may be too few graduates to serve society's needs efficiently. A related policy implication involves how far private versus public financing of higher education should go if higher education is to remain economically efficient. That is, if the external benefits of education are to be realized, then some government investment will be necessary to encourage private families to invest more. Apart from equity, this is the primary economic rationale for public support of the schools, colleges, and public universities. (Equity is an important part of the rationale for public support, but distributional issues are not externalities and so are not considered further here.)

The Indirect Effects from Education

The indirect effects from education are those that operate through intervening variables. They are part of the total market benefits, of the private nonmarket benefits, and of the social nonmarket benefits in panels B-1, B-2, and B-3 above. For example, private earnings and the quality of life are higher in part due to the education of others and the education of prior generations. Looking forward, the education of current graduates benefits the earnings and quality of life of others in future generations. However, future benefits cannot be measured directly. Instead, they can be measured based on the benefits received from the past using simulations with difference equations that have been estimated by regression methods and contain parameters that then generate time paths into the future. Estimates and simulated outcomes for many countries worldwide and for internal US Deep South states are presented in McMahon (2002, 2007), respectively.

Why Are Indirect Effects Externalities?

The indirect effects from education are externalities not only because the effects of the individual's investment in education on intervening variables such as, say, the rule of law, is small and taken for granted, the Lucas (1988) rationale, but also because many of the benefits flow to others in the society and future generations and cannot be captured by the individual, the standard definition of externalities. Therefore, families have no incentive to invest more in education in order to receive either free public benefits or indirect benefits which are also free.

Yet, these indirect effects are a significant portion of education's total benefits. The best estimate available so far is that they are about 42% of the total benefits of education (McMahon, 2002: ch. 13). Their value, shown in panels B-1, B-2, and B-3 of **Figure 1**, must be added to the value of the direct social benefit externalities shown in panel A-3 to arrive at the total value of the external benefits of education.

The Evidence: Identifying and Valuing the External Social Benefits

Studies quantifying and valuing the external social benefits of education will be discussed first, followed by studies that estimate the value of aggregate education externalities. Once the quantity of external benefits is estimated there are four methods for estimating their monetary value:

- First is the income-equivalent method developed by Haveman and Wolfe (1984). This method finds the amount of income the typical household would be willing to pay for the increase in the social benefit that results from one more year, or one more level, of education. It is based on the standard economic proposition that individuals typically adjust until the ratios of the marginal products of each good including education to their respective prices are equal. For public benefits the income-equivalent value is interpreted as the amount of income the typical household is willing to give up or vote for in support of civic institutions.
- Second is the dynamic simulation method in McMahon (2002: ch. 13, 2007). This is needed to value the indirect effects, which then can be added to the value of the direct effects to obtain total education externalities. This is explained following **Table 1** below where it is used, and more extensively in McMahon (2009: ch. IV). Then the difference equation model estimated by regression methods which contains many control variables is used to generate the total benefits of education by means of dynamic simulations. These methods are widely used in astronomy, physics, meteorology, and macroeconomic forecasting. From this is subtracted the values at each point in time given by a simulation generating only the direct effects to obtain the indirect benefits as a residual. The latter can be expressed as a percentage of the total market benefits, thereby establishing their value.
- The third method is to value the aggregate external benefits of education as in Breton (2008). This is done by estimating a growth equation based on international data to arrive at the total social benefits, public and private, from which are subtracted the private benefits estimated using Mincer earnings functions based on micro data. Aggregate external benefits have also been

Table 1 The direct external social benefits of education

Specific social benefits: Dependent variable	Value of the social benefits of bachelors	Reported coefficient ¹ of education	Reported coefficient ² of income	Control variables (see footnote ³)	Source
Democratization & pol. institutions	1,830				
Democratization	994	0.018***	0.372*	ln Y, M	McMahon (2002)
Democratization	1,726	0.0101*	0.05***	Y,M	McMahon (2009)Appendix.D,HE
Democratization	2,771	0.0114***	0.05**	Y, M	ibid, Appendix.D,OECD,Sec.Ed.
Democratization	59,982	0.00917***	0.032	ln Y, P, S	Keller (2006) ³
Democratization					Besley, Case (2003) ⁸
Human rights, civic Institutions	2,865				
Human rights	2,865	0.006*	0.194***	Y,M,D	McMahon (2002)
Political stability	5,813				
Political stability	8,625	0.0793***	0.00025***	Y,M,D	McMahon (2002; 107)
Political stability	4,041	0.0423	4.7E-04***	Y,M,D	McMahon (2009)Appendix.D,HE
Political stability	3,001	0.0849**	4.1E-04***		ibid. Appendix.D,OECD Sec.Ed.
Life expectancy	2,308				
Positive benefits	3,344	0.0504**	2.61E-04***	Y,P	ibid. Appendix.D, OECD, HE Coef.
Negative growth	590			I,T,PS,Y(70)	ibid.Appendix.D,OECD,LEXP
Positive benefits	2,452	0.0483***	2.11E-04***	Y,P	ibid. Appendix.D.OECD, Sec Coef.
Negative growth	537			ln Y,S,G,PS,t	Barro <i>et al.</i> (1995; 425.(2)) ⁹
Reduced inequality	3,110				
Greater opportunity	+ US Only				Leslie & Brinkman (1989) ⁴
Reduced inequality	-(OECD)	0.0015**		S. T.	McMahon (2009)Appendix.D,HE ⁵
Poverty reduction, Sec	3,110	-1.41***	-5.6*	Y, P, H	McMahon (2002; 115)Model
Lower crime	5,647				
Homicide	719	-15.9***	1447***	ln Y,U	McMahon (2002; 144)
All other crime	4,928	-974***	22612***	Y, GI, PV	McMahon (2002; 148)
Lower public costs	544				
Lower health costs	544				Muenning (2000, p.28) ⁴
Lower prison costs					Lochner & Moretti (2002) ⁸
Higher Tax Receipts					A market social benefit
Environment: indirect	5,609	Effects from less pop. growth & poverty, more democracy			
Cleaner water	136	-3,202**	7.79***	Y,y, P, PV,D	McMahon (2002)
Less air pollution	1,482	-1.32**	-1E+00**	Y,S,D,p,PS	McMahon (2002; 137)HE, ⁶
Less deforestation	3,991	9.9E-05*	6.7E-07**	Y,P,H	McMahon (2002) ⁶
Social capital					
Social capital	+	Education effects positive			Helliwell & Putnam (1999)
Happiness	+(?)	Effect above \$20,000		Many	Helliwell (2005)neg.effect ⁷
R&D dissemination	++				Non-mkt, apart from growth
Total soc.Benefits	27,726				Direct effect externalities

Significance level: *** = 0.01, ** = 0.05, * = 0.10

Contribution of education to economic growth in eight studies

Growth equation estimates, macro data	In 2007 dollars	Education coefficient	Source
	28,672	7.20E-03***	Barro (1998)
	18,919	0.05*	Barro & Martin (1995; 426)
	13,274	0.005*	Oliva & Rivera-Batiz (2002)
	28,379	0.075***	Keller (2006; 24), globally
	35,568	0.094**	Keller (2006; 30), HE, OECD
	9,843	0.047***	McMahon App.D,HE,OECD
	0		Benhabib & Spiegel (1994)
	0		Pritchett (2006)
Average, All studies	16,832		

Source of Table 1: McMahon (2008)

¹ Gross Enrollment Rate includes replacement investment (65% of total)

² GDP Per Capita

³ Definitions of Control Variables: (For data sources see article or book cited)

Y = GDP Per Capita

M = Military Expenditure as % of Govt Budget

P = Primary Gross Enrollment Rate lag 10 Yrs.

S = Sec. Gross Enrollment Rate lagged 10 Yrs.

H = Higher Education Gross Enrollment Rate

D = Democratization, Freedom House (2007)

G = Government Consumption as % of GDP

U = Unemployment Rate lagged two years

GI = GINI Coefficient: inequality in the distribution of income

I = Investment in Phys. Cap. as % of GDP

T = Trade Openness; exports + imports as % of GDP

PS = Political Stability, International Risk Guide

Y(70) = Initial GDP per capita in 1970

lnY = log of GNP Per Capita

PV = Poverty Rate

p = Population Growth Rate

⁴ No regression in the survey.⁵ Not included in average because income coefficient is not significant.⁶ Not included in average because education coefficient is not significant.⁷ Helliwell's income and other controls contribute to this. See McMahon (2009, Ch. IV).⁸ To get the effects of only higher education when only a secondary education coefficient is available and when there is no control for higher education, the assumptions are made that this secondary education coefficient captures both, and that four years.⁹ No income variable in the paper.¹⁰ Government consumption (reflecting social security and aging) as a percent of GDP.

estimated using panel data for US states or US cities, including a variant that uses the average level of education in the community to represent externalities based on Lucas (1988). This approach has been used by Rauch (1993), Acemoglu and Angrist (2000), Moretti (2003, 2004), and Ciccone and Peri (2006). But these have also been criticized by Lange and Topel (2006), although for reasons that Breton's (2008) newer study avoids.

- The fourth method is to examine the total social accounts in Eisner (1989). They estimate total income and total consumption that include the value of the nonmonetary qualities of life. They include the value of housewives' services, and build on earlier work by John Kendrick. However, the total accounts provide no method for separating the social benefits of education from the private benefits, or for isolating the value of the quality of life that is due only to education. For these reasons this approach will not be pursued further here.

The Value of the Direct Nonmarket Public Benefits of Education

To place a monetary value on each of the direct external social benefits based on the Haveman and Wolfe (1984: 395) method, a standard proposition in economics is that households will tend to substitute among inputs until they find relatively cost-effective ways of producing each final satisfaction. Better health, for example, can be produced by earning a bachelors degree which leads to more effective use of time in sustaining health, or it can be produced

by using time in the labor market to produce income and then to purchase doctors' services and drugs, or by some combination. As households balance these alternatives, the ratio of the marginal product of education for achieving health, $MP_{\text{education}}$ below, to its value, P_E , will approximately equal the ratio of the marginal product of income in purchasing medical services, $MP_{X \text{ market}}$ to their price, P_X :

$$\frac{MP_{\text{education}}}{P_E} = \frac{MP_{X(\text{market goods})}}{P_{X(\text{income})}} \quad [1]$$

By cross-multiplying and moving P_E to the left, this value of education for producing better health becomes equal to the ratio of the marginal product of education to the marginal product of market goods (i.e., income), times the marginal cost of the market goods, P_X , needed to produce an equivalent amount of better health. These marginal products, $MP_{\text{education}}$ and MP_X , are the regression coefficients for education and for income in a regression where the dependent variable is democratization, human rights, or some other external benefit shown in Table 1 below. The education and income coefficients are shown in columns 3 and 4, control variables that are significant in are shown in column 5, and the source of each regression is shown in column 6, so the reader can interpret each estimate.

The estimates of the value of education in Table 1 apply to the annual benefits generated by a college bachelor's degree, which is also interpreted as one more percentage point on the per capita enrolment rate. Attention is given to this in part because, in the past, some have asserted that externalities at the college level are

negligible since college graduates earn so much. But this assertion avoids analyzing the specific direct external benefits shown in Table 1, as well as the research on these, and also ignores consideration of the indirect effects from education that increase earnings. If most of the benefits listed have a roughly linear effect for one more year of schooling, whether it be at the high-school or college level, then the values in Table 1 could be interpreted alternatively as also an approximation of the external benefits from high-school graduation. The valuation must relate to some level of education if they are to be relevant to policy. To include comparable tables for primary and junior secondary education and for masters and PhD levels would expand the scope beyond that of a short article.

To illustrate how these values are estimated, the ratio of the education coefficient to the income coefficient in columns 3 and 4 of Table 1 is first calculated. This is the ratio of the marginal product of higher education in producing refinements in democracy, D , in the typical OECD country, for example, which is the $MP_{\text{education}}$ in eqn [1] above or 0.0101 empirically in Table 1 below, to the marginal product of \$1 of income, $MP_{X(\text{income})}$ or 0.05, in producing the same amount of democratization. It is this ratio that is used to obtain the income-equivalent values of the net effects from more education. So using household income as the basis for the imputation, the average annual increase in the Freedom House (2007) index for D achieved in the OECD countries from 1975 through 2004 of 0.0017 is taken to be the amount of D to be produced, either through increased education enrolments or through purchases or votes in financial support for civic institutions. Using the income coefficient in the regression, it can be estimated how much income it would take to produce the 0.0017 typical increase in D based on past experience. This turns out to cost \$55 per capita. Taking this therefore to be P_X , the price or marginal cost of achieving the typical improvement in D in the OECD countries, the income equivalent value of achieving this same outcome through increased education is estimated to be \$1726 as shown. This is fairly close to the \$1830 average of the three studies that contain education and income coefficients that are both significant. The work of skeptics is considered later.

The imputations for the value of education in improving human rights, political stability, and almost all of the other social benefit outcomes in Table 1 are made on the same basis. That is, the value of the social benefit of education is the income equivalent of achieving either by more education or by spending more income the average annual improvement in each of the other indices in the OECD from 1975 through 2004. The details for standardizing the studies in Table 1 to convert everything to 2007 dollars and to make them comparable in other respects as well as further details for each imputation appear in McMahon (2009, Appendix E).

It must be stressed that these are the direct effects, calculated directly from the regressions, which usually apply to 5-year periods, and do not include the indirect effects that feed back and build up over time to make total education externalities larger. These are considered further below. The control variables that often remove these indirect effects that are listed in column 4 and footnote 3 of Table 1 are only those that are significant at the 0.05 level. Other control variables thought to influence each dependent variable are often mentioned, but the data generally will not support their significance. There are also many studies not included in Table 1 simply because both education and income are not in the regression, or if they are, both coefficients are not significant. Another constraint is that basic research does not exist in appropriate form to value all social benefits, so there are gaps and the total value in Table 1 is conservative. Most studies have either checked for simultaneity or used instrumental variables or two-stage least squares methods. Nevertheless, this is the first effort to standardize the many studies and estimate the value of individual social benefit externalities comprehensively. Total precision is not claimed, and as gaps in the research pointed out here are filled further refinements will become possible. (All regressions control for heteroscedasticity. Those not using IV have been checked for simultaneous bias. For those from McMahon (2002), alternative specifications are reported there.)

Evidence Concerning Specific External Social Benefits

The empirical evidence on direct specific social benefits follows, with both indirect effects and efforts to estimate aggregate education externalities considered later.

Democratization

Democratization is the degree of development of political institutions at the national, state, and local levels as measured by the Freedom House (2007) index. Democratization worldwide is empirically determined as shown in line 1 of Table 1 primarily by access to education, growing per capita income, and lower military expenditure as a fraction of public budgets (McMahon, 2002: 97–101; Diamond, 1992; Clague *et al.*, 1996). Other factors are empirically less significant. Clague *et al.* find that an additional variable for Muslim religion is negatively related to democracy. But it becomes insignificant whenever literacy is included indicating that completion of basic education displaces Muslim's role. Secondary education enrolments are especially important, although for the most developed OECD member nations the effect is smaller (see rows 2 and 3 of Table 1). The reason is relative homogeneity; the variation in the democracy index is very small, the variation in enrolment rates is also small, and the result is statistically less dependable.

Using worldwide data, Keller (2006) controls for per capita income and secondary education and finds investment in higher education lagged 10 years to be a highly significant determinant of democratization ($t=3.22$). However, her income coefficient is not significant. In contrast to her result showing a large education impact, Acemoglu *et al.* (2005a) find no effects whatsoever from education on democratization. The methodology of their study, however, is not based on a dynamic view of the process since it includes no lags in education's impacts, includes year dummies which eliminate most of the effects of technology embodied in human capital, and uses school achievement that also eliminates effects from new technology embodied in replacement investment in human capital. It also uses lagged democracy as an explanatory variable that eliminates what little variation is left in 5-year movements in the very-slow-moving process of democratization. Therefore, with these problems their study is not averaged in. The Beasley and Case (2003) study cannot be included because there is no control for income.

The best estimate therefore averaging the first three studies is the \$1830 value per year of a bachelor's degree to the development and operation of civic institutions shown on line 1 in Table 1. The evolution of democratic institutions is a long, slow process. The most difficult context for showing the relation of education to democracy is within the relatively homogeneous OECD or among states within the US both because of this and because of the spatial equilibrium involved.

There are also contributions of education to behaviors such as voting that are important to democracy. The empirical evidence on this is strong and strengthens the case, but the value of these behaviors cannot be added to the value of education's contribution to overall democratization measures without double counting. Therefore, the important effects of education on contributing behaviors are not included in Table 1. To mention a few, those with more education voluntarily give twice as much of their time and twice as much of their money at each income level to civic institutions as do those with a high-school education or less, where only 12% give (Hodgkinson and Weitzman, 1988; NCES, 2005). There are also large positive effects on voter participation, support for free speech, and the quality of civic participation, the latter as indicated by the frequency of news readership (Dee, 2004). Tastes are shifted away from drag racing, dog fighting, and TV game shows, and toward world affairs. UK college graduates have also been shown in tracer studies of graduates to exhibit greater racial tolerance, less cynicism, and less unquestioned support for authority than those with only high-school education (Byner *et al.*, 2003). These graduates engage in more lifelong learning about public affairs' importance to good citizenship and social capital. More education also increases support for democracy in Muslim countries based on micro data by Shafiq (2009).

Human rights

Human rights are a public good that is very important to the quality of life. As measured by Freedom House's (2007) index of civil rights it includes freedom of the press, freedom of speech, freedom of assembly, the legal protections of *habeas corpus*, trial by jury, freedom from unlawful searches, freedom from unlawful incarceration, protections from torture, reasonable equality of opportunity, and limited corruption. All require an effective criminal justice system and civic institutions. In worldwide data, human rights depend significantly on secondary education, higher per capita income, lower military expenditure as a percent of the government's budget, and on democracy (McMahon, 2002: 103). The highly significant effects from democratization mean that human rights are important benefits of democracy.

The value of education's contributions to human rights is estimated to be about \$2865 per year for each bachelor's (or high-school graduate) in Table 1. Other studies of education's contribution to human rights are very limited and also do not control for income (e.g., IHEP, 2005). Contributing behaviors discussed above also contribute to human rights. But their value cannot be added to the total without overlap.

Political stability

Political stability is measured by the comprehensive index from the International Country Risk Guide (2007) that includes both political and economic risk. Stability is generally agreed to be an important determinant of economic growth (Barro and Sala-I-Martin, 1995: 426; McMahon, 2002; Oliva and Rivera-Batiz, 2002). Political stability is significantly dependent on education, per capita income, lower military expenditure as a percent of government budgets, and democracy (McMahon, 2002: 105–110). However, although growth depends on political stability, stability is not 100% dependent on democracy in the regressions. Singapore, China, and Dubai, for example, are all authoritarian and yet growing rapidly. However, as growth continues and education spreads, the pattern may follow South Korea and Taiwan. Both were authoritarian after World War II; extended basic education and promoted growth; and both became full democracies in 1980. In contrast, Pakistan grossly underinvested in basic education to the point that a majority of the labor force and 95% of rural women are illiterate. From 1980 to 2008 it remained a military dictatorship, with low per capita income.

The value of each bachelor's contribution to political stability after controlling for income is estimated to be \$5813 per year in 2007 dollars in Table 1.

Life expectancy

Increased life expectancy is a positive private benefit of education in many studies (McMahon, 2009: ch. 4). However, the contribution of education to longevity in aggregate data can also be regarded as a social benefit. This is

most obvious in the poor countries where life expectancy is very low, and many die before reaching the most productive years in their life cycle. The value of the net effects from more of education is estimated to be \$3110 per year in Table 1. But from this has been subtracted the negative effect on economic growth of increasing longevity in the OECD countries, estimated to be the average of the \$590 and \$539 estimates shown. The latter is a negative externality. The \$537 estimate uses Barro's government consumption, a proxy for life expectancy because it reflects the social security and health expenditures for an aging population. (The per year value is estimated by spreading out the value of the number of years of increased life expectancy over an average of 65 years remaining in the life cycle.)

Reduced inequality and lower poverty

Inequality in the distribution of income is increasing dramatically in the US and in other OECD countries. It is related to inequality earlier in access to education as shown by Psacharopoulos. More recent studies also show that remarkable increases in earnings inequality in the US, UK, and OECD since 1980 is linked with human capital skills in dealing with new technology (Faggio *et al.*, 2008).

Reducing high-school dropout rates also reduces inequality (Levin, 2006: 9). In higher education, Leslie and Brinkman (1988) conclude that increased access in the US reduces inequality except in states where the tax systems are regressive as in Florida and Mississippi. In the OECD countries, however, higher education contributes to greater inequality as shown in Table 1. Admissions are restrictive in many European universities, 2-year associate degrees are far less widespread, and need-based aid is less available. Therefore, although increased access to higher education reduces inequality in most states in the US, it probably does not in Europe because of policies related to less need-based aid and proportionally fewer in associate degree programs.

Poverty is reduced, however, by economic growth, increased high-school completion, and increased access to higher education. The value of this direct effect is estimated to be \$3110 per year for completion of college degrees in Table 1.

Lower crime rates

The effect of education in reducing crime rates and criminal justice system costs has received more attention than other externalities. Witte's (1997) review reveals that further education of those who have started on a life of crime is of limited effectiveness, whereas reducing high-school dropout rates and increasing 2-year college enrolments that cause young males to be under supervision in school (and in employment later) are effective. The value of high-school or college graduation in reducing murder

rates (violent crime) and property crime (all other crime) after controlling for per capita income, lagged unemployment, inequality, and poverty is estimated to be \$719 per year per graduate for lower murder rates, and \$4928 per year per graduate for all of the many other kinds of crime. Higher education contributes to white-collar crime, a negative externality, but this has been netted out against education's positive benefits in reducing overall crime. Lochner and Moretti (2002) do not control for income.

Lower public health, welfare, and prison costs

Education reduces public welfare costs. Only 0.5% of all college graduates receive public assistance or Aid to Families with Dependent Children (AFDC) compared to 5.6% of all high-school graduates. The percentage of college graduates on welfare is 16.6 percentage points lower than those that stop short of high-school graduation (NCES, 1992). Muennig (2000: 28) estimates the lifetime savings in public costs of uninsured populations to be \$11,077. When converted to 2007 dollars, his present value (he uses a 3.5% discount rate) is \$544 per year over 45 years after graduation as shown in Table 1. (His present value for each student completing 2 years of college is \$6317.) Muennig's estimate means that welfare costs to state governments could be reduced by about two-thirds if all students completed high school. They would be reduced by 91% if all high-school graduates completed a bachelor's degree. Education policy would dramatically augment welfare reform that has sought to move welfare recipients into often unskilled work.

The decrease in criminal justice system costs, and larger state and federal tax revenues from increased high-school completion are also found to be enormous in studies reported by Levin (2006). This evidence of external benefits from public support of schooling in poor districts benefits residents of wealthier districts by lowering their public welfare, prison, and health care system tax costs while also increasing tax revenue from others.

Increased tax receipts

Education dramatically increases income, sales, and property tax receipts in estimates by Rouse (see Levin, 2006). They are external social benefits, but not included in Table 1 which is confined to nonmarket benefits. Taxes are already included in standard social rates of return based on earnings.

Environmental benefits

Many effects of education on the environment are indirect. There are direct effects of secondary education in reducing water pollution, but the indirect effects of education through lower poverty and increased democratization are greater. Together, they offset the adverse effect of income growth, so that education's direct effects plus indirect effects on balance reduce water pollution.

The per graduate annual value of education's contribution to cleaner water is estimated to be \$136 in Table 1.

Similarly, although growth has adverse effects, there are net positive contributions of education to reduced air pollution and slower deforestation. The value of education's annual contribution to reduced air pollution and, probably, global warming is estimated to be \$1482 in Table 1. Education's contribution to reforestation and wildlife habitat is estimated to be \$3991. However, the coefficient for education's net effect has a lower level of significance, so this estimate may be too high. Most of education's net effects after controlling for income growth on the environment are indirect through lower fertility, slower population growth, and more democratization.

Happiness and social capital

There are many studies that show that education has a positive effect on happiness, known earlier as subjective well-being. But few of these control adequately for per capita income. Happiness not only is a private benefit of education, but it also is known to benefit others by contributing to greater social cohesion and social capital (Helliwell, 2005). The latter are external social benefits.

Happiness is now measured cardinally based on brain waves. It is known to increase with income up to about \$20,000 per capita, or \$80,000 for a family of four, but not beyond that (Layard, 2006). Education contributes to earnings and therefore indirectly to happiness up to this point. But beyond that, the basic research on education's effects on happiness and social capital at family incomes above \$80,000, where the income effect flattens out, is missing.

However, some informal inferences can be made. This is because education is well known to contribute to most of the major sources of happiness, and hence to social capital. These sources include genes; some persons are born to be happy, and others to be unhappy. However, beyond this, happiness increases with the better selection of a mate, less unemployment, lower divorce rates, better civic institutions, better human rights, less crime, better health, and a better work environment, all of which are positive functions of the level of education (Layard, 2006). The bottom line, however, is that there must be further research, especially on education's effects on happiness and social capital through these intervening variables and also at family incomes over \$80,000.

Dissemination of technology

Probably the largest external social benefit of higher education is left to last. It is the benefit to the broader society from the embodiment in graduate students and undergraduates of new knowledge created by research and development (R&D) in all academic fields and disseminated by them as they take teaching jobs in other institutions or jobs engaged in creating new ideas (Jones and Romer, 2009). Utilization of most modern knowledge

and technology in production is very complex, requires advanced education, and has little effect on the economy unless the means to use it are disseminated. Knowledge from throughout the world is accessed by faculty engaged in research and embodied in students at masters, PhD, professional, and undergraduate levels, who later disseminate it to other colleges, government agencies, and firms. This basic complementarity between human capital and R&D is stressed by Griliches (2000: 88) and fundamental to Romer's (1990) endogenous growth model. Unfortunately, it is too often overlooked in studies of the relation of education to growth. However, an important fraction of the external social benefits from research are also external social benefits from higher education. It is not possible to place a value on these, but the value of the knowledge embodied in the number and skill levels of postgraduate students may be a promising approach.

The Value of External Indirect Effects

The total value of the direct external social benefits of education in Table 1 is estimated to be \$27,726 per year. These direct benefits per year per degree are not the total benefits from the average level of education in the US, and also do not include the indirect effects.

The indirect effects of education operate through other variables to set the stage for growth of earnings and non-market benefits later. To estimate these, a dynamic simulation is first run using regression equations that control for other significant variables to generate the total benefits of education over the rest of the life cycle, say 40 years. Then a second simulation is run with the indirect effects suppressed, giving only the direct effects (i.e., the cross partial derivatives are set to zero). These direct effects then are subtracted at each point in time from the total benefits leaving only the indirect effects. Expressing the indirect effects as a percent of the market benefits (and as a percent of the value of the private nonmarket benefits as in McMahon, 2009: ch. 4) which establishes their value. Based on McMahon (2002: ch.13, pp 228–242) where this is done, the value of the indirect benefits is about 42% of the value of the market benefits – 42% of the market benefits is \$10,540 in 2007 dollars (panel B-1), and 42% of the value of the private nonmarket benefits is \$15,993 (panel B-2). Therefore, the total value of the market plus nonmarket indirect benefits is estimated to be \$26,533 per year.

The Total Value of Education's External Benefits

Adding the \$27,726 of direct public-good-type benefits from Table 1 to the \$26,533 of indirect benefits (part of which are future values) gives a total estimated value of all of education's external benefits of \$54,259. This addition

is possible because all regressions considered control for per capita income so the direct public good benefits do not overlap the market benefits. Indirect benefits, however, do overlap private benefits since some private benefits are due to the education of others and to the education of earlier generations. (It is assumed that the indirect social benefits (panel B-3) are included in the other indirect effects.)

External social benefits, as a percent of the total benefits from education, is a matter of interest to public policy. If the total benefits are \$90,902 per year for a bachelor's degree in 2007 dollars, composed of \$25,096 in earnings increments (the average over the life cycle for males and females based on Census data from McMahan (2009: ch. 3)), \$38,080 in private nonmarket benefits (McMahan, 2009: ch. 4), and \$27,726 in direct social benefits from Table 1, then the external benefits of \$54,259 are 59% of this total. If the indirect effects simulated over a 40-year period were discounted back to their present value, they would be smaller. However, the total net effects of education would also have to be discounted back to the present. Therefore, the 59% would not be much affected.

Studies of Aggregate Externalities

The third method of estimating the value of the external benefits through studies of aggregate education externalities involves macro regressions of education's effects on growth. Either a social rate of return is estimated using a macro growth equation and the private Mincer return estimated from micro earnings data is subtracted to obtain the net externalities, or else a macro growth equation is estimated that contains the average education level in the community that represents the externalities. Obviously, if education is found to contribute nothing to growth in the macro growth equation, there are no externalities. Therefore, either of these aggregate approaches involves getting into the education and growth literature.

The results of various growth equation estimates are summarized in Table 1 (continued). Benhabib and Spiegel (1994), Acemoglu *et al.* (2005a), and Pritchett (2000, 2006) cannot find that education contributes anything to growth, and there are therefore no externalities. The details of these studies are reviewed elsewhere. (See McMahan (2009: chs. 3 and 4) and the cross-referenced growth entry below.) However, briefly, there are many other studies that show significant contributions of education to growth, six of which are summarized in the continuation to Table 1. The three zero-return studies mentioned have in common that they use a static conceptual view, eliminating education's role in the dissemination of new technologies. They do this by using time dummies, using school attainment measures that exclude

technology embodied in human capital replacement investment which is about 68% of the total, and using controls eliminating education's indirect effects through democracy and political stability. The further severe problems with the Acemoglu *et al.* study were discussed above under democratization. Lange and Topel (2006: 479) in their thorough recent review conclude that there is "little evidence in favor of *negative* external returns to education," and that recent studies "cast doubt on the earlier studies by Benhabib and Spiegel and Pritchett who argue for small or even zero aggregate returns to schooling."

The aggregate approach to externalities has most frequently been applied using differences among US states or US cities. But questions can be raised as to whether externalities can ever be found using this type of data. There are two problems: there is little variation because of homogeneity within countries in slow-moving variables such as democratization, human rights, and stability. Second, Lange and Topel (2006: 505) conclude "that this type of evidence is inherently flawed as it does not sufficiently account for endogeneity issues implied by the spatial equilibrium in Rauch, 1993; Acemoglu and Angrist, 2000; and Moretti, 2003." In other words, worker mobility among localities responds to exogenously imposed differences in demand and earnings differences are not due just to prior human capital investments.

Studies based on differences among nations such as Breton (2008) or those as in Table 1 are not subject to these problems. There is less worker mobility among nations and greater differences in democratization, human rights, political stability, and education since some countries are at earlier development stages. So with proper controls for other factors there is enough variation to estimate statistically meaningful coefficients. Using cross-country data, Topel (1999) and Heckman and Klenow (1997) estimate aggregate education externalities by first estimating a growth equation and then subtracting the private returns to schooling based on Mincer regressions from individual earnings data. Topel's estimate is a 23% social rate based only on market returns and Heckman and Klenow's is 30%. After the average private Mincer return of 8.3% is subtracted, this leaves 14.7% and 21.7%, respectively, for the external benefit. This offers useful insight but has two problems. It is biased upward because it does not control for other things that affect growth; and it is biased downward because it does not include the externalities related to nonmarket private and social benefits. They seek to correct for the former by introducing life expectancy and time dummies as proxies for technology. The problems are that life expectancy subtracts from growth in the OECD countries because an aging population shrinks the labor force and increases social security costs. Moreover, time dummies again imply a static interpretation that rejects the role of education in disseminating technology. With these very debatable controls, no externalities are left.

In his later eclectic review of world data Pritchett (2006) considers OECD data. He does not recognize this role of life expectancy, control for oil shocks, or include the role of technology through replacement investment in human capital. He again finds no positive contributions of education to growth and hence no externalities. Larger positive and roughly comparable effects of education on growth are found by Keller (2006), Barro (1998), Barro and Sala-I-Martin (1995: 426), Oliva and Rivera-Batiz (2002), and McMahon (2009: Appendix D), all in Table 1 (Continued), and also by McMahon (1998), the World Bank (1993), and many others.

In a recent thorough study Breton (2008) using international data that avoids twin problems of spatial equilibrium and of homogeneity within a single country that plagued earlier studies estimates the market-based social rate of return to be 22% in the US and 24% in the UK. He uses instrumental variables to avoid simultaneous bias, with the percent of the population that is Protestant as the somewhat debatable instrument for education. He uses cumulative investment expenditure on education to reflect quality and not just quantity that dominates attainment measures. Subtracting the private Mincer return based on micro earnings data he finds the residual pure external social benefit rate to be 10.6% in the US and 16.2% in the UK, close to Topel's 14.7% and Heckman and Klenow's 21% above. However, Breton's study is also confined to only earnings benefits. So if an imputation is made for the private nonmarket benefits, then his external social benefits as a percent of the total benefits is 57% for the US and UK. This is almost identical to the 59% external benefits as a percent of the total that we have independently obtained above through analysis of the specific external social benefits and indirect effects.

Implications

With the cautions mentioned earlier, these estimates suggest that public support of education should be a little over 50% of the total costs on average to provide for these external social benefits. Total investment in human capital formation includes foregone earnings costs borne primarily by parents as they support room and board costs and not just institutional costs. At the high-school level, public investment is very close to this, a little over 50% on average, although the public share is lower for private schools and higher for public schools (where foregone earnings costs are less than half the total). At higher education levels, public support is less than 50% on average. This suggests overall that the trend toward privatization in financing higher education through higher tuition and fees may have gone far enough if overall economic efficiency that includes external benefits is to

be maintained. Of course, there is wide variation. Public support of community colleges is above 50% when Pell Grants and Stafford Loans are considered. Some private universities have large endowments which support external social benefits. But for most 4-year public colleges and universities and for the less-well-endowed private institutions public support plus endowment support has fallen significantly below 50% in recent years.

In conclusion, education externalities are not the same as nonmarket benefits; some externalities raise monetary market benefits, and some nonmarket benefits are purely private and not social externalities. Many specific non-market external social benefit externalities are poorly understood and undervalued. When corrected social rates of return are calculated, they are much higher than conventional rates based only on earnings benefits. Poor information about what they are and their value is a significant source of market failure and underinvestment in education, both by households and by governments.

From a dynamic perspective, the external social benefits from education set the stage for each new round of growth and broader development within families and within nations over time. The process is cumulative so that the short-term effects of education, including the external benefits, are smaller. But they grow as interactions and feedbacks occur to the point that they can be extremely important to the future of both individual families and of nations.

See also: Education and Civic Engagement; Education and Crime; Education and Economic Growth; Education and Health; Education Production Functions: Concepts; Human Capital; The External Benefits of Education.

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Relevant Website

- <http://netfiles.uiuc.edu/wmcmahon/www>. The EXCEL spreadsheets used to estimate the value of the non-market social and private benefits of education can be downloaded.