Fiscal Studies (1999) vol. 20, no. 4, pp. 351–386

This is the second in a commissioned series of survey articles from distinguished academics covering the economic issues in public spending.

Education and Public Policy

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Abstract

This article surveys the literature on education as a matter of public policy. We present international comparisons of expenditure on education and then discuss the contribution of education to economic growth, distinguishing between growth accounting and regression approaches, but concluding that the picture is still confused. We assess the risky nature of investment in higher education and also discuss the link between educational experience and social class. We show that this, when studied in aggregate, accounts for less than half of the persistence of earnings between fathers and sons but it nevertheless does a good job of relating fathers' and sons' occupations. Finally, we look at the link between education and earnings in the UK. For most subjects, the private return to university education has held at over 15 per cent p.a. despite the introduction of fees. However, some subjects offer a negative return.

JEL classification: I20, J24, J31.

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The authors are grateful to many people for helpful discussions. In particular, Mike Biggs, Jacques Dreze, George Kapetanios, Sig Prais, Rebecca Riley, Richard Smith, Mario Tirelli and Dirk te Velde have been extremely helpful with various aspects of preparing this paper. Financial support from the Economic and Social Research Council under grants R022 251064 and L138 251022 is gratefully acknowledged.

I. INTRODUCTION

In this survey, we aim to discuss the economic aspects of education and to evaluate the relevant facts, in the UK and across comparable industrial countries.

Economists usually concentrate on the productive aspect of education; it is the most important way by which societies can, and do, invest in human capital.[1] The fact that education increases the skill levels of individuals and contributes to the rise and spread of technological progress is beyond dispute. One may ask, nevertheless, how large these effects are, who pays the costs and who obtains the benefits. It is a type of investment where public financing is substantial, even in countries where the level of state participation in economic activity is otherwise low. The proportion of education financed by central, state or local governments is at least 75 per cent in the major industrial countries and is often in the region of 95 per cent. There are several good economic reasons for this to be the case. In this survey, we evaluate the quantitative importance of these reasons and their implications for public policy, both actual and potential.

Education generates higher incomes for private individuals; it is generally believed that the whole is more than the sum of its parts and that the social returns to education exceed private returns. Better-educated workers are likely to be more productive at their own jobs; they may, at the same time, raise the productivity of their colleagues, by demonstration, discussion or dissemination. The importance of peer-group effects of this kind are self-evident in our everyday tasks of teaching and research. Their importance has valuable implications for the role of public financing as well as for the organisation of education. Economic reasoning says that private individuals are likely to underinvest in activities that generate *positive externalities*. The importance of peer effects, and other externalities, is critical in determining location, districting and access rules for the state school system, as well as the choice of target schools or universities for preferential funding.[2] An argument with similar economic flavour relies on the fact that the provision of education may display *economies of scale* — the education of, say, the 51st pupil in a class imposes negligible costs. This sort of argument is of particular importance in policy debates on class sizes. In Sections III and IV, we review the available evidence on the private and social returns to education; we have little to say, as yet, about returns to scale in its provision.

A second justification comes from the facts that the returns to education are risky and that private individuals may underinvest because of their inability to diversify the resulting *income risk*. The argument is typically made for higher education (see, for example, Kodde (1986)). The likely increase in skills and productivity depends on inherent ability as well as chance. The possibility of the

[1]For a sociological critique of this, see Fevre, Rees and Gorard (1999).

[2]Benabou (1996) evaluates the effects of such rules on the distribution of earnings in the presence of peer externalities.

former implies that the latter cannot be insured and that the income risks must be borne by the worker. Anticipating this, a school-leaver may choose not to go to university, which is a high-return investment with high risk. Public subsidies to higher education lower the cost of the investment; the taxes used to finance these subsidies may succeed in lowering the associated risk. We evaluate this argument in Section V.

The arguments so far speak to the relative efficiency of public education. The third reason calls upon *equity* and is of special relevance to school education: public financing is important if school-age children cannot borrow against future incomes to finance their own education. Otherwise, the quantity and quality of education will be entirely dependent on their parents' ability to pay. Loury (1981) makes a persuasive argument that, in the long run, the inequitable is, in fact, inefficient, because purely private financing lowers the average skill level far below its potential. In Sections VI and VII, we review the issue of distributional effects of public expenditures on education and the evidence about its implications for intergenerational mobility, both economic and social.

Data for about a dozen OECD countries allow us to make comparisons. By virtually any criterion, the UK does not do well in these comparisons. The proportion of national income spent on education is much lower than in other English-speaking countries or in Northern Europe. A relatively small proportion of this is spent on higher education: the UK has the lowest expenditure rate in our sample. Arguably, the returns to educational spending are likely to be high at earlier stages; which is not the same as saying that higher education should be starved of funding. In Section III, we present the costs and benefits of university education and, for five countries, quote figures for the rate of return.

The OECD data measure aggregates. In the presence of selective higher education, these estimates may overstate the return to an expansion of higher education, because of selection biases on ability as well socio-economic backgrounds. In Section VIII, we report a more careful analysis of the British experience. The rates of return are indeed lower — but, for most subjects, compete well with an assumed return on physical capital of 7–9 per cent p.a.

There remains the crucial question 'Who should pay for this?'. As we argued before, the case for substantial public funding is relevant to primary and secondary education. There is less of a case for higher education, on equity as much as efficiency grounds. The gains from higher education are appropriated by the graduates; and, even now, there remains a participation bias in higher education, with more students from better, and higher-income, backgrounds.[3] Should the median taxpayer subsidise the future earnings of the relatively privileged?

[3]Tables 9 and 10 emphasise this. Around 40 per cent of university graduates have parents with professional qualifications.

The alternative is higher fees: an increase of fees raises real concerns about the possibility of tilting the scales even further against children from poorer backgrounds. The experience of the US — which has substantially higher intergenerational mobility than the UK, despite a large fee-based university system — may reassure us on this count.[4] Certainly, a student loan system is financially feasible. There may be good arguments for public administration of such a system, where the fee is paid back as a graduate tax. Taxation, unlike loans, can be equitable and impose fewer risks on individuals. Indeed, it is reasonable to imagine a rationalisation of the structure of fees, by which medicine or engineering degrees are charged differently from humanities degrees. We evaluate the suggestion in Section VIII. For the moment, we aim to establish whether this is a desirable direction of change; we have not attempted a full fiscal analysis of the alternative policy packages.

TABLE 1

Spending on Education as a Percentage of GDP: All Levels

Per cent

	1990		1995	
	Total	*Public*	*Total*	*Public*
Australia	4.9	4.3	5.6	4.5
Austria	—	5.2	—	5.3
Belgium	—	4.8	—	5.0
Canada	5.7	5.4	7.0	5.8
Denmark	6.4	6.2	7.1	6.5
Finland	6.4	6.4	6.6	6.6
France	5.6	5.1	6.3	5.8
Germany	—	—	5.8	4.5
Ireland	5.2	4.7	5.3	4.7
Italy	—	5.8	4.7	4.5
Japan	4.7	3.6	4.7	3.6
Netherlands	—	—	4.9	4.6
New Zealand	—	5.5	—	5.3
Norway	—	6.2	—	6.8
Spain	4.9	4.2	5.7	4.8
Sweden	—	—	6.7	6.6
Switzerland	—	5.0	—	5.5
UK	—	4.6	—	4.3
US	—	—	6.7	5.0
OECD	—	—	5.9	4.7

Source: OECD, 1998.

[4]See, for example, Dearden, Machin and Reed (1997).

II. EDUCATION EXPENDITURES

Just how much do countries spend on education? Tables 1 to 4 summarise the very broad facts about educational expenditures and their financing. These and other cross-country aggregates are from OECD (1998).

The Scandinavian countries have the highest levels of spending on education as a proportion of GDP although not per pupil in absolute terms; most education is financed by the state, irrespective of level. The US has a relatively low level of public participation; while this is no surprise, the total expenditure (public and private) is one of the highest. For purposes of comparison, expenditure rates in the UK are among the lowest in the sample, and particularly so for university education: indeed, it is an outlier in an otherwise clear picture of Anglo-Saxon bias towards higher education. These facts are of particular importance in evaluating rates of return, as we do next. The fact that overall expenditure rates in the UK are typically unavailable is unfortunate and due to the absence of systematic accounting of private school expenditures.

TABLE 2

Levels of Education: Spending as a Percentage of GDP, 1995

Per cent

	Primary	*Secondary*	*University*	*Other tertiary*
Australia	1.6	2.1	1.5	0.3
Austria	1.2	2.7	0.9	0.1
Canada	2.1	2.2	1.5	0.9
Denmark	1.3	2.6	1.1	0.2
Finland	1.8	2.4	1.3	0.3
France	1.2	3.2	1.1	—
Germany	1.8	2.1	1.0	0.1
Ireland	1.3	2.1	1.3	—
Italy	1.1	2.1	0.8	—
Japan	1.3	1.7	0.9	0.1
Netherlands	1.2	2.0	1.3	—
Spain	1.8	2.3	1.0	—
Sweden	2.0	2.5	1.7	—
UK	—	—	0.7	—
US	1.8	2.0	2.0	0.4
OECD	1.6	2.1	1.5	0.3

Note: Data missing for Belgium, New Zealand, Norway and Switzerland.
Source: OECD, 1998.

TABLE 3

Public Funding as a Percentage of Expenditures, 1995

Per cent

	School[a]	*Tertiary*[b]	*All*
Australia	87	65	79
Austria	98	—	97
Belgium	100	—	—
Canada	94	61	82
Denmark	98	99	98
France	93	84	91
Germany	76	92	78
Ireland	96	70	90
Italy	100	84	97
Japan	92	43	75
Netherlands	94	88	93
Spain	87	76	84
Sweden	100	94	98
UK	—	72	—
US	90	48	75
OECD	91	75	86

[a]Includes primary and secondary.
[b]Includes university.
Notes: Data missing for Finland, New Zealand, Norway and Switzerland. Based on final funds after transfers.
Source: OECD, 1998.

We note that 28 per cent of education expenditure at the secondary level in the UK is accounted for by private schools, which are attended by about 10 per cent of all secondary pupils (see, for example, Biggs and Dutta (1999)); the per capita expenditure on a private education is thus more than three times that in state schools. This is relevant to our discussion on distributional effects (Section VI); it may also be a partial indicator of the nature of scale economies in education provision.

III. THE RETURN TO EDUCATION

The most basic economic analysis of education is conducted in terms of the returns to education. Spending on education is an investment which can be looked at in the same way as any other. One can work out either the increase in income per year of stage of schooling completed or the return to particular types of education, comparing the earning power of graduates with that of those who leave education with A levels. Estimation of these differentials is notoriously

TABLE 4

Expenditure per Student, 1995

US dollars

	Primary	*Secondary*	*University*
Australia	3,121	4,899	11,572
Austria	5,572	7,118	7,687
Belgium	3,270	5,770	6,043
Canada	—	—	12,217
Denmark	5,713	6,247	7,656
Finland	4,253	4,946	7,412
France	3,379	6,182	6,569
Germany	3,505	6,543	8,101
Ireland	2,144	3,395	7,249
Italy	4,673	5,348	4,932
Japan	4,065	4,465	9,337
Netherlands	3,191	4,351	9,026
New Zealand	2,638	4,120	8,380
Spain	2,628	3,455	4,966
Sweden	5,189	5,643	13,168
Switzerland	5,893	7,601	18,365
UK	3,328	4,246	7,225
US	5,371	6,812	19,965
OECD	3,595	4,971	12,018

Notes: Data missing for Norway. Conversion to US dollars at purchasing power parity.
Source: OECD, 1998.

difficult, and actual estimates cover a very wide range. Psacharopoulos (1993) quotes figures for the private return to higher education ranging from 0.7 per cent p.a. in Canada for humanities degrees (estimated in 1985) to 48 per cent p.a. for social science degrees in the UK in 1971.

The calculated figures are, however, typically based on the cross-section data of a survey of earnings in a particular year. The returns are calculated on the assumption that the income differences observed in that particular year persist throughout the remaining life of someone choosing whether to pursue a particular course of study or not. This in turn means that there may be substantial fluctuations in returns from one year to the next, so that claims about the temporal behaviour of earnings differentials must be treated with caution. For example, Mincer (1994) quotes figures for the rate of return to college education in the US that show the return falling to below 4 per cent p.a. in 1979 and then recovering to over 10 per cent p.a. by 1986. As there are no confidence intervals

provided, we have little to go on to determine the extent to which this is mere sampling variation. Since the return falls gradually from its level of around 9 per cent p.a. in the mid-1960s and recovers steadily from its low point, it does seem that there is a real fall and then rise in the premium. On the other hand, Willis (1986) quotes rates of return to higher education in the US for the same period; these do not show the decline in the late 1970s that Mincer explains.

In any calculation of this type, there is real concern as to how much the observed differences in earnings or employment reflect innate differences in ability rather than schooling. Three of the 11 post-War Prime Ministers (Sir Winston Churchill, Lord Callaghan and Mr Major) had not been to university. If they had, any calculation of the effects of university education would have included their and similar successes in it. There are a number of other biases that can creep into the calculations. Some argue that earning power depends on social background; but so does the likelihood of going to university. The effect of social factors may well inflate the measured return to education. As universities ration places by performance, graduates are unlikely to represent a random draw from the population of A-level students. Three As at A level are probably a very good predictor of future performance; relatively few students with three As choose not to go to university.

A number of corrections have been made for these biases. For example, Harmon and Walker (1995) look at the return to secondary education in the UK by comparing those who stayed at school into the fourth form both before and after the 1947 and 1973 raisings of the school-leaving age. This method plainly cannot be applied very generally. Other studies have looked at the differences between twins (see, for example, Ashenfelter and Krueger (1994)). There are questions over estimation methods used. Blackburn and Neumark (1995) argue that, provided early indicators of ability are introduced, ordinary least squares estimation offers a satisfactory result. Blundell, Dearden, Goodman and Reed (1997) use a 'matching' approach, with ability test scores at age seven among the regressors, along with other background and demographic variables designed to control for the other factors affecting the education decision; their careful study of the cohort represented in the National Child Development Survey means that their methods cannot be used for snapshot calculations from less detailed data sources.

Evaluating Costs and Benefits

University education takes time during which teaching costs are incurred and wages are not earned. After taking a degree at university, a graduate decides whether or not to take a job, and finds one with some probability. In fact, a university education raises the rate of labour force participation, as well as the

TABLE 5

Costs and Benefits of a University Education

	Annual cost (US$)[a]	*Average duration (years)*	*Labour force participation rates (%)*		*Unemployment rates (%)*		*Earnings differential*	*Income differential*	*Private rate of return (% p.a.)*	*Social rate of return (% p.a.)*
			(S)	(U)	(S)	(U)	(U)	(U)		
Australia	11,572	3.1	90	93	6	4	61%	70%	14	11
Canada	12,217	4.8	89	92	9	5	52%	59%	14	9
Denmark	8,157	3.6	89	94	6	4	55%	67%	8	8
France	6,569	6.2	90	92	8	6	85%	93%	20	13
Germany	9,001	5.3	85	93	8	5	52%	72%		
Ireland	7,249	3.5	92	94	6	3	71%	80%		
Italy	4,932	4.4	80	92	6	5	73%	101%		
Netherlands	9,026	3.4	87	90	3	3	35%	40%		
New Zealand	8,380	3.3	93	93	3	2	71%	73%		
Spain	4,966	5.0	91	91	12	9	45%	50%		
Switzerland	18,365	7.9	94	95	3	5	46%	45%		
UK	7,225	4.2	89	94	8	4	61%	77%		
US	19,965	4.2	88	93	6	2	83%	102%	11	10

[a]Annual expenditure per full-time-equivalent student converted to US dollars at purchasing power parity.
Note: All figures are for men aged 25–64 in 1996.
(S) refers to those with secondary education only.
(U) refers to those with university education.
Source: OECD, 1998.

probability of finding a job. It is certainly associated with increased earning on the job, once found. All of these contribute to a greater expected income for a graduate; this higher income is earned for the many working years remaining.

In Table 5, we show the costs and benefits of university education. First of all, we present the cost of education per annum, with local prices converted to US dollars at purchasing power parities, and the average duration of university education. We also report differences in labour force participation and unemployment rates. We indicate the overall income differential per year associated with a university education, for a selection of countries for which the raw data are available. This is calculated from published earnings differentials (also shown in the table, averaged over all age-groups), adjusted for the different participation and unemployment rates experienced by those with university education relative to those with only upper secondary education. Finally, we present, for the small number of countries for which they are available, the estimates of the private and social rates of return to university education calculated by the OECD. The private rate of return is the discount rate that equates the private cost of education — measured as any fees that students have to pay, plus the loss of post-tax earnings due to university attendance but less any maintenance grants paid — to the benefits of education, measured by the increase in earnings, again after tax and other deductions and after adjusting for differential participation and unemployment. The social rate of return compares the social costs and the social benefits. The former include the cost of providing university education, whether it is borne by the student or not, and the value of earnings lost before any deductions. The social benefits are measured by the increase in gross earnings, adjusted for participation and unemployment effects, but do not allow for any external benefits of education.

The rate-of-return figures are not available very widely. In Section VIII, we add our own estimates of the position in the UK in 1995. However, the data shown here do suggest that the social return to higher education, at around 10 per cent p.a., is comparable to or slightly above the social return to physical capital. This may be a reason for countries to expand their higher education provision somewhat. The private rates of return suggest that, for any suitable individual, investment in higher education is a very good deal. Private returns are higher than social returns because governments bear some of the costs of higher education. In view of these data, one might ask, at least for the countries for which data are available, whether this is reasonable.

IV. EDUCATION AND ECONOMIC GROWTH

We deduced, in the previous section, that higher education is a good investment. Here, we ask a slightly different question, motivated by the fact that Microsoft and other similar high-tech and high-growth firms are partly the *consequence* of high-quality education. What is the measured effect of education on

technological progress and economic growth? We review the evidence in the light of growth accounting methods, which follow Solow (1957), and in the context of growth regressions, popularised by Baumol, Blackman and Wolff (1989) and Barro and Sala-i-Martin (1995).

Growth in output, or GDP, is due in part to growth inputs and in part to technological progress which allows societies to produce more from the same resources. Solow (1957) provides an elegant decomposition. Suppose g_y is the rate of growth of aggregate output and g_L and g_K are the rates of growth of aggregate inputs of labour and capital. We can measure the rate of total input growth as a weighted average of g_L and g_K, the weights being the expenditure shares of each factor.[5] Call this $g_I = \lambda g_L + (1-\lambda) g_K$, with λ being the share of wages in national income. g_I measures input growth; the remaining growth in output is attributable to technological progress. This remainder is often called the (Solow) residual, and growth effects of phenomena *other* than labour and capital are quantified by their relation to this residual. Education, to the extent that it enhances productivity of individual workers, should appear in an appropriate measure of g_L, the growth of labour input; its external effects, on technology growth, should then appear a second time, in the residual. At this point, regression analysis is valuable in measuring the overall impact. Roughly, a relation between individual education and individual productivity represented by earning power measures 'level effects' — more education raises the level of income — while a cross-country link between residual growth and education measures potential 'growth effects', as the level of education may affect the rate of technological progress and output growth.

1. Growth Accounting

Education affects human capital; how should we account for this in growth accounting?

A first answer suggests that the effective quantity of labour used in production should be measured in efficiency units, rather than in, say, man-hours. If g_L is the rate of growth of the effective labour force, it must depend on the rate of growth in hours worked, say g_n, and the rate of growth of labour quality due to education, say g_e. The real question here is how the latter should be measured. If an average graduate is paid twice as much as a school-leaver with O levels, and if it is assumed that rates of pay reflect marginal productivity, it would be sensible to give graduates twice as much weight as workers with O levels. An approximate means of making this calculation is offered by the next

[5]The method is fully justified if production displays constant returns to scale and each factor is paid its marginal product. Even otherwise, it provides a reasonable accounting device to measure technical progress.

equation, from Mincer (1974); here, s is years of schooling, x is years of work and y is income:

$$(1) \qquad \log y = 6.20 + 0.107s + 0.081x - 0.0012x^2 .$$

Equation 1 suggests that earnings increase by 10 per cent for every year of schooling, providing ready-made weights for consolidating a labour force built up from people with varying levels of education. It also draws attention to the fact that separate corrections must be made for changes to the age structure of the labour force.[6]

The calculation described above suggests that one type of labour is a perfect substitute for another type of labour: one graduate can always replace two school-leavers with O levels. This assumption is, to say the least, open to criticism. A slightly different approach, suggested by Mankiw, Romer and Weil (1992), is as follows. Suppose that skilled labour, with higher education, and unskilled labour are separate factors, both necessary for production. It is a simple task to extend the growth accounting method to a three-factor production function, and thus measure growth in labour input as the weighted sum of growth in these two components. Input growth is now defined to be $g_I = \lambda_s g_s + \lambda_u g_u + (1 - \lambda_s - \lambda_u) g_K$: the subscripts s and u refer to skilled and unskilled labour respectively and $\lambda_{\cdot}$ are their factor shares. Human capital is then just another factor in the aggregate production function. Mankiw, Romer and Weil estimate λ_u and λ_s to be about one-third each, which provides a useful mnemonic and reconciles the usual stylisation that λ_L is two-thirds. Importantly, the calculation assumes constant returns to scale. If factors are paid their marginal product, the social return on human capital formation is simply the sum of private returns.

There have been a number of studies of this sort which have identified the contribution of education to economic growth. Matthews, Feinstein and Odling-Smee (1982, p. 113) suggest that, between 1873 and 1924, the UK's effective labour force was increasing at 0.5 per cent p.a. due to the spread of education, after a rate of 0.3 per cent p.a. between 1856 and 1873. The rate increased to 0.6 per cent p.a. between 1937 and 1964 and fell back to 0.5 per cent p.a. between 1964 and 1973. Over the whole period from 1856 to 1973, the actual growth in man-hours worked was 0.2 per cent p.a., with a larger population offset by a shorter working week. But the effective labour input increased by 1.2 per cent p.a., with changes in the age, nationality and sex mix contributing 0.2 of a percentage point p.a. and changes in the intensity of work adding another 0.3 of

[6]The estimates presented by Ashenfelter and Krueger (1994) suggest a higher return, of the order of 12–16 per cent per year of schooling, but the difference is not statistically significant.

a percentage point p.a. in addition to the effects identified above. Thus, improved education accounted for almost half of the identified growth in the labour input in the UK between 1856 and 1973.

Denison (1967) compares levels of education and their variation in the US with those in eight European countries (Belgium, Denmark, France, Germany, Italy, the Netherlands, Norway and the UK) with a view to understanding why growth rates differed. He concludes educational differences tended to hinder the European countries relative to the US, despite the fact that per capita growth was faster in Europe. Thus output per person employed grew 2.08 percentage points p.a. faster in Germany than in the US, but –0.41 of a percentage point was accounted for by education. The quality of the US labour force improved much faster than that of Germany's.

These observations illustrate that, while education can have an important effect on economic growth, it is not necessarily the most important influence: in Germany, non-residential capital formation accounted for +0.62 percentage points p.a. of the difference, and it can easily have an impact in the opposite direction from the overall difference in economic growth. From a public policy perspective, the observation that increased education leads to higher output is no more useful than the observation that investment in manufacturing leads to more manufacturing output. The key policy question is whether investment in education offers a good return to society at large. Growth accounting methods assume that all returns can be privately captured; the social rates of return in Section III measure the accounting rate of return in this situation. For evidence on external effects, we turn to the now considerable body of regression evidence.

2. Regression Methods

In the last 10 years or so, the careful growth accounting method for estimating the effects of education on economic growth has lost favour and been replaced by a much broader-brush regression method. Suppose we observe growth in output and in labour and capital inputs for a range of countries. In regression format, the Solow equation writes as

$$(2) \qquad g_{yi} = \lambda_L g_{Li} + \lambda_K g_{Ki} + \gamma_i + u_i ,$$

where the subscript i refers to a typical country in the sample. This equation can be estimated, and the quantities $\gamma_i + u_i$ yield the productivity growth residual. Clearly, estimation is meaningful only if the residual is uncorrelated with input growth. Many difficulties arise with the measurement of capital and its depreciation. Nevertheless, the approach is useful if we aim to quantify the growth effects of some relevant variables, or policy decisions, by positing that γ_i depends on these. If, for example, it is suspected that education levels have

growth effects, the natural hypothesis is $\gamma_i = \alpha + \beta e_i$, with e_i the level of educational attainment.

Quite a large number of such regressions are estimated by, and reported in, Barro and Sala-i-Martin (1995). They conclude that education — and especially publicly funded education — does have significant growth effects. These effects can be attributed to secondary and to higher education levels. An increase in education expenditures by 1 per cent of GDP increases growth rates by 0.15 of a percentage point; in later work, Barro (1998) suggests a yet higher estimate. An extra year of secondary or higher education, which represents (say) a 10 per cent increase in expenditures, will raise growth rates by 1 percentage point per year. It may be useful to compare this with Table 2. A single percentage point of GDP on secondary and higher education is the difference between Italy and the US, and this makes sense from what we imagine about their rates of technological progress; but it is also less than the difference between the UK and Ireland, with Ireland having the higher expenditure rate, which would recommend caution in interpretation. Quantitative reliability apart, these results suggest that the social rate of return may be much larger than the returns we quote.[7]

Benhabib and Spiegel (1994) conduct a careful analysis, measuring the incremental effect of the *level* of education on the rate of technological progress, correcting for the effects of other variables likely to be correlated with it. Their results suggest that the effect of education is indirect: it is associated with greater levels of research and development expenditures, higher rates of innovation and higher rates of new technology adoption. Once these factors are included, the growth effects of education are no longer significant. A quantitative analysis requires measurement of these intermediate inputs, which we have not attempted in this study. The important issue here is that these indirect effects can be priced and need not be pure externalities.

Clearly, the quantitative importance of education externalities is not yet established beyond doubt. They do, probably, exist; the available data present serious difficulties with measurement. Data on years of schooling are typically unavailable and equations were often estimated using the proportion of adults who had attained a particular level as a 'proxy'. Second, in many such regressions, the initial level of educational attainment, rather than its change, is used as an explanatory variable. The meaning of this can only be imagined. Consider a growth regression being carried out for a panel that includes a large number of developing countries, most of which had very little education in 1940. If the proportion attaining a particular level in 1960 is used in place of growth in attainment, the coefficient is very difficult to interpret. Even if enrolment rates stay constant at the 1960 level, the proportion of the working-age population

[7]Regression analysis suggests that growth effects are of constant elasticity form, i.e. $g = e^{\gamma}$. This form displays decreasing returns, and hence higher returns at lower levels of investment.

with school education will rise steadily between, say, 1960 and 2000, as uneducated people leave the labour force and are replaced by educated people. Thus, depending on the education policy and the demographic structure, any level of education at the start of the period may be closely correlated with the increase in the education attainment of the labour force during the period of concern. Barro and Sala-i-Martin (1992) do provide information on number of years of education. They show, for example, that, over the period 1960–85, the average number of years of schooling per worker in the OECD rose from 6.5 to 8.6. Using Mincer's value of a 10 per cent increase in output for each extra year of education, this implies that the effective labour force rose by 0.8 per cent p.a. on average as a consequence of improved educational standards, with UK experience slightly below the OECD average, as indeed it is for most educational spending indicators.

Judson (1998) provides further empirical support for the link between education and economic performance and growth, with more detailed analysis. She suggests that the effect of education spending on economic growth depends on how that spending is allocated between primary, secondary and higher education. An efficient allocation equates the returns to the marginal pupil in each of the three types and she is able to calculate the extent to which countries depart from an efficient allocation. Countries that allocate their education spending efficiently find that education supports economic growth; those that are very inefficient find that it does not.

There is never a last word on a topic of this sort; Temple (1999) accurately reflects the unease with empirical analysis of education and growth with the phrase 'there is much work still to be done on the role of human capital'. It is difficult to disagree. Certainly it would be verging on the foolhardy to make policy on the strength of the estimates so far available.

V. RISK AND HIGHER EDUCATION

It is often believed that higher education, or skill acquisition, is risky. The risks cannot be fully diversified. As a result, individuals may underinvest in training. This is an argument partly for providing subsidies to private individuals, which most European governments routinely practise by paying for higher education from the government budget. Partly, it is an argument for a careful design of income taxation, to reduce the associated risks.

The economic argument is a relatively straightforward application of the economics of uncertainty and asymmetric information. Suppose individuals differ in innate ability, which here captures all characteristics relevant to being a more productive skilled worker. Typically, individuals know their own ability

better than others do.[8] Suppose that productivity, employment and incomes depend on this innate ability as well as on pure chance. It is the latter that is risky and potentially diversifiable. Outsiders — including insurance firms, or banks handing out student loans — cannot observe the former *ex ante* and so are unable to distinguish pure bad luck from bad judgement of the person's prospects, *ex post*. Indeed, cheaper loans or insurance may be likely to attract pools of low-ability workers. In response, income insurance is not offered or is offered at prohibitive premiums. Skilled workers must thus bear income risks. If skill premiums are risky, individuals may choose to invest less often, or lower amounts, in human capital than in the presence of income insurance.[9]

There are three steps in the argument, each in need of quantification. Are skill premiums risky and by how much? To what extent are they non-diversifiable? What is the extent of underinvestment?

There are relatively few answers as yet available. First, the question of risk. We know that labour incomes are uncertain; for the argument to hold water, it should be the case that the incomes of skilled workers are *more* uncertain than those of unskilled workers. From our own earlier work, on the British Household Panel Survey, we know that this claim is simply not true. In Dutta, Sefton and Weale (1999), we evaluate a model of income dynamics fitted separately to individuals with and without higher education. It turns out that the variance of incomes for those with higher education is lower than that for the rest, a finding echoed in our study of the General Household Survey described in Section VIII. As skill premiums are positive (about 17 per cent), higher education yields higher return with lower risks, and its coefficient of variation is 0.83, compared with 0.68 for the secondary-school-leavers. These estimates, being based on panel data, partially correct for individual-specific ability effects.[10]

This would suggest that there is not much to worry about. The second question is particularly difficult to answer, as it asks about the extent to which individuals can, and do, insure against income uncertainty; in other words, how large is the benefit from full income insurance, and is this larger for skilled workers? Consumption studies routinely report failures of the permanent income hypothesis (see, for example, Campbell and Mankiw (1991)). Theoretical or simulation work suggests that the welfare cost of these failures may be quite small, especially with higher income groups, as saving provides a significant method of self-insurance (see, for example, Sefton, Dutta and Weale (1998)).

[8]This may well be disputed, given the battery of tests and examinations that the average person takes until the age of 18 and the volumes of data produced in psychometrics.

[9]This argument adapts the framework of Rothschild and Stiglitz (1976). Spence (1976) suggests that higher education performs an important role in signalling the ability of students, which function is hampered if education is subsidised.

[10]These numbers are for steady-state distributions associated with the estimated non-linear dynamics. Skill premiums are more risky for individuals at the very top of the ability distribution, whose earnings are also much higher.

We can thus conjecture that the costs of bearing risk actually fall, rather than rise, with higher education, because average incomes are that much higher.

Finally, does the prospect of risk discourage prospective students from attending university? This may seem an odd question, given our findings that a university education may lower the burden of risk. Kodde (1986) estimates the direct impact of perceived risks on the education decisions of Dutch school-leavers. Students were asked to report their likely income prospects if they took a university degree; these were then correlated with the participation decision after correcting for observable characteristics. Notice that risk perceptions are subjective, rather than deduced from observed income variations for different sorts of degrees. Nevertheless, his findings are counter-intuitive: perceived risks do not reduce the decision to participate in higher education. Indeed, coefficient estimates are often positive rather than merely insignificant.[11]

Insuring Human Capital

The line of argument pursued above has clear implications for how to pay for higher education. We have seen earlier that the return to higher education accrues privately to the skilled. Certainly these returns are high enough, on average, for higher education, and its expansion, to be fiscally sustainable. In the following, we summarise an argument made by Kodde (1986).

Consider two distinct ways of paying for university education. In the first, a student is asked to pay a fixed charge, which may depend on the nature of the degree taken, is payable out of future income, but does not depend on actual income or labour force participation.[12] This mimics the structure of a pure student loan with each degree separately priced. In the second, individuals pay a graduate tax; the *tax rate* may be degree-specific (for example, 10 per cent for a medical, law or engineering degree but 2 per cent for Ancient History); the actual amount paid depends on income earned, so that an engineering graduate who works as an (unsuccessful) musician pays relatively little by way of tax, though more than he or she would have paid for a degree in music. The latter method provides income insurance which the former does not. Indeed, efficient tax rates can be set in order to offset fully the extent of underinvestment. The structure now adopted in the UK is a hybrid. Graduates have a fixed amount to repay after graduating and they contribute 9 per cent of their income above £10,000 in each year to repaying their debts. It follows that very low earners and those who do not participate in the labour market do not face any repayments.

[11]An increase in riskiness may actually increase, rather than decrease, investment; this is true if risk aversion increases with income. Most studies of attitudes towards risk suggest that this is not the case.

[12]Indeed, the poll tax introduced in the late 17th century did have charging rates that depended on qualifications. It proved no more durable than either its predecessor or its successor.

VI. EDUCATION AND INEQUALITY

One of the important *political* arguments for state intervention in the provision of education — especially school education — is equity, within and across generations. If education is expensive, only the rich can afford it. The poor remain poor because they do not have access to the quality (and quantity) of education available to the rich.

This argument hinges on imperfections in capital markets. If the main cost of education is income forgone, and if extra education raises subsequent earning power by a constant proportion independently of each individual's potential, then the financial return to education will be the same for most individuals. If individuals — parents or their children — are able to borrow, considerations of equity become irrelevant. In light of our earlier results, virtually every parent could deduce that a good education provides a better investment than most physical or financial assets, and certainly pays for bank loans at the usual interest rates they face.

The source of imperfections in the capital market are not difficult to deduce. Children cannot inherit debts; nor can parents underwrite a debt obligation for under-age children. Clearly, this particular difficulty is important for school, rather than university, education. Galor and Zeira (1993) suggest a plausible story of why higher education may be subject to similar borrowing constraints. Typically, banks charge a premium on lending over borrowing rates, partly to account for costs due to non-payment and its prevention. Individuals who face different borrowing and lending rates borrow less often, and the incidence falls on the education of the poor.

Loury (1981) considers an efficiency argument for state intervention in the presence of imperfect capital markets. Imagine that the effect of education on labour productivity and earnings has decreasing marginal productivity. If so, the return on education expenditures is likely to be exceptionally high for the poor, who have little to spend and cannot borrow. To illustrate the point, suppose every parent is willing to spend 5 per cent of his or her income on his or her children's education. Aggregate productivity is higher if 5 per cent of national income is spent uniformly on the education of all children, relative to a situation where every child gets an education costing 5 per cent of their parents' income and no more. A society with fully state-funded schools will have higher growth than one with fully private education. Persson and Tabellini (1994), in yet another growth regression, find empirical support for this hypothesis: state education reduces inequality, and inequality is harmful for growth.

Chiu (1998), following Meade (1937), suggests a different mechanism whereby the cost of education is higher for students from poor than from rich backgrounds. He assumes that the capital market is imperfect, so that individuals cannot smooth out their consumption over their lifetimes. This raises the utility cost of education to a poor student and implies, once more, that underinvestment

is more likely for poorer students. Hence, inequality is harmful for growth. It also follows that policies such as student loans will lead to an increased demand for post-compulsory education. Eeckhout (1999) provides a microeconomic model that yields similar conclusions. It is unclear whether the fear raised by Meade — that people will dislike loans because of the resulting loss of control of their lives — has been removed by the expansion of home-ownership and consumer credit.

These analyses of education and inequality have looked at education as though it is a single indivisible commodity. The reality is that quality varies considerably. It is often believed that richer people have better access to education for their children, either by living in areas with better schools or by educating their children privately. Biggs and Dutta (1999) show that the degree of participation in the private sector is likely to be fairly sensitive to the amount of public spending. If private education is better than state education, the ability to afford it is an important factor leading to a high correlation between parents' incomes and children's incomes. The authors suggest that, with plausible parameters, raising the proportion of GDP spent on education by the state from 5.5 per cent to 6 per cent will reduce the correlation between parents' incomes and children's incomes from 0.6 to 0.2, and produce a much more equal distribution of incomes, reducing standard measures of inequality by almost a half. At the same time, they suggest that there is a U-shaped link between public spending on education and national income. With a high level of public spending, everyone uses the state system and the level of human capital is high. Lower levels of spending reduce the educational quality of those in the public sector but drive more children into the private sector. Initially, the first effect dominates while, for further reductions, the second effect is stronger again and national income begins to rise.

There is, of course, a related issue over the quality of schooling provision and what makes good schools. Do the poor have access to poor education because state education is badly run? We do not give this topic the space that it deserves but limit ourselves to one account (Prais, 1996a). The London Borough of Barking and Dagenham for many years had schools that delivered poor results. In 1990, it decided to improve its schools and joined forces with the National Institute of Economic and Social Research to study school teaching in Zürich. There, as in Barking, there are problem schools teaching children from poor backgrounds in a language that is not their mother tongue. But levels of attainment seemed much higher. Inspectors and teachers from Barking visited Swiss schools to study how the Swiss taught and to develop, from this, new methods of teaching Maths to primary school children. Over the last four years, the attainment levels of Barking children in Maths at age 11 have risen from 10 points below the national average to the national average. This average has also risen sharply over the period. Generalising from one experiment is, of course,

dangerous, but teaching teachers how to teach may be cheap compared with some of the other suggested ways of improving school quality.[13]

VII. SOCIAL MOBILITY AND INCOMES

There is a considerable body of evidence suggesting that there is a strong link between the earnings of parents and those of their children and also that the link is greater in the UK than in the US. A certain amount of caution is needed because the range of estimates is fairly wide. But in the UK, the evidence from the National Child Development Survey suggests that 33-year-olds in 1991 inherited about half of the relative earning power of their fathers in 1974 (Dearden, Machin and Reed, 1997). This might be taken as evidence to support the view that inequality persists across generations. In this and the following section, we look at the interaction of this with social mobility and educational attainment.

Table 7 shows the Markov matrix for social mobility in Britain. Each entry represents the probability of a male child in full- or part-time work being in a particular socio-economic group as a function of the socio-economic group of his father. The data are taken from the 1991 General Household Survey, the last to record this. The table shows the mean of the log of the income of the people in each socio-economic group, μ_j, and also its standard deviation, σ_j. An interesting comparison can be made with the similar data for 1949 presented by Prais (1955). His figures, reproduced in Table 8, show that (a) there is a much greater chance that the sons of male manual workers will also be manual workers and (b) a much larger proportion of the steady-state population are manual workers. The proportion of sons of male professional and managerial workers who become manual workers has not changed much. Thus *embourgeoisement* has disproportionately benefited the sons of male manual workers.

TABLE 6

Key to Occupations in Tables 7–11

P	Professional
E	Employer / Manager
NM1	Non-manual, intermediate
NM2	Non-manual, junior
M1	Skilled manual
M2	Semi-skilled manual
M3	Unskilled manual

[13]The most notorious of these is reducing class size. Politicians often argue that classes need to be smaller. They do not explain how they know this; the evidence does not support it (Prais, 1996b).

TABLE 7

The Social Transition Matrix in Great Britain, 1991

Son's occupation	Father's occupation							
	P	*E*	*NM1*	*NM2*	*M1*	*M2*	*M3*	*Steady state*
P	0.27	0.12	0.11	0.14	0.06	0.05	0.02	0.11
E	0.27	0.33	0.21	0.23	0.17	0.17	0.15	0.23
NM1	0.17	0.17	0.26	0.16	0.11	0.09	0.09	0.15
NM2	0.07	0.12	0.11	0.15	0.07	0.05	0.10	0.09
M1	0.15	0.19	0.19	0.19	0.39	0.39	0.43	0.27
M2	0.06	0.07	0.12	0.12	0.16	0.22	0.15	0.13
M3	0.02	0.01	0.01	0.02	0.05	0.03	0.06	0.02
Mean log income	9.86	9.83	9.59	9.31	9.38	9.08	8.89	
Standard deviation (log income)	0.49	0.54	0.45	0.65	0.48	0.61	0.78	

Note: Key to occupations is given in Table 6.
Source: 1991 General Household Survey.

TABLE 8

The Social Transition Matrix in England, 1949

Son's occupation	Father's occupation							
	P	*E*	*NM1*	*NM2*	*M1*	*M2*	*M3*	*Steady state*
P	0.39	0.11	0.04	0.02	0.01	0.00	0.00	0.02
E	0.15	0.27	0.10	0.04	0.02	0.01	0.01	0.04
NM1	0.20	0.23	0.19	0.11	0.08	0.04	0.04	0.09
NM2	0.06	0.12	0.19	0.21	0.12	0.09	0.08	0.13
M1	0.14	0.21	0.36	0.43	0.47	0.39	0.36	0.41
M2	0.05	0.05	0.07	0.12	0.17	0.31	0.24	0.18
M3	0.02	0.02	0.06	0.06	0.13	0.16	0.27	0.13

Note: Key to occupations is given in Table 6.
Source: Prais, 1955.

The table allows us to estimate how much of the persistence in incomes is a class phenomenon. We assume that the son of a man in socio-economic group i is randomly allocated a socio-economic group, with P_{ij} — the probability of being in group j given a father in group i — being shown in Table 7. Second, we assume that the log income of each person in j is drawn randomly from a normal distribution with mean μ_j and standard deviation σ_j. We set up a panel of 5,000 dynasties, each indexed by the subscript n, and simulate it for 10 generations. By the end of the 10 generations, the social distribution has converged to its steady

state and we can link the incomes of those in the 10th generation to the incomes of those in the 9th generation using the regression

$$(3) \qquad y_{n,10} = \alpha y_{n,9} + \beta + \varepsilon_n .$$

If the link between father's and son's socio-economic group were the main factor explaining the link between father's and son's income, we would expect to see a value of α approaching that found from the National Child Development Survey. In fact, with the parameters set out above, we find α=0.16. In other words, the link between fathers' and sons' incomes is very much stronger than can be explained simply by the persistence of socio-economic groups. It has the implication that the sons of male managers are better managers, or at least better-paid managers, than the sons of male manual workers. Social class effects summarise about a third of the link between fathers' and sons' earnings.

Education and Social Mobility

But, for the component associated with social class, we can examine whether education plays a positive role, using the framework described by Boudon (1973, Ch. 4). In Table 9, we show the probability that a male child currently in full-time work reached a particular level of education. The table shows clearly the well-known fact that the sons of male professionals and managers are much more likely to go to university than the sons of male unskilled workers. We denote by V_{ij} the probability that someone from socio-economic group i reached education level j. Table 10 shows the probability that someone with education level j is in socio-economic group k. We denote this by W_{jk}. If it is the case that males with fathers from socio-economic group i are randomly allocated across educational attainment with probabilities given by V_{ij}, and that people with particular educational attainment are randomly allocated across their own socio-economic group with probability W_{jk}, then it follows that the elements of the Markov matrix linking fathers' and sons' socio-economic groups are given by

$$(4) \qquad Q_{ik} = \sum_j V_{ij} W_{jk} .$$

The resulting transition matrix is shown in Table 11. A comparison of this with Table 7 indicates the extent to which the link between class and education explains social transition. Plainly, the tables are reasonably similar, but without a clear alternative hypothesis it is difficult to say how good the model is. This comparison of Q_{ik} with the actual transition matrix, P_{ij}, indicates that a model that attributes lack of social mixing to education does a reasonable job in explaining the observed social transition matrix.

TABLE 9

Probability of Educational Attainment by Father's Socio-Economic Group (male child currently in full-time work)

Son's educational attainment	Father's occupation						
	P	*E*	*NM1*	*NM2*	*M1*	*M2*	*M3*
Degree	0.42	0.22	0.27	0.18	0.07	0.05	0.05
HE < degree	0.15	0.16	0.20	0.18	0.13	0.09	0.05
A levels	0.18	0.17	0.15	0.15	0.13	0.10	0.07
GCSE A–C	0.15	0.21	0.20	0.21	0.19	0.19	0.15
GCSE D–G	0.02	0.07	0.04	0.06	0.11	0.11	0.11
None	0.07	0.18	0.14	0.20	0.38	0.45	0.56

Notes: Key to occupations is given in Table 6. HE = higher education.

TABLE 10

Probability of Socio-Economic Group Classed by Education

Father's occupation	Son's educational attainment					
	Degree	*HE < degree*	*A levels*	*GCSE A–C*	*GCSE D–G*	*None*
P	0.40	0.14	0.07	0.03	0.01	0.01
E	0.30	0.32	0.29	0.25	0.17	0.14
NM1	0.24	0.19	0.14	0.10	0.04	0.04
NM2	0.02	0.05	0.08	0.10	0.04	0.04
M1	0.03	0.26	0.36	0.40	0.56	0.48
M2	0.00	0.03	0.06	0.11	0.15	0.21
M3	0.00	0.00	0.01	0.02	0.03	0.08

Notes: Key to occupations is given in Table 6. HE = higher education.

TABLE 11

A Synthetic Matrix of Socio-Economic Mobility Probabilities

Son's occupation	Father's occupation						
	P	*E*	*NM1*	*NM2*	*M1*	*M2*	*M3*
P	0.21	0.13	0.15	0.12	0.07	0.05	0.04
E	0.28	0.25	0.27	0.25	0.22	0.20	0.19
NM1	0.18	0.14	0.15	0.13	0.10	0.09	0.07
NM2	0.05	0.06	0.05	0.06	0.06	0.05	0.05
M1	0.22	0.32	0.28	0.33	0.40	0.42	0.43
M2	0.05	0.09	0.07	0.09	0.13	0.14	0.16
M3	0.01	0.02	0.02	0.02	0.04	0.04	0.05

Note: Key to occupations is given in Table 6.

It would be too soon to conclude from these results that equal access to the education system would provide equal employment opportunities for all. But the similarity between the synthetic and actual transition matrices does suggest that, if the sons of men in the different social classes had similar educational chances, then the inheritance of social class would be much reduced. There is plainly a great deal to do in this respect, and one might regret the tendency to blame the élite institutions rather than the educational system and cultural environment in general for this. If many state schools leave children with the belief that they will not fit into Oxford or Cambridge Universities, one could reasonably ask 'What is wrong with the school system?' rather than, as the question is usually put, 'What is wrong with the ancient universities?'.

Even though the social transition matrix allows us to identify less than half of the persistence between fathers' and sons' incomes, it does appear that this component of the persistence at least is partly due to the lower take-up of A-level and higher education by the sons of male manual workers. Unless one believes that this reflects hereditary characteristics, it represents a waste of resources that public policy should offset. The rates of return identified in our analysis of OECD data suggest that public action is likely to prove a good investment.

VIII. HIGHER EDUCATION IN THE UK

In fact, considerable progress has been made in expanding the scope of higher education over the last 15 years. In this section, we examine whether, despite this, it still offers a good investment for an individual.

In 1995, 26.6 per cent of 19- and 20-year-olds were undertaking full-time higher education (with 21.8 per cent at universities). In 1987, the comparable figures were 12.4 per cent of the population with 10.3 per cent in universities and polytechnics.[14] Thus the proportion of the cohort at university has approximately doubled over the period. Table 12 shows how the proportion of working men with the relevant qualifications has changed since 1981. This obviously lags the expansion of the throughput of the higher education system. But, at the same time, we can see a visible tendency for older men to improve their qualifications. The proportion of men aged 40–49 with degrees in 1996 is markedly higher than the proportion of 30- to 39-year-olds 10 years earlier.

While this has happened, expenditure per student has fallen sharply; the increase in student numbers has been achieved with little real increase in overall expenditure. Teaching expenditure per student in 1985–86 was £8,470 per student in the then universities. In polytechnics and other local authority colleges, it was £4,250. In 1990, the figure for universities was £7,680 and in the polytechnics (excluding other local authority colleges) it was £4,810. In 1996–97, the expenditure per student was £4,790. All these figures are in 1998 prices.

[14]The polytechnics and universities were merged in 1992.

TABLE 12

Men's Qualifications and Earnings

Percentage of male cohort qualified to level shown

	Degree				A level			
Age:	*20–29*	*30–39*	*40–49*	*50–69*	*20–29*	*30–39*	*40–49*	*50–69*
1981	8.2	11.3	6.7	5.8	18.5	10.8	6.2	4.1
1986	12.5	15.2	11.9	9.2	19.6	13.9	6.9[a]	
1991	10.3	13.5	15.7	10.2	20.8	16.1	11.1	7.3
1996	15.3	18.3	21.1	11.6	25.3	17.2	15.3	10.6

Median earnings (median of whole population = 100)

	Degree				A level			
Age:	*20–29*	*30–39*	*40–49*	*50–69*	*20–29*	*30–39*	*40–49*	*50–69*
1981	103	161	218	249	93	123	135	119
1986	103	164	176	183	90	111	120[a]	
1991	116	164	189	183	85	121	122	115
1996	107	167	165	160	81	119	119	116

[a]All men aged 40–69.
Source: General Household Survey.

The shift from student grants to loans yields an additional saving. Expenditure on all maintenance grants reached £840 million in 1985–86 (in current prices) and rose only to £1,250 million in 1996–97 despite the increase in student numbers. With the almost complete abolition of higher education maintenance grants from Autumn 1999, this is set to fall to around £300 million. Loans to students are still treated as expenditure in the public accounts, so these data are misleading as to the true extent of student support.

Table 12 also shows median earnings of men in each age-group relative to median male earnings in the economy as a whole. The data are shown for both graduates and A-level non-graduates with no other higher education qualification. These figures do not give the impression that graduate salaries have been depressed by the expansion of graduate numbers for younger workers, although they have fallen for men over 40. The data for A-level workers may indicate that their position has worsened relative to the median, raising the prospect that oversupply of A-level non-graduates has damaged the market.

A fuller perspective can be obtained by looking at the rates of return to university degrees. We estimate the return to graduates in 1995, as compared with those with two or more A levels who leave the full-time education system at that point. The basic equation we estimate relates earnings to educational attainment. We look at whether the person has any GCSE grades A–C or equivalent, and take account of the number. We also identify people who have

two or more A levels, but no degree, who have below degree-level higher education and we distinguish those who gained their degrees by attending universities or polytechnics. The equation is estimated only for people in full-time work, and therefore indicates the benefit of a degree for someone who works full-time. A preliminary run suggested that we could consolidate non-medical degree subjects into the three groups shown in Table 13, with medicine as a fourth subject. Each of the dummy variables enters in two forms, as a level effect and multiplied by the age of the individual,[15] but in the regression we present, we have suppressed insignificant variables; this also meant that the distinction between universities and polytechnics was not maintained. We explored a role for dummies multiplied by age squared but did not find any. Apart from the fact that qualification dummies are used instead of years of study, the equation has the form suggested by Willis (1986). We also tested whether men under 30 earned significantly less than the model predicted, as a means of examining whether the expansion in graduate output since 1985 had depressed wages. There was no evidence of this: a dummy was positive but insignificant. The equation is estimated by ordinary least squares. Data limitations mean that it is not possible to allow either for sample selection issues or for endogeneity of education choices.

While the equation presented in Table 14 gives 'plausible' results, there is one aspect in which it is very peculiar. It does not show the heteroscedasticity that one would expect. If earnings of individuals followed something close to a random walk, then the variance of the residuals should be a function of age. If the effect of a degree on the earnings of individuals is uncertain, then the variance of the earnings of graduates should be higher than that of those of non-graduates, unless there is an adequate negative correlation between the effect of

TABLE 13

Classification of Subject Groups

Group A	*Group B*	*Group C*
Subjects allied to medicine	Engineering	Biological sciences
Agriculture	Architecture etc.	Humanities
Physical sciences	Mass communication	
Maths and computing	Education	
Social studies		
Business studies		
Design		
General courses		

[15]The use of both level and age-interactive dummies means that it does not matter a great deal whether the equation is in terms of age or work experience.

TABLE 14

The Determinants of Men's Earnings in 1995

Dependent variable: log of annual equivalent earnings

	Coefficient	*Standard error*	*t statistic*
Age	0.1030	0.0051	20.3
Age^2	–0.0012	0.0001	–19.3
ZGCSE × Age	–0.0022	0.0007	–3.1
NGCSE	–0.0156	0.0086	–1.8
NGCSE × Age	0.0009	0.0003	3.5
ALev × Age	0.0038	0.0009	4.4
OHE × Age	0.0039	0.0006	6.7
DegA	0.1043	0.0393	2.7
DegC	–0.2044	0.0752	–2.7
Med × Age	0.0166	0.0031	5.3
Deg × Age	0.0054	0.0010	5.2
Univ	0.1146	0.0384	3.0
Constant	7.4887	0.1007	74.4
$R^2 = 0.35$			
Standard error = 0.45			

3,191 observations, General Household Survey 1995–96.

Key:

ZGCSE = 1 if no GCSE grade A–C exams or equivalent

NGCSE = number of GCSE grade A–C exams or equivalent

ALev = 1 if two or more A levels

OHE = 1 if two or more A levels and higher education below degree level

DegA = 1 if a degree from Group A (Table 13)

DegC = 1 if a degree from Group C (Table 13)

Med = 1 if a medical degree

Deg = 1 if any degree

Univ = 1 if last place of full-time education was university or polytechnic

A levels on earnings and the effect of a degree. The effect of uncertainty on investment in higher education is as important as on any other aspect of investment. But without a satisfactory identification of the effects of uncertainty, our assessment of its importance below has to be conjectural.

There is a further aspect of the regression that we should mention. Earlier studies (Weale, 1992) suggested that polytechnic[16] graduates were at a substantial income disadvantage relative to university graduates, and this was

[16]Polytechnics became 'new universities' in 1992.

borne out by the estimation of a similar regression for 1985 (available from the authors on request). That showed a difference of 11 per cent in the average earnings of the two groups. By 1995, that difference had fallen to a statistically insignificant 3 per cent, and we restricted that to zero in the equation presented. Thus, as compared with 1985, it looks as though the income disadvantage of having been to a polytechnic has more or less disappeared.

Finally, we should draw attention to a matter the regression cannot examine. As mentioned above, the General Household Survey stopped asking people about their father's social class in 1992. We have therefore been unable to identify effects of background on earning power. However, we note that Bennett, Glennester and Nevison (1992) find, from data for the mid-1980s, that the return to higher education is bigger for children from disadvantaged backgrounds. This is consistent with a view that, without the benefits of university education, children are handicapped by their background, but that university goes some way towards levelling the playing field. The fact that Weale (1992) found, looking at 1980 graduates six years after graduation, that attendance at grammar and public schools gave an income advantage of 5 per cent and 15 per cent respectively over attendance at comprehensive schools suggests that universities did not level the field completely. It would be interesting to know whether this is still true. In the mean time, there is a risk that the regression suffers from an omitted 'background' variable.

1. Private Rates of Return

From the equation in Table 14, we can calculate private and then social rates of return for higher education. These are, of course, subject to some of the reservations expressed in Section III. But we calculate the earnings profiles for average male graduates and A-level non-graduates, both with five grade A–C GCSEs, assuming that the non-graduates start work at age 18 and the graduates at age 21. In both cases, we assume the 1995 tax and National Insurance structure and calculate the figures for a single man. If we denote by $y_t(A)$ the expected income of a non-graduate with A levels at age t and by $y_t(D)$ the comparable figure for a graduate (with loans treated as income and fees and repayments treated as expenditure), then the rate of return is the value of r that equates the present values of the streams of earnings, satisfying

$$(5) \qquad \sum_{t=18,64} \frac{y_t(A) - y_t(D)}{(1+r)^{t-18}} = 0 .$$

This can usually be found by iteration. However, we have to make some assumption about the method of student support available. We assume that each student receives a government loan of £3,635 p.a. while a student. Of this, £1,000 is used to pay fees and £2,635 provides 'income'. There is no real interest

on the loan and it is repaid out of salary after graduation. The graduate pays 9 per cent of gross salary over £10,000 until the loan is repaid. These figures are 1999 values. We assume that, had the current system been in operation in 1995, the amounts would have been adjusted by the movement in average earnings (taken from the New Earnings Survey) in 1995 relative to 1998. Thus the parameters of the loan and fee structure are multiplied by 336.3/384.5.

However, we also assume that students have both to work while studying and to borrow in order to support themselves. We assume commercial borrowing of £2,000 p.a. combined with earnings of £1,000 p.a. in 1995 values. It is assumed that the commercial borrowing is funded at a real rate of interest of 7 per cent p.a. and that the graduate is expected to repay it over five years after graduating. This is assumed to be an outcome imposed by a lender rather than the consequence of optimal saving by the graduate. This has the effect of raising the return to the degree provided it is above the commercial rate and depressing it if it is already below the commercial rate. Rates of return calculated assuming that the model parameters are correct are shown in the first row of Table 15.

The calculation needs to take account of the effects of uncertainty. There are two aspects to this. The first is that the coefficients from the regression equation are uncertain. Since the rate of return is a non-linear function of the regression coefficients, the expected value of the rate of return cannot be calculated simply by setting the regression coefficients to their expected values. In any case, it is

TABLE 15

Private Rates of Return to a Degree Gained through Full-Time Study

	Degree[a]		
	Group A	*Group B*	*Group C*
Rate of return estimated from model (% p.a.)	16.2	9.9	–11.7
Welfare gain	36.3%	19.8%	–26.7%
Rate of return with parameter uncertainty (% p.a.)	16.3	9.7	–3.0[b]
Standard error	2.5	2.8	8.5
Welfare gain	36.0%	19.3%	–27.3%
Number of failed cases	—	—	467
Rate of return with parameter & individual uncertainty (% p.a.)	17.1	10.4	0[b]
Standard error	7.6	7.1	10.0
Welfare gain	35.3%	18.3%	–28.2%
Number of failed cases	4	36	442
Years to repay loan	6.1	6.9	8.3

[a]For composition of groups, see Table 13.
[b]These figures should be interpreted in the light of the comments in the text.

desirable to give some indication of the precision with which the rate of return is estimated.

We denote the vector of regression coefficients by **b**. The vector $\mathbf{c}^D(t)$ is the value of the exogenous variables used to calculate the forecast income of a graduate; $\mathbf{c}^A(t)$ is the analogous vector for an A-level worker. In other words,

$$(6) \qquad y_t^D - y_t^A = \exp(\{\mathbf{c}^D(t)' - \mathbf{c}^A(t)'\}\mathbf{b}) .$$

We consider a panel of 1,000 individuals, indexed by the subscript k. Each individual faces a set of parameters $\mathbf{b}_k$, where $\mathbf{b}_k=\mathbf{b}+\varepsilon_k$ with $\varepsilon_k \sim N(0, V(\mathbf{b}))$, so that, for each individual,

$$(7) \qquad y_{kt}^D - y_{kt}^A = \exp(\{\mathbf{c}^D(t)' - \mathbf{c}^A(t)'\}\mathbf{b}_k) .$$

These are earnings gross of taxation and we have to adjust to after-tax figures in order to calculate the net return as well as taking account of the various loans needed for study. The rate of return for the k^{th} individual is calculated from the individual-specific earnings differentials. The expected rate of return and its standard deviation are calculated as the mean and standard deviation of r_k. These figures do not take any account of any postgraduate training received. This is unlikely to be an important bias because the return to the typical postgraduate course has historically been very low (Weale, 1992). Nor do the figures take account of the effect of education level on employment rates and on labour market participation. This may be important, particularly when negative rates of return are found, if graduates are less likely to take early retirement than A-level workers.

The second question concerns the uncertainty that affects the individual student arising from the difference between average log income and actual log income. Here, as noted above, we have been unable to identify the incremental uncertainty associated with a degree. The overall standard deviation of log income in the regression in 1995 was 0.45 but we were unable to identify any extra uncertainty associated with a degree. We also present results assuming that a degree course adds a random term with a standard deviation of 0.1 in addition to the parametric effects and that this persists through the individual's working life. Thus, in this case, for the k^{th} individual,

$$(8) \qquad y_{kt}^D - y_{kt}^A = \exp(\{\mathbf{c}^D(t)' - \mathbf{c}^A(t)'\}\mathbf{b}_k + \eta_k) ,$$

where $\eta_k \sim N(0,0.1)$.

Table 15 quotes figures for different types of degree calculated (a) using the estimated parameters of the model, (b) after taking account of the parametric uncertainty and (c) after compounding the effects of parametric uncertainty with

those of individual uncertainty. We do not present figures for the return to medical degrees; these obviously need to take account of postgraduate training as well as degree courses. The figures for the first two groups are reasonably robust to the precise choice of variables included in the regression.

However, the rate of return is calculated iteratively and, typically, if the return to a degree is very poor, the solution method can fail to converge. We have reported the failure rate in our sample of 1,000 synthetic graduates in each subject group, and it can be seen that it is high for the Group C degrees. This in turn means that figures for Group C with uncertainty are calculated from only the more successful cases. The figures for Groups A and B suggest that the biases arising in the calculation of the rates of return from the model parameters alone are not very great, but the indication of the uncertainty surrounding them is very important.

We complement this analysis of uncertainty with one in terms of utility, which therefore takes account of risk aversion. We make the simplifying assumption that utility is a function of income and not of expenditure. This fails to take account of the benefits of consumption smoothing, but the scope to which the latter is possible depends in part on access to credit markets. We assume that $U(z_{tk}) = -z_{tk}^{-2}$, where z_{tk} is the disposable resources of the individual in each period after taxation and fees and after any loan repayments. Loans drawn down are included in z_{tk} at the appropriate point. The lifetime utility, V_k, of the k^{th} individual is calculated by summing using a discount rate of 5 per cent p.a.: $V_k = \sum_{t=18}^{64} U(z_{tk}) \times 1.05^{t-18}$. We can calculate this both for someone who has only A levels and for a graduate to show the welfare gain from a degree. It can be seen that the welfare gain figures in Table 15, which reflect expected utility, suggest that this is affected only slightly by uncertainty, perhaps explaining why Kodde (1986) is unable to find negative effects. This in turn leads us to speculate that, if larger loans were available to students in Groups A and B, the gearing effect on raising welfare would more than offset the extra uncertainty. Expected welfare would be increased and more students would be drawn to higher education.

2. Social Rates of Return

In Table 16, we show estimates of the social rates of return to the three types of degree. These are calculated by comparing A-level and graduate salaries gross of tax. The cost of producing a graduate is assumed to be £4,790 p.a., which we adjusted to 1995 price levels, plus earnings forgone during study. These are the earnings of an A-level worker less the £1,000 p.a. the student is assumed to earn while studying. Social rates of return are lower than private rates but, except for Group C graduates, they are very respectable.

TABLE 16

Social Rates of Return to a Degree Gained through Full-Time Study

	Degree[a]		
	Group A	*Group B*	*Group C*
Parameter uncertainty	11.4	7.5	–3.5[b]
Standard error	1.3	2.1	9.1
Number of failed cases	—	—	436

[a]For composition of groups, see Table 13.
[b]This figure should be interpreted in the light of the comments on estimating the rate of return.

Why, indeed, does the rate of return seem to remain good despite the increase in the graduate population? Mason (1996 and 1998) finds, from detailed case studies, that there is some evidence of graduate underemployment and that there are also quality concerns about students from less-good departments in both old and new universities. But Machin (1998) argues that the pattern of demand has, overall, shifted in favour of skilled workers, allowing overall differentials to be maintained, and Riley and Young (1999) support this conclusion. This may explain why reasonable rates of return have been maintained. Perhaps, following Arrow and Capron (1959), we can conclude that employers' attitudes to graduates are a bit like the old complaints about the shortage of domestic servants: they would like to pay less than they have to for the labour that they do hire and they blame an inability to recruit on a shortage instead of on an unwillingness to pay market rates. On the other hand, the anecdotal evidence could be an indicator that, with the most recent graduates, oversupply is starting to appear and we may be in the early stages of a period in which high returns lead to an eventual oversupply followed by a period of poor returns.

IX. PROSPECTS

There are two important questions raised by this analysis. First of all, is there a case for raising university participation further? Second, might one expect it to rise even if charges on students are increased? The answer to both these questions is probably yes. The current private rates of return are such as to make higher education an attractive investment. However, further work is probably needed to assess the benefits of higher education for more marginal students, and this probably requires another survey of graduates comparable with the 1986 survey of 1980 graduates. Alternatively, it may be possible to put together a sample of reasonable size by merging a number of General Household Surveys in order to establish whether we are in the early stages of the price–quantity fluctuations that can result from oversupply.

But, subject to this qualification, raising the tuition fee to £2,000 p.a. would reduce rates of return to higher education by less than 1 percentage point p.a. In

view of this, it does seem difficult to justify the continuing subsidy to the private sector implicit in the difference between the cost of a student and the fee charged.

The theoretical work identifies a real concern that charging for education can deter children from poor backgrounds and thus perpetuate inequality. The student loan scheme is intended to address this inequality, but there must be a question about whether it does so adequately while it is inadequate to support a student and provide fees. On the other hand, the evidence of very high returns to students from disadvantaged backgrounds provides an incentive to study that is absent from the models showing that inequality can be perpetuated. But it would be difficult to rely on this alone, since we do not know whether there is an additional element of pre-selection involved here. It may be that only the most determined children of manual workers go to university and that, even without a university education, they might be able to do reasonably well in the labour market. Our rate-of-return calculations do not identify this, but they do suggest that, in subjects with good rates of return, the effect of uncertainty on the expected welfare gain is not likely to be very large.

There is a separate question concerning the functioning of the universities. While this survey article has not really addressed the question of how universities should be funded, there is nevertheless an important comparison that should be made. In the UK, student participation has increased despite higher charges. This is indicative of a combination of an easing of rationing and an increased demand for graduates. But there is stiff opposition to the notion that universities should be able to set their own fee levels. At the same time, at least in economics, it is clear that universities are having trouble in attracting at least British teaching staff. In the US over the last 10 years or so, the first-division universities have increased their charges as the costs of maintaining good research faculties have risen. But they have also increased the availability of scholarships to students from modest backgrounds. Demand for places with them has increased, despite the increase in fees; the perceived higher returns to university education have meant that the process has allowed the universities to increase their revenues without feeling a loss of quality of the student body (Clotfelter, 1996).

Given this example, the question must arise of whether British universities should be allowed to come to their own judgement about the appropriate balance between teaching and research and how best to deliver this. For example, instead of an effective prohibition on universities from charging top-up fees, the Minister might require the universities to follow the US example and offer a suitable range of scholarships as a condition for receipt of public funds. The US experience suggests that this would allow the best universities to maintain or enhance their international reputations for research while at the same time retaining a vibrant undergraduate community.

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