Chapter

12

Education

I hold it to be indisputable, that the first duty of a state is to see that every child born therein shall be well housed, clothed, fed and educated, till it attain years of discretion.

John Ruskin, *Time and Tide*, letter xiii

Introduction ♦ Market Failures, Equity and Role of Government ♦ Returns to Education ♦ Funding Education ♦ Producing Education

There is longstanding acceptance that government should be involved in the provision of education. In ancient Greece, Plato argued in *The Laws* that education is the most important single activity in society and that the prime minister should also be the Minister for Education. Today, most governments in developed economies provide free primary and secondary education. The public good nature of education and fundamental equity considerations provide strong reasons for government involvement in education.[1] However, the extent and form of public involvement are critical and debatable issues.

In the first section below, we provide some information about expenditure on education and discuss some basic issues in the provision of education. We then consider reasons for government involvement in education, the returns to educational expenditure and issues associated with the funding and production of education.

Introduction

Overall, Australia spends about 5.6 per cent of GDP on education (see Table 12.1 overleaf). Primary, secondary, and other non-tertiary education account for about 70 per cent of expenditure on education. Universities and technical and further education account for the rest. As of 2011, average annual expenditure per student was about $12 000 in a public primary school and $14 500 in a public secondary school (Productivity Commission, 2011).

Average expenditure across OECD countries is 5.2 per cent of GDP. The range includes low rates of about 4.5 per cent of GDP in Italy and Germany and rises to nearly 8 per cent of GDP in Denmark and the United States. **CHECK** There are also differences in the composition of spending on education. Compared with Australia, on average, OECD countries allocate a higher proportion of educational funds to pre-tertiary education and a lower proportion to tertiary education.

[1] "In the old days class warfare was between the rich and the poor… These days it is clearly between the educated and uneducated", Joe Bageant, 2009, p.26, *Deer Hunting with Jesus: Dispatches from America's Class War*, Scribe Publications, London.

Table 12.1 Expenditure on education by purpose as % of GDP in 2016

	Public[a]	*Private*[b]	*Total*
Australia			
Primary, secondary and other non-tertiary	3.3	0.7	3.9
Tertiary education	0.7	1.0	1.7
Total[c]	3.9	1.7	5.6
OECD average			
Primary, secondary and other non-tertiary	3.4	0.2	3.6
Tertiary education	1.1	0.5	1.6
Total[c]	4.5	0.7	5.2

(a) Includes public subsidies to private (and religious) schools as well as direct spending on educational institutions.

(b) Net of public subsidies to private educational institutions.

(c) The totals include pre-primary spending not shown here. The OECD average for pre-primary spending is higher than Australian spending.

Source: OECD (2017) *Education at a Glance*, Table B2.3.

In Australia, in 2016 governments funded about 70 per cent of education, with the balance provided by private funds. Governments contributed 85 per cent of the funds for pre-tertiary education, but only 41 per cent for tertiary education (and this proportion is falling).

On average, OECD governments fund a higher percentage of educational expenditure, funding over 90 per cent of pre-tertiary education and 67 per cent of tertiary education.

In Australia, state governments fund and manage public primary and secondary schools and colleges for technical and further education. The Commonwealth provides funds to the public universities, although they are state-based statutory authorities. The Commonwealth also provides substantial subsidies to private schools (mainly secondary schools, and especially to religion-based schools) and some funds for technical and further education.

Issues in educational economics

Many of the problems of resource allocation that occur with non-marketed public goods arise in education. Outcomes are hard to measure and value and there is considerable disagreement about the relationship between inputs and outcomes. Figure 12.1 shows the basic relationships between educational inputs, outputs and outcomes. Inputs include market inputs of labour, capital and materials, but also household inputs, which can have an important influence on educational outcomes. Educational outputs are typically classes, course completions, exam passes and university degrees. But these outputs are only indirect measures of real outcomes: cognitive achievement, knowledge and employment skills. Some general questions can be inferred from Figure 12.1. What are the most cost-effective ways of producing educational outputs? Do these outputs achieve desired educational outcomes? What are the benefits of these outcomes? Do they justify the costs?

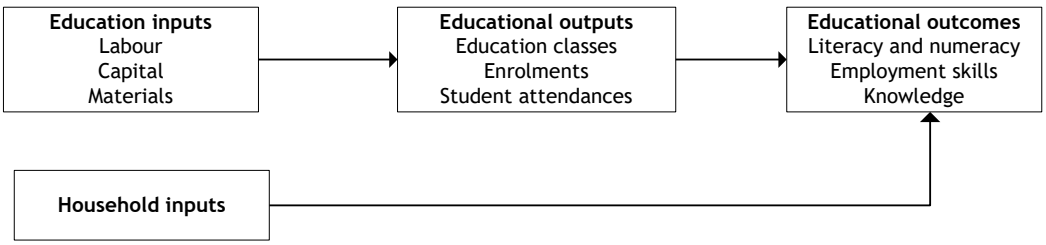

Figure 12.1 Education: inputs, outputs and outcomes

In pragmatic terms, to determine the efficient quantity of education, we want to know the net benefits (or returns) to education. To determine how that education should be financed or paid for, we want to know to what extent these net benefits accrue to the community as a whole or to private persons (to what extent education is a public or private good). We also want to know how educational outcomes can be produced most efficiently. Following a review of the role of government in education, each of these issues is addressed below

Market Failures, Equity and Role of Government

The main market failures in the education sector are the public good (positive externality) attributes of education and capital market imperfections. Also, economies of scale may limit competition. In addition, arguably some households underestimate the value of education.

Education provides substantial non-excludable and non-rival positive externalities.[2] Basic public benefits arise when people learn to read and write, communicate, understand laws and participate fully in the life of the community. These are basic requisites of an effective democracy and commercial system. Education also contributes to the social capital of a community, reducing crime and anti-social behaviour, and to the skill base of the economy. Universal primary education, especially, has long been viewed as a public good. At higher education levels, knowledge and skills pass between people in numerous ways. More educated workers make other workers more productive and in imperfectly competitive conditions make employers more profitable. Also, government gains increased tax revenues from the higher earnings. The development of European countries such as Germany, Switzerland and Sweden has often been attributed to national investment in advanced technical disciplines in the universities.

Not all economists accept that education is a public good. For example, Blaug (1989) argued that 'we cannot specify, much less measure, the externalities generated by educated individuals'. He criticised writers who simply list the various types of external benefits and infer with confidence that there is a strong case for state subsidies. However, since Blaug wrote this, there has been considerable research into the nature and size of externalities in education (see the discussion of the social return to education below).

Capital market imperfections arise from borrowing constraints. Typically, students cannot purchase education because they have neither the current income nor the capacity to borrow against future income. Few lenders accept human capital as a security against a loan. If the return from education exceeds normal lending rates allowing for risk, borrowing constraints indicate that the capital market is imperfect. In effect, children from low-income households would be excluded from market-based education. Research by Belley and Lochner (2007) in the United States indicated that credit constraints could be quite large. On the other hand, in Australia, Cardak and Ryan (2006) found no evidence of credit constraints deterring higher achieving school students from entering universities. However, they attribute this to the government's income-contingent loan scheme described below.

The literature on the economics of education pays less attention to imperfect competition in the supply of education services. However, there are substantial entry costs and economies of scale in provision of education services because of the high fixed costs. It is also hard to provide quality specialist teaching in small schools. Thus, there are significant constraints on competition in many areas of education.

The idea that some households undervalue education is a merit good argument (see Chapter 4 for introduction to merit goods). It is often suggested that households with less educated adults undervalue the benefits of education and under-invest in education. The alleged undervaluation of education by children and parents is employed to justify compulsory

[2] Of course individuals may be excluded from education, but educational providers cannot appropriate all the social benefits derived from their education.

education, for example minimum periods of primary and secondary schooling. Merit good arguments may also be used suggest that professional educational suppliers rather than parents should determine what students learn.

The merit good argument is hard to assess. Doubtless some early school leavers would benefit from more education and the increased earnings that would follow. However, given the strength of demand for education in most countries it is not clear that the benefits of education are widely undervalued. Also, the problem of early school leaving, at least over a certain age, may be addressed better by increasing student choice in educational subjects than by compelling students to attend prescribed schools or classes.

Equity issues. Equity is central to public provision of education. Many people would agree with Ruskin's dictum that the state should ensure that all children receive a basic education as of right. Normal market operations will not provide even a basic education for all and will certainly not provide an equal quality education for all. The often-observed geographical segregation of society into distinct socio-economic groups exacerbates the uneven supply of market-provided education. Accordingly, government is generally viewed as having an overriding responsibility to provide a basic education to all citizens. In developed countries, this responsibility is generally interpreted to provide free schooling at least to age 16.[3]

These equity arguments for government involvement in education may be taken further. At one level, it may be argued that the principle of equality of opportunity implies that all children should have access to equal educational resources. However, it may be contended further that children with less ability or less family support should have access to additional educational resources. These various points of view are influential in educational policy. It is the role of decision makers (politicians) to arbitrate between these different views of equity. Economists may assess the resource costs and outcomes of these alternatives.

Conclusions. Market failures and equity considerations justify substantial public funding of education. However, the precise form of public intervention needs to be determined. Importantly, the funding and delivery of education are separate issues. Arguments for funding and monitoring education do not themselves justify government production of education services. Educational services can be funded and supplied in various ways to meet efficiency and equity objectives.

Returns to Education

Education provides private and social returns. The private return is the estimated net benefit of education to an individual after allowing for any private costs incurred. The social return from education is the net benefit to society, inclusive of private and third-party benefits. In this section, we first discuss methods of estimating private and social returns and then summarise some results.

Private returns

Human capital model
An individual invests in education or training to increase the present value of their lifetime income

The human capital model provides the basis for analysing returns to education. Human capital is the present discounted value of the productivity of people with skills and training. Education increases knowledge and skills and thus human capital and earnings. In the human capital model, an individual invests in education to maximise the present value of their lifetime income. A student forgoes income now and incurs out-of pocket expenses (for learning materials, travel and fees where applicable) for more income in the future. He or she makes the investment if the present value (PV) of the increase in income over time exceeds

[3] Arguably this should include pre-school assistance as this can be critical to school performance.

the PV of the total cost to the student. Of course, this model simplifies the education decision. It assumes that the income gains from education are reasonably assured and that the individual is indifferent between studying and working. Also, individuals may invest in education for lifestyle reasons, but these benefits are rarely estimated.

The income benefits of additional education can be estimated by simply comparing the incomes of similar age persons with different educational qualifications. This would allow for any age effect. However other factors may also affect wages so the standard way to estimate the income benefits of education is to estimate a full wage equation as developed by Becker and Chiswick (1966) and Mincer (1974). This is typically of the following general form:

$$\ln w_i = b_0 + b_1 S_i + b_2 X_i + b_3 X_i^2 + e_i \qquad (12.1)$$

where $\ln w_i$ is the natural log of wage earnings for individual i, S_i is years of schooling, X_i is years of work experience and e_i is a disturbance term. The quadratic expression for X_i allows for declining earnings in later working life. Other factors, notably parental educational qualifications, can also be included. Equation 12.1 can be estimated using ordinary least squares regression and cross-section data across individuals at a point in time. Holding other factors constant, an increase of one year in an individual's schooling would increase $\ln w$ by b_1. In other words, the estimated value for b_1 represents the percentage increase in earnings for one extra year of schooling.

As with any regression model, the results may be biased by model mis-specification or omission of an important variable. For example, Equation 12.1 does not allow for hours of work. Wage rates may be a better measure of the impact of education than total earnings. An explanatory factor that is often important is parental level of education, omission of which may bias results especially if years of schooling are associated with parental learning.

Generally, the estimated return to education is biased upwards if length or type of schooling is correlated with an unobserved measure, such as parental level of education or student ability, which causes an increase in earnings. This is sometimes described as **endogeneity bias**. This occurs when the level of schooling is itself a function of other variables that may cause an increase in earnings. If more intellectually able and motivated individuals choose to undertake higher levels of education, an econometric study that does not control for these factors will give a biased (upwards) estimate of the importance of education.

Empirical studies generally attempt to deal with omitted ability bias in one of three ways: by direct controls, natural experiments or instrumental variables (see Ashenfelter *et al*., 1999; Leigh and Ryan, 2008a). The first approach is to control explicitly for ability by introducing a proxy for ability (such as results in IQ tests) into the equation to be estimated. However, these ability proxies may themselves be influenced by or related to education, leading to a downward bias in the estimated return to education. Natural experiments use natural events that factor out the effect of ability on earnings. For example, Ashenfelter and Krueger (1994) used sample sets with twins who received different kinds of education.

The third approach is estimate the education-earnings relationship by using an instrumental variable (IV). Generally, to estimate the effect of a variable x on another variable y, an instrument is a third variable z which will affect y only through its impact on x. In our present context, an IV is a variable that is related to the amount of education but not to ability. The analysis of the education–earnings relationship first models the relationship between the amount of education and the IV and then estimates the relationship between earnings and the modelled amount of education. For example, Angrist and Krueger (1991) used date of birth as an instrument. The date of birth influences the length of time that children spend in school in the United States but is unrelated to ability. They inserted the predicted values of a regression of education on date of birth into the earnings equation, thus removing the ability element. However, IV studies give biased results if the IV is itself not truly independent of earnings (that is, if it affects earnings other than via its effect on education).

Table 12.2 Social cost and benefits of public education

Party	*Costs*	*Benefits*
Students	Forgone earnings Out-of-pocket costs (transport, books etc)	Increase in private earnings Improvement in lifestyle
Government	Provision of public education Subsidies to higher education and private sector	Increase in tax revenues Lower social security payments Lower costs of health care, prisons etc
Employers		Increased profits
Other parties	Displacement of existing workers	Productivity of other workers Improvement in social capital Improvement in health and mortality Reduction in crime

Social rate of return

The main costs and benefits of publicly-funded education are shown in Table 12.2. The costs include all the public costs of education, inclusive of any subsidies to households or businesses. On the other hand, government may gain from increased taxes, lower social security payments, better qualified employees, and savings in social expenses, such as health care or corrective detention costs. Employers may profit from a more skilled workforce. Other benefits may include productivity spillovers to other workers, improvements in public health, and reduced crime.

Many of these benefits are hard to value. Wolfe and Haveman (2001) surveyed the variety of benefits from education including improvements in health, reductions in crime and an increase in social interactions and contributions to the community and concluded (p. 245) that the value of non–labour market influences is conservatively 'of the same order of magnitude as estimates of the annual marketed, earnings-based effects of one more year of schooling'. Fu (2007) provides a good quantified account of local market externalities. The OECD (2010) reports quantitative estimates of the increased proportions of people reporting good health, an interest in politics and interpersonal trust as a result of increases in education across OECD countries. Lochner (2011) provides a useful analysis of the empirical issues in sorting out the impacts of education on crime, health and political participation. There appear to be particularly high returns to completing secondary school education.

Some analysts employ macroeconomic models to estimate the full economic value of education. These models are typically cross-country regressions of the sort described in Chapter 5 in which GDP is the dependent variable and investment in education an explanatory variable. The difference between the impact of education on total income (growth of GDP) and on individual earnings is attributed to externalities. Kreuger and Lindahl (2001) argue that such macroeconomic models can be used to evaluate the social returns to education although they also consider the microeconomic studies to be the more econometrically robust. However, analysis of causation presents a major difficulty in macro studies. Hanushek and Woessmann (2010) note that there remains 'considerable controversy' over the causal interpretation of any statistical association between education or skills and output or growth—for example, whether higher cognitive abilities lead to higher growth or whether higher growth leads to higher cognitive abilities. Krueger and Lindahl (2001) also note that it is difficult to separate the causal effect of education from the positive income demand for education in cross-country data over long time periods.

Screening model of education. It is sometimes argued that the social return to education is less than the private because education simply reallocates jobs among workers. In the screening model proposed by Arrow (1973), education separates high- from low-ability people but does not necessarily improve skills. Educational qualifications are signals to employers about the likely productivity of employees. These signals minimise employers' search costs and ensure a productive workforce. In the extreme version of this model, education has no effect on productivity. Educational qualifications would provide private benefits. But the social benefits would only be savings in search costs. The case for public funding of education would be greatly reduced.

Screening model of education
Educational results act as a screening device to indentify pre-existing ability rather than the benefits of education

Analysts have tried to test for screening in various ways. Most tests attempt either to control for underlying ability in a human capital wages equation, so that remaining wage effects reflect productivity differences due to education, or to find control groups that are similar except for the amount of schooling that they receive. Gruber (2016) concludes that these tests generally support the human capital model rather than the screening model. However, some studies show a significant return to obtaining educational credentials.

Quiggin (1999) discusses two other tests. First, the screening model would predict that earnings differentials due to education would decline over time as employers could directly observe productivity differentials, but this does not occur. Second, people who plan to run their own businesses should invest less in further education than individuals looking for employment, but this does not appear to be the case. Thus, both these tests suggest that the screening model has limited applicability.

Empirical results

Table 12.3 provides an overview of estimates of the private and social returns from education for OECD countries as a whole and for Australia in 2016. The private returns are based on the discounted stream of after-tax earnings less the private costs of education. The public returns are based on the full costs of education and include government contributions, tax effects and other savings in social contributions. A low real discount rate of 3 per cent is applied to the earnings stream to estimate net present values. The estimated internal rates of return are perhaps easier to understand and more useful as a guide to investment. But whichever criterion of value is used, the average returns are high.

Table 12.3 Some key results in OECD countries in 2016

		Net present value (US$s)[a]		*IRR (%)*	
		Male	*Female*	*Male*	*Female*
Private net present value for an individual obtaining upper secondary or post-secondary non-tertiary education as part of initial education	Australia	116,600	51,900	16	9
	OECD	112,400	64,600	12	8
Private net present value for an individual obtaining tertiary education as part of initial education	Australia	209,600	147,100	9	9
	OECD	258,400	167,600	14	12
Public net present value for an individual obtaining tertiary education as part of initial education	Australia	128,700	89,900	10	10
	OECD	143,700	74,100	10	8

(a) Net present values are calculated using a real discount rate of 3%.

Source: OECD, *Education at a Glance*, 2017, Tables A7.1, A7.2, A7.3 and A7.4.

Table 12.4 Estimated rates of return by school type and area

	Social (public)			*Private*		
Region	*Primary*	*Secondary*	*Higher*	*Primary*	*Secondary*	*Higher*
OECD	8.5	9.4	8.5	13.4	11.3	11.6
World	18.9	13.1	10.8	26.6	17.0	19.0

Source: Psacharopoulos and Patrinos, 2004.

International microeconomic studies produce similar results. Using a Mincer-type equation Card (1999) found that each year of schooling increases earnings in the United States by between 6 and 15 per cent. Controlling for ability using instrumental variables or by natural experiments, he found an average rate of return on education of 10 per cent in the United States. The meta-analysis by Ashenfelter *et al*. (1999) found similar results. These are purely private returns.

On the other hand, Psacharopoulos and Patrinos (2004) provided OECD and worldwide estimates of average public and private rates of return from education (see Table 12.4). Their estimated rates of return are similar to those shown in Table 12.3. Their estimates suggest that the average private rates of return are nearly everywhere higher that the social returns. They also indicate that returns to education are significantly higher in less developed countries than in the OECD.

Early macroeconomic studies, for example Barro (1997), found that an average extra year of schooling would increase GDP growth by as much as one per cent per annum. However, Hanushek and Woessman (2010) argue that this growth effect is principally associated with increase in cognitive skills and that the quantity of schooling has no statistically significant additional effect once cognitive skills are included in the model. This does not mean that education does not increase growth. Rather, it would imply that education is important to the extent that it is responsible for building cognitive skills.

Australian studies have produced similar but slightly lower results. Using a study of twins, Miller *et al*. (2006), found a mean return to schooling of 5–7 per cent after controlling for genetic and family effects. Leigh and Ryan (2008a) used two different natural experiment techniques (month of birth and changes in compulsory schooling laws) to estimate a return to schooling of around 10 per cent after correcting for ability bias, which the authors argued accounted for between 10 per cent and 40 per cent of the gross differences. Barrett (2012) estimated that the mean return from an additional year of education is 6.2 per cent, but when cognitive ability is allowed for the return to education falls to 4.4 per cent. Barrett's interpretation is that 29 per cent of the return to an additional year of education is due to the higher levels of cognitive skills associated with an extra year of education. Barrett also found that credentials give rise to additional returns beyond those from the accumulation of years of education, especially for higher education.

Leigh (2008) estimated the return to various specific educational attainments, finding the greatest per year returns at the level of high school completion (as high as 30 per cent depending on the correction for ability bias) and Grade 10 completion (20 per cent). Bachelor and higher degrees also give significant returns as do diplomas/advanced diplomas and, for high school-dropouts only, Certificates III or IV. Drawing on extensive Australian census data, Wei (2010) also found high returns to a university education in the order of 15 per cent for males and 17 per cent for females but he acknowledges that these estimates did not take account of possible ability bias.

Finally, it should be remarked that, important as these high-level results are, government needs to know the return to *additional spending at the margin* and whether this will produce equivalent or greater benefits than on average. Thus, government needs to know, or at least

estimate, the marginal social rates of return from a larger or smaller education program and from investments in the many different levels and kinds of education.

Funding Education

As we have seen, government's role in providing funds for education arises from the public good features of education (notably positive externalities), the merit good nature of education, capital market imperfections and, above all, for reasons of equity or social justice.

In principle, the implications of positive externalities for funding education are exact. Government should provide a subsidy equivalent to the marginal external benefit of the service. If the cost of a year's education is $12 000 and the estimated external benefits are $5000, the subsidy should be $5000 and the student (or their family) would pay the $7000 balance. The aim is to produce an efficient allocation of resources to education. Students (or their families) will purchase a year's education if the expected private benefit is worth at least $7000 but will not do so if the expected benefit is worth less than $7000. Of course, this implies both that government can accurately estimate the external benefits of different kinds of education and that students understand and can afford to fund the private benefits.

There are other limitations to this approach to educational funding. One is that the subsidy must be received by, or passed on, to the student. A subsidy to educational suppliers will be passed on fully to consumers only when the suppliers are fully competitive. However, governments in Australia and elsewhere usually provide subsidies to suppliers of education who operate in an imperfectly competitive market, so that subsidies may not be fully passed on.

Secondly, students may undervalue their education. Arguably, from an efficiency perspective government would then fund the difference between its valuation of an individual's private benefit and the individual's own valuation. This would establish the appropriate private incentive to invest in education. However, there are obvious practical problems associated with eliciting student or family valuations of education when respondents have an incentive to minimise their true valuations. Accordingly, on merit good (and equity) grounds governments commonly make education compulsory for certain age groups (up to school year 10, about age 16, in Australia) and pay for most education expenses. There may remain some merit good effects beyond age 16 which would warrant a public subsidy (in addition to the externality subsidy) at older ages. However, identifying those students who need to be encouraged and subsidised is hard and community-wide subsidies are expensive.

On the other hand, borrowing constraints on private educational investment do not necessarily justify educational subsidies. The efficient policy response to this form of market failure is public loans. Australia has been a world leader in providing income-contingent loans to tertiary students and this policy is discussed further below.

But overwhelmingly, public funding of education at least for children up to the age of 16 or 17 is based on equity considerations. Children cannot pay or borrow for education. In most countries, there is widespread agreement that the state should finance education for those who cannot afford it. However, critical questions remain. Should families who can afford to pay for their children's education be required to do so? How much education should the state pay for? The answers to such questions require ethical judgements beyond the scope of this discussion. Below we briefly discuss some equity–efficiency trade-offs in the provision of education.

Who should receive subsidies: producers or consumers?

Governments usually provide subsidies to public suppliers of education. Government may also subsidise private schools or universities. The Australian government provides substantial subsidies to private schools based on the number of students they attract and, more

contentiously, on the socio-economic attributes of the local population—which may have little correlation with the school population.

The traditional system of funding state-owned institutions was based on the concept of a vertically integrated supply model. The vertical system of control facilitated administration by limiting transaction costs and the number of agencies that received a subsidy. Government could more easily control the supply of education services, how education is supplied and the prices charged. Also, it can ensure that less advantaged communities receive equitable access to educational services.

However, providing subsidies to education suppliers in an imperfectly competitive market may create cost padding and permit inefficiencies rather than improved educational services. This applies especially to government schools which provide free education and where there is limited competition between schools and limited choice for families.

Crowding out
Free public schooling may crowd out private educational expenditure and so reduce total resources allocated to education

Another issue is **crowding out**. This occurs when subsidised public schools crowd out private schooling. Suppose (*A*) that a family has to choose between a public school with an annual fee of $12 000 or a private school at $18 000 a year and chooses the latter. This family has judged that the extra $6000 expense provides a net benefit. Now suppose (*B*) that a family has a choice between a free public school and a private school at $18 000 a year, it may choose the public school. Now the subsidy has crowded out the private schooling and reduced total expenditure on education by $6000 (unless the family purchases supplementary private tuition). There is also a net social cost. True, the family has saved $18 000 under (*B*). But the taxpayer has lost $12 000 and the family has forgone an educational benefit that it valued at over $6000.

In this example marginal crowding out reduces total expenditure on education. However, other families that have low demand for education may consume more of it when it is free than when priced. Therefore, the overall effect of providing a free education service on total expenditure on education is indeterminate.

Educational vouchers

Providing subsidies to consumers avoids many of these problems but raises others. The most common proposal is that government would provide vouchers worth a given amount, say $12 000 per annum per child of school age, which can be spent at any type of school (subject to accreditation). The parents would choose the form of education, including education that requires private funding top-ups. There are several variants of this strategy (Johnes, 1993). For example, vouchers could be larger for disadvantaged children. Also, the dollar value of the vouchers could be subject to income tax. Other related issues are whether schools should be permitted to charge different fees or vary entry requirements for enrolments. If they cannot vary the number of enrolments, they have to deal with excess or insufficient demand by varying entry conditions. While educational vouchers are still rare, Sweden and various communities in the United States have some form of educational voucher system in place.

While the pros and cons of vouchers depend on the nature of the scheme adopted, some general points can be made. The main arguments in favour of education vouchers are that they promote user choice and competition among education suppliers. This competition would promote an efficient product mix (the kind of education that families want) and lower production costs. Vouchers would force public schools to compete with other public and private schools and be more cost effective. Methods such as differential vouchers can be devised to mitigate equity concerns. Marlow (1997) shows that increased competition among schools, including competition in the public sector, significantly increases student achievement. In a study of the effects of schooling vouchers on poor pupils in Columbia, Angrist *et al*. (2002) found that voucher recipients were more likely to attend private school, to attend school for longer and to have a lower drop-out rate than those who did not receive vouchers. In a follow-up study in Columbia, Bettinger *et al*. (2010) found similar positive

attendance results for voucher recipients—those who chose vocational schools instead of main-stream schooling were 25 per cent more likely to complete high school.

Turning to some contrary points, in an imperfectly competitive market where there are significant scale economies in school services, vouchers may create an inefficient outcome. Suppose that a community contains 1000 students, that school *A* can provide education at a cost of $12 000 per annum per student, and that with a voucher of say $5000 per student the families would be willing to pay $13 000 per year per student. If the voucher reflects external benefits, the net social benefit would be $1.0 million per annum (1000 students × $1000). Now suppose that a new school *B* could provide a high quality education for $18 000 per annum per student and that 300 families, with the $5000 subsidy, are willing to pay $20 000 a year at *B*. Also suppose that school *A* would lose scale economies and the cost of its services would rise to $14 000 per annum per student. Although school *B* would generate a net social benefit of $600 000 per annum (300 students × $2000), school *A* would now generate a net social loss of $700 000 per annum (700 students × –$1000). The net social surplus of $1.0 million has turned into a net social loss of $0.1 million. A simple voucher system could result in a cost-inefficient two-school solution with a lower overall net social benefit and an increase in the public subsidy for students at school *A*.

Perhaps more important, voucher schemes have potential equity problems. First, if vouchers are provided universally without means testing, they are expensive and poorly targeted. Second, when schools can vary fees and entry requirements, a hierarchy of schools from excellent to poor may emerge, with weaker students tending to attend poorer schools. Segregation over schools could accentuate prevailing social disadvantages. Third, some schools by consequence of their location may be more expensive to run.

Some educational authorities would add the merit good argument that they are better judges of a child's educational needs than are the parents.

Doubtless some of these issues may be resolved by effective scheme design. However, voucher schemes illustrate a general point about public policy. A scheme's effectiveness and acceptability often depend as much on the way in which the scheme is designed and implemented as on general theoretical principles.

Income-contingent loans

An important argument against charging fees for education is that, because students cannot readily borrow from financial institutions against future earnings, fees discriminate against poor students. One response to this could be means testing. However, it is not clear whose income (the family's or the student's) would be means tested. Nor is it satisfactory that someone should be deprived of education because their wealthy parents (or partner) will not pay for their education. Another possible response to discrimination against poor students would be government guarantees for private loans to students. But this raises moral hazard issues because financial institutions would not have full incentives to recover loans. Public loans to students do not have these drawbacks. The loans allow students to invest in education. Government has the incentive and the means through the tax system to recover loans.

An income-contingent loan is a loan for which repayment depends on the borrower's income. In a world first, the Australian government introduced income-contingent loans for university students in 1989. However, questions arise again in scheme design. Should the scheme be self-financing? Should repayments depend on income? If so, at what level of income should students start to repay their loan? What interest rate, if any, should be charged? At what rate should the loan be repaid? Chapman (2005) provides an excellent discussion of these issues. Here we make a few observations on the first two questions.

First, a self-financing scheme would require some students to cross-subsidise other students who do not repay their loan with appropriate interest. This would be actuarially unfair and, if

the premium were significant, it would lead to some students opting out of the scheme and finding capital from other sources. It would be more efficient, and probably viewed by most people as fairer, for the community to subsidise those students who do not repay their loans.

Second, there are arguments for and against making repayments depending on income. Loan repayments that depend on income are fairer in that they reflect both some of the benefits received from education and ability to repay the loan. On the other hand, they create disincentives to earning and may have adverse efficiency implications for labour supply.

In his review of income-contingent loans, Chapman (*ibid*.) found that they have two major advantages compared with private financial arrangements. They provide default protection and consumption smoothing for students. They also increase the funding available to finance higher education. Moreover, Chapman found that the introduction of higher university fees combined with income-contingent loans did not reduce enrolments in higher education. Enrolments have increased significantly. Although low-income households remain under-represented in higher education, the proportion of disadvantaged households in universities has not fallen. Further, the administration costs of higher education fees and income-contingent loans are modest. However, as Chapman notes, 'the operational and design features of such schemes are of fundamental importance to their potential efficacy'.

Equity and the allocation of education services

Equity would be uncomplicated if all children had similar abilities and opportunities. The principle of horizontal equity (that similar individuals should be treated alike) implies that each child should receive an equal share of resources devoted to education. In this case, outcomes as well as inputs would be equal.

In practice, children have different abilities and capacities to learn. The efficient use of resources requires that educational resources should be applied until the value of the marginal outcome equals the marginal cost. If an able student can learn more from an hour of teaching than can a less able student, he or she would receive more teaching hours. This maximises the outcome that can be achieved from educational resources. However, this increases any inequity due to differential ability. Not only do the able students achieve more with an equal input of educational resources, but they would also receive more educational inputs.

Compensatory education
Slow learners should receive more educational resources than fast learners even though value added per dollar of education is lower

On the other hand, the principle of vertical equity requires that children who need more educational assistance should receive it. This is called **compensatory education**. Children who are slow learners or disadvantaged in any way should receive more educational resources than would able students. Only then do individuals enjoy real equality of opportunity. In the United Kingdom the government allocates funds to local authorities based on pupil numbers in various age bands, weighted by socio-economic group. Thus, more funds and inputs are provided per capita to less advantaged groups. In Australia the Gonski (2011) review of school funding recommended additional funding per child for children with learning disabilities.

This is another example of the trade-off between equity and efficiency in public policy. Compensatory education requires that government allocates more resources per capita to children with low marginal gains from education than to children who would achieve higher marginal gains.

Subsidies to education for equity purposes are provided not only via funding differentials for slow learners but also more generally through pricing subsidies, particularly for post-school education. Again, such subsidies may not be a simple zero sum income transfer. Subsidised prices for post-school courses increase the demand for education and the allocation of resources. If prices are set below the cost of services, students may enrol in courses of low value to them and in which they apparently make little application. Unless there are significant social benefits, the misallocation of resources can be considerable.

Producing Education

Efficient production of education means achieving quality educational outcomes at least cost. In this discussion of production issues, we first discuss the use of tests of outcomes and the cost-effective size for a school. We then discuss how school management, class size (educational inputs) and teacher quality may affect educational outcomes.

Education tests. Central to most discussions about education is whether educational outcomes are improved more by increasing educational inputs or by more effective use of educational resources However, as is often the case in the public sector, it is hard to measure quality of outcomes. The outcomes that matter most are cognitive and creative skills. To a large extent, these skills must be measured by tests.

Yet the creation of tests may itself distort the behaviour of teachers and the provision of education. In addition, many factors, most notably home environment, contribute to the development of skills. To measure the impact of different educational inputs, such as differences in class size, it is necessary to account for these other factors. This may be done by assessing the change in achievements by different groups of students over a period such as a year (where the home environment is a constant) rather than by the relative levels that they achieve at the end of the period. Concern about misinterpretation of the results of tests, with excessive focus on levels rather than changes in levels, has been a major issue in the recent introduction of national student tests in Australia. It is also an issue when we consider matters like class size and teacher quality below.

School size. To provide education cost-effectively, educational authorities need to know the costs of schools of alternative sizes. They will want to avoid establishing or maintaining small schools with high unit costs. On the other hand, parents often prefer small schools that are perceived to provide more personal services than large schools and value small local schools that minimise journey-to-school travel distances and times. It is important therefore to determine the cost penalties, if any, of small schools. In particular cases, the costs of running a school may be determined from its accounts. However, for general planning purposes it is desirable to have a model of school costs in relation to size. To determine such costs, we need to estimate a cost function like:

$$C = a + bQ + cQ^2 + dZ_i \qquad (12.2)$$

where C is total cost, Q is the number of students and Z_i represents a vector of other factors. The constant term a captures the fixed cost and the quadratic function allows for possible diseconomies of size. Other cost factors may include rural locations or a high proportion of culturally and linguistically diverse students.

Johnes (1993) reviewed several estimated cost functions, mainly in the UK. He concluded that primary schools can realise substantial scale economies up to 800 students, but that unit costs level off thereafter. On the other hand, the cost-minimising size for secondary schools is about 1200 students in the United Kingdom, but higher in the United States. In the tertiary sector, the optimal size of an institution is likely to be over 10 000 students. Colegrave and Giles (2008) estimated that the efficient secondary school size in the United States is about 1543 students. These school sizes are much larger than are typically found in Australia.

School management. Public school management can be classified broadly into three models: a hierarchical centralised government control model, a decentralised public service model and an outsourced community or privately-run model. Under the first model, the education authority controls not only the curriculum in detail but also the allocation of staff to schools. School principals cannot select staff and have little control over the allocation of their

budgets. This model has been the traditional one in Australia. In New South Wales, school principals have not even been aware of the salaries paid to individual staff. The traditional model has been justified by both quality control and equity arguments (that this ensures an even quality of staff in schools around the state).

There are currently some attempts to move towards the second, more decentralised model, which would allow principals some control over curricula, allocation of budgets and staffing decisions. Indeed, this is the practice in Victoria. A more decentralised model may enhance management of both schools and staff, allow schools to be more responsive to local conditions and generally enhance efficiency by introducing an element of competition between schools. Under the 2011 Commonwealth-State Teacher Quality National Partnership, principals in 47 schools across New South Wales were given a greater say in staffing mix, budgets and other areas; those principals have generally claimed positive benefits for their students including improved attendance, behaviour and results.[4] This appears to be an area where some robust research is required.

Under the third and more radical model, public schools operate under special government charter. These schools are often called charter schools. They are publicly funded schools and held to state standards, but within the limits set by their charters they have some freedom in methods of education and in hiring and expenditure decisions. Rosen and Gayer (2014) reported that 41 states in the United States support charter schools. The UK also has charter schools. There is some evidence that charter schools improve educational outcomes. Hoxby and Rockoff (2004) reported on a case study in Chicago where there was excess demand for admittance to charter schools and the students were selected by lottery. Because admittance to charter schools was by lottery it could be assumed that students gaining entrance to charter schools were similar to those not gaining entrance (there was no self-selection bias). Hoxby and Rockoff found that those in charter schools scored higher grades in both maths and reading tests. Rosen and Gayer also observe, citing the example of Arizona, that charter schools increase diversity of choice. This is generally assumed to increase efficiency (by varying the product package according to preferences) but takes us again into the position where there may be some inequity in the provision of education.

Class size. Staff make up two-thirds of costs in Australian public schools. Therefore, government is naturally concerned about the number and pay of teachers. Currently in Australia the student to total staff ratio in public schools is 16.5, compared to 15.5 in private schools. On the other hand, teachers often argue that educational outcomes would be improved by smaller class sizes (and therefore more staff)

Formally we need to estimate production functions, as distinct from cost functions, to analyse the effectiveness of educational inputs. Following Hanushek (2002), a production function typically has the following general form:

$$O_{it} = f\ (F_i^{(t)}, P_i^{(t)}, S_i^{(t)}, A_i) + v_{it} \tag{12.3}$$

where O_{it} is the performance of student i at time t, $F_i^{(t)}$ represents family inputs cumulative to time t, $P_i^{(t)}$ is cumulative peer group inputs, $S_i^{(t)}$ is cumulative school inputs, A_i is innate ability and v_{it} is a stochastic term. Of course, all the variables must be well defined. This formulation allows student performance to be a function of cumulative factors, including non-school factors. In some models, teachers are distinguished from schools, thus allowing the effectiveness of individual teachers to be estimated.

Hanushek (2002) reviewed the results of 376 estimates from 75 studies. He concluded controversially that adding resources to schools has little effect on performance principally as measured by test scores. He found little support for beliefs that employing more teachers,

[4] Minister for Education, Employment and Workplace Relations, Media Release, 6 December 2011. However, some principals claim that the government has also used the reforms as a shield for cost-cutting.

paying teachers a higher salary or increasing overall spending will improve student performance, principally as measured by test scores. Only 27 per cent of the estimated coefficients for per pupil expenditure were positive and statistically significant. Only 14 per cent of the estimated coefficients showed lower class size has any significant positive effect. Hanushek found that teacher quality and peer effects were more important than class size.

Other studies have reached different conclusions about class size. Hedges et al. (1994) conducted a meta-analysis of a subset of early studies assessed by Hanushek, in which they took account of the precision of the estimates and found that a positive relationship between expenditure and performance was likely. Card and Krueger (1994) found that a 10 per cent increase in school spending is associated with 1–2 per cent higher annual earnings for students in later life. However, this study used earnings rather than test scores as a measure of educational output. Krueger (1998) analysed 11 600 students and their teachers who were randomly assigned to different classes from kindergarten to third grade. He concluded that, on average, performance on standardised tests increases by 4 percentile points in the first year that students attend small classes and that the test score advantage of students in small classes expands by about one percentage point per year in subsequent years. Dewey et al (2000) found that although school inputs were often used ineffectively, overall an increase in school inputs improved student performance. Krueger (2003) contended that his 1998 study represents the gold standard in research methods. He critically reviewed Hanushek's conclusions and found that Hanushek relied on many estimates from small samples within a larger study and that these had disproportionate weight in Hanushek's results. He also found that several of the studies were weak. When he allowed for study quality in Hanushek's sample, he concluded that class size is a statistically significant determinant of student performance.

Teacher quality. On the other hand, there appears to be widespread agreement that teacher quality is a key input into educational performance. Hanushek (2002) found that, of all the school measures, higher student standards were significantly related to stronger teacher test scores. Hanushek (2010) reinforced this finding. He estimated that a teacher one standard deviation above the mean effectiveness generates marginal gains of over US$400 000 per annum in present value of future student earnings with a class size of 20 and proportionately higher with larger class sizes. He also estimated large gains to the US economy from replacing the bottom 5–8 per cent of teachers with average quality teachers.

There is less agreement on how to raise teaching quality. Hanushek (*ibid.*) notes that, in the United States, there is little attention to teacher contributions and that there are few rewards for them. Leigh and Ryan (2008b) estimate that the quality of new teachers in Australia has fallen significantly in recent years. Drawing on longitudinal literacy and numerical tests of students at school and afterwards, they estimate that between 1983 and 2003, the average percentile ranking of new teachers fell from 70 to 62. Leigh and Ryan attribute this to a more than 10 per cent decline in the mean pay of teachers relative to other professions and the increased variance in salaries outside teaching. Another major factor has been the increase in non-teaching employment opportunities to women. This trend towards lower aptitude teachers represents a challenge to public sector employment practices that are based on compressed wage differentials and that tend to resist performance testing and incentive payments. Drawing on Queensland experience, Leigh (2010) estimated that the top tenth of teachers were twice as effective at adding value to students as the bottom tenth. He also noted that teacher performance was not correlated with experience or qualifications. Work by Lavy (2004) in Israel suggests that rewarding teachers for strong value-added results improves student outcomes without biasing the teaching process. Unless government responds to these market challenges, teacher quality will continue to fall in the public sector and there will be

increasing demand for private school education. In Canberra over half of all students now attend private schools.

Efficiency and equity. Finally, it is necessary to remind ourselves that productive efficiency is only part of the aim of education. For example, student streaming by ability either in separate schools or within the same school may be efficient in that it maximises the beneficial impacts of peer groups. But streaming also tends to increase inequality among children. A major challenge for public policy in education is how to use resources to maximise the return to educational expenditure along with providing equal opportunities for all and special help for slow learners.

Summary

- Educational spending accounts for 5.6 per cent of GDP in Australia. Of this, government contributes about three-quarters.
- Educational spending in OECD countries overall is slightly lower than in Australia and the share of government funding is also higher.
- Equity objectives are core to government involvement in education. The public good nature of education (extensive positive externalities) along with merit good views also justify substantial government funding of education.
- The human capital model provides the basic framework for analysing the benefits of education. Using this model, most studies find that private and social rates of return to education are high.
- For efficient use of resources, government funding would reflect the public share of benefits. Public income-contingent loans help to make this feasible for tertiary students.
- For children, equity issues are dominant and usually warrant free education up to at least 16 years of age. However free education may crowd out private education and reduce the total resources allocated to education.
- Educational vouchers provided to consumers enhance consumer choice and competition in supply. However, there are significant design issues such as means testing or taxation of the vouchers.
- Economic analysis has many applications in the supply of education. For example, cost functions can provide evidence on the cost efficiency of different school sizes.
- Production functions can show the factors, such as class size, that contribute to student performance. However, analysts differ on the impacts of alternative school management systems, smaller classes and increased educational resources on student performance.
- Teacher quality is widely considered to be an important contributor to student outcomes but there is little agreement about how this may be achieved.
- Educational programs must also meet equity objectives. Equality of opportunity or social needs may require that more resources be devoted to slow learners or to children from disadvantaged backgrounds rather than to students who will learn most from education.

Questions

1. How can the benefits of education be measured?
2. What is the screening model? How can we test whether it is a valid model?
3. It is sometimes argued that the provision of free education can reduce the amount of education supplied and consumed. How could this happen?
4. Suppose that the full cost of a year of university education is $18 000, that a student pays $12 000 and a university course takes three years. Also a university student forgoes $30 000 a year to study. Suppose further that a university education increases a student's gross income from $50 000 to $65 000 a year for 25 years, but the student's income rises after tax from $40 000 to $50 000 a year.

   What are the private and public rates of return to the student's university education?
5. Teachers often argue that smaller class sizes will improve educational outcomes. How would you test this claim?
6. What are the main arguments for and against a voucher system for primary and secondary schools? How can these arguments be resolved?
7. How might a researcher attempt to measure teacher quality?
8. What are the arguments for and against paying teachers on merit?
9. To what extent, if at all, are student literacy and numeracy tests an indicator of school quality?
10. What efficiency issues arise, for and against, income-contingent loans for education expenses?
11. How may equity considerations alter otherwise efficient allocations of educational resources?

Further Reading

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