THE UNIVERSITY OF MELBOURNE

Melbourne Institute Report

No. 1

Returns to Investment in Higher Education

The Melbourne Economics of Higher Education Research Program Report No. 1
Report to the Vice Chancellor, The University of Melbourne

Jeff Borland, Peter Dawkins, David Johnson and Ross Williams

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MELBOURNE INSTITUTE
of Applied Economic and Social Research

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Published by
Melbourne Institute of Applied Economic and Social Research
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Executive Summary

Rates of Return to Investment in Higher Education

Introduction

- Full-time employed graduates receive a substantial wage premium over non-graduates, on average of the order of 65 per cent; that is controlling for age, experience and other characteristics usually included in such analysis, an employed graduate receives on average about 65 per cent more than an employed person without a degree.
- It is generally accepted that this mainly reflects the effect of higher education on their productivity and the standard assumption is that 80 per cent of the increment is due to the higher education received.
- This benefit to the individuals in the form of higher post-tax income and to society of higher pre-tax income, has to be weighed against the cost of the education to the individuals and society.
- We estimate that the total gain in earnings over the working lifetime, that a graduate can expect on average, is just under $300,000.
- Allowing for the cost of the education and applying a four per cent real rate of interest, as the rate of discount, the present value of the net monetary benefit of the higher education over a lifetime, is estimated to be about $90,000.

The Rate of Return to Investment in Higher Education

- In making the investment the individual incurs tuition costs, and foregoes some income; society incurs the full cost of the education and any lost output while the individual is being educated.
- Thus the investment in the education can be viewed like other investments, and evaluated for its rate of return.
- individuals can then compare the rate of return with the rate of interest to decide whether it is a good investment, and society can compare the social rate of return to higher education with other possible uses of funds.
- typically, when researchers estimate the private or social rate of return they are estimating an average; thus some individuals earn a higher rate and some a lower rate.
- for society, in principle, government policy should be concerned with the marginal rate of return when deciding whether to increase their expenditure on higher education; if the additional expenditure were to enable more students to be educated it is the return from that marginal student that is the issue; if it is higher expenditure per student that is being considered it is the effect of such extra spending on those students, through any improvements in quality that is the issue.

Evidence on Average Rates of Return

- Australian studies in the 1980s of the private rate of return to a bachelors degree relative to completion of high school, suggested that it was around 10% to 15% on average; this suggests that it was, on average, a good investment.

- the only previous Australian study looking at both private and social rates of return to higher education (Miller 1982), used data from 1976, and found the private rate of return to be higher than the social rate by about five per cent.
- in other words individuals were getting more from the investment than society; evidence such as this provided a rationale for cutting back on public expenditure per student on higher education and requiring individual's to make a greater personal contribution to the investment.
- in this study we are estimating rates of return to higher education from data for the 1990s; preliminary estimates suggest that the private rate of return has been reduced since the introduction of HECS (albeit still on average being a good investment) and the social rate of return is now above the private rate.
- the table below provides a comparison between findings by Miller (1982) using 1976 data and our findings based on a similar methodology, using data for 1997.

Table 1: Comparison of findings

Study	Year of data	Private rate of return	Social rate of return
Miller (1982)	1976	21.1	16.3
This study	1997	15.0	16.5

- we have experimented with alternative ways of measuring the rate of return, which may be preferred to the approach adopted by Miller and find that:
    1. The magnitude of private rates of return increases significantly once account is taken of the effect of having a university degree on the probability of employment. (Previous studies did not allow for this effect.)
    2. Increasing the assumed degree length from 3 years to 4 years (and assuming that earnings and employment effects remain constant) lowers the private rate of return to a university degree by about one-fifth, and the social rate of return by about one-eighth.
    3. Allowing that having an extra person with a university degree might expand total employment to some degree significantly increase the magnitude of the social rate of return to a university degree. For example, if aggregate employment expands by one for every extra ten persons who acquire a university degree then the social rate of return increases from 16.5 to 20.5 per cent.
- In a future study we recommend looking at disaggregating graduates for example by discipline areas and by degree types, exploring more advance methodologies for obtaining estimates, and seeking to obtain estimates of marginal rates of return as well as averages.

Returns to Quality in Higher Education

- international evidence of the effect of higher education quality (proxied by expenditure per student) on the productivity (and earnings) of graduates, has generally found positive effects; this is especially the case for the effect of expenditure on higher paid (presumably higher quality) staff; we are not aware of any such study for Australia.
- early studies of this kind have been criticised on the basis of the presence of "selectivity bias" i.e. higher quality students go to higher quality universities; however, a recent US study by Brewer, Eide and Ehrenberg (1999), controlling for such bias, still finds that

    'even after allowing for selection effects, strong evidence emerges of a significant economic return to attending an elite private institution, and some evidence suggests this premium has increased over time'

- in general the evidence is more supportive of the proposition that it is the quality of the staff rather than say staff student ratios that are important for raising the quality of graduates.
- interestingly, an Australian study of the research productivity of staff (which related to academic economists) found no evidence of staff student ratios affecting research productivity: in contrast fewer teaching hours did raise research productivity substantially.
- the above evidence suggests that additional investment in higher education should perhaps be invested in high quality staff and research grants to assist their productivity, while containing their hours of teaching, but not necessarily by reducing staff student ratios.

Returns to Investment in University Research

- evidence suggests that there is a high social rate of return to industrial R & D in Australia and overseas.
- international evidence suggest that university research makes an important contribution to innovation in industry; there is lack of Australian research on this but there is no reason to believe that this does not hold true for Australia.
- the social rate of return to R & D tends to be substantially higher than the private rate of return, because of spillover benefits to other parties than the one who funds the research; this provides a strong rationale for public support for R & D.
- industrial R & D as well as university R & D, is largely conducted by university graduates. As there is a high social rate of return to R & D due partly to substantial spillover effects to firms other than where the research is done, this can be viewed to some extent as an external benefit of graduates of higher education, that is not typically accounted for in estimates of rates of return to higher education.
- spillover benefits from R & D are thought to be especially important in the case of university research, because academics have a strong incentive to make their findings public; as well as highlighting the importance of government funds directly into university research, this provides a rationale for larger tax concessions for industry expenditure on R & D in universities, than for R & D, in general, especially where the intellectual property rights are not given solely to the sponsor.
- the importance of encouraging strong links between universities and industry, in such ways, suggests that such mechanisms as ARC “SPIRT” grants and cooperative research centres (CRCs), are good ideas; (it would be good to undertake research evaluating the economic benefits of such schemes).
- contributions of university research to industry are not confined only to science, engineering and medicine; since industry can gain from social science, management science and humanities research, there is a case for extending CRCs to these discipline areas just as ARC SPIRT grants are.
- In a relatively small country like Australia, compared say with the United States, a high proportion of new knowledge comes from overseas; however, domestic R & D is an important mechanism for accessing knowledge from overseas.
- evidence suggests that Australian industry has not traditionally been very good at obtaining overseas knowledge, partly because of our tradition of protecting industry from international competition.
- encouraging international openness is an important policy implication; in this regard universities that are active in the international research community can play an important role.

The Higher Education Balance Sheet for the Government

- one way of looking at higher education from the government's point of view is in terms of a balance sheet approach; i.e. how much does it spend on higher education and how much does it get back in the form of higher tax revenue from the higher earnings of graduates (a broader balance sheet would also take into effect any flow on effect of graduates on the earnings of others).
- We use two different approaches to estimate the position of the government in relation to higher education
    1. A spreadsheet of actual and projected government expenditure and income from 1981-82 to 1996-7 with some projections for future years.
    2. A calculation of the rate of return to government of a new cohort of students, commencing in 1999.
- Our estimates suggest that government spending on teaching in higher education in 1997-98 (excluding research) was about $5.3 billion and that government receipts that result from the higher incomes of the stock of graduates due to their higher education was about $8 billion, pitting the government about $2.7 billion "ahead" on the balance sheet.
- Prior to 1994-95 the balance was often negative. In recent years it has moved into substantial surplus, primarily due to developments in relation to HECS.
- Our central estimate of the average rate of return to government from their investment in higher education is about 11 per cent, which is a very high return.
- More research is required to shed light on the marginal rate of return to government. That is what is the return to an increment in investment in higher education.

The Export of Higher Education

- There has been a dramatic growth in foreign students undertaking higher education in Australia increasing from about 20,000 in 1988 to about 70,000 by the late1990s.
- This increases the value of our net exports. Baker, Creedy and Johnson (1996) report that overseas exchange earnings in 1992 amounted to $1287m (in 1994 prices).
- In terms of future trade flows it is argued that the contacts and knowledge acquired may lead to higher Australian exports in the non-education sector.
- Baker et al (1996) have estimated that jobs created by demand generated by overseas students exceed those taken by overseas students and their families.

Conclusions and Further Research

- Evidence presented in this report suggests that investment in higher education yield high return to individuals, society and the government.
- On the face of it this suggests that there may be the case for government implementing policies to increase the investment in higher education in Australia.
- More evidence is needed about marginal rates of return with respect to different types of education expenditure.
- Evidence presented suggests that investing in the quality of education may be an important priority.
- Evidence is also presented which suggests that there are high social rates of return to investment in research.

Chapter 1: Introduction

The principal aims of this report are:

- to review and uncover new research evidence on the returns to individuals and society of higher education in Australia;
- to examine the evidence on returns to quality in higher education;
- to review the evidence on returns to university research;
- to provide sound estimates of government expenditures on, and government revenue that results from, higher education; and
- to evaluate the role of higher education as an export.

We also seek to draw out the policy implications of the findings and highlight further research needs.

The five aims form the basis of chapters 2 to 6 respectively. However, it is helpful to provide a perspective in which to consider returns to higher education. We discuss the importance of higher education in this introductory chapter.

A number of economic concepts are used in this report such as "the private rate of return to education", 'the social rate of return to education", and "external benefits from education". These will mostly be defined as they arise. However, it is useful to provide a conceptual introduction to the key ideas of the private and social rates of return and of the governments balance sheet for higher education and this forms the last part of this chapter.

1.1 Importance of Higher Education to the Economy

Universities are important industries in the economy. Activities undertaken in universities provide about 2 per cent of GDP. The importance of universities is growing. Numbers of students undertaking higher education have increased dramatically over the last twenty years.

Government is both a major provider and a funder of universities. In 1996 government provided about $4.6 billion to fund teaching and research activity in universities.

Table 1.1 shows the composition of estimated outlays on education and training by source and by level. In 1996 about $37.6 billion was spent by government and private sources on education and training. Given standard ways of measuring the value added by the education industry this represents about 7.3 per cent of Gross Domestic Product.[1] The school sector makes up about 51 per cent of the total industry followed by training, 26 per cent and university 23 per cent.

[1] In national accounts since there is no free market to establish a value for much of the education product the value added of the education industry is estimated as the value of resources used in its production. Thus we use the estimated outlays by government and private individuals and firms as the estimated value added of the industry. In 1996 GDP was about $516 billion.

Table 1.1: Outlays on education and training, $ billion 1995-6

	Government	Private	All	
	$ billion	$ billion	$ billion	Per cent
School (Primary and secondary)	13.5	5.8	19.3	51
TAFE/ employers	4.4	5.4	9.7	26
University	4.6	3.9	8.5	23
All education	22.5	15.1	37.6	100

Source: ABS (1998), and estimates of author

Participation in higher education has grown strongly over recent years rising from 28 per 1000 in the age groups 17 to 64 in 1975 to stabilise at 50 per 1000 in 1996 (Table 1.2). This trend together with the growth of the population has led to enrolments in higher education increasing from 250,000 in 1975 to about 690,000 in 1999.

Table 1.2: Participation in higher education

Year	Participation rates, (rate per 1,000 population age 17-64)	Total higher education enrolments, persons
1975	28	250,000
1980	31	300,000
1985	36	370,000
1990	42	485,000
1995	48	604,177
1996	50	634,094
1997	50	658,827
1998	50	671,853
1999	50	686,202

Sources: DETYA (various issues) Selected Higher Education Student Statistics, November AGPS: Canberra; ABS (various issues) Estimated Resident Population Catalog 3201.0; and calculations of authors

Government support of Universities

Government is the main funder of universities although its importance is diminishing. Table 1.3 shows the sources of university funds in 1997. The table shows that government grants make up over half the income of universities.

Table 1.3: Funding of higher education

Funding source	1997, per cent
Commonwealth government grants	53.8
Fees and charges	14.9
HECS	14.7
Investment income	4.0
Donations and bequests	1.2
State government	1.1
Other (industry support etc)	10.0
All	100
Total funds	8.2 $billion

The shares in Table 1.3 reflect the historical situation. However an effective doubling of HECS fees in 1997 means that in future the contribution from HECS will double and the net cost to government will fall concomitantly, probably to around 40 per cent of university budgets. These effects will occur with a long lag as the net impact on government will not be fully in place until current HECS students have repaid their debts and this is likely to take up to ten years for many.[2]

Output of universities

Universities provide three main classes of output, private benefits for students, research and social benefits that accrue to the society at large. The private benefits include the intrinsic value of the learning acquired in a particular field during their period at university, the more general value of the acquisition of a dispassionate approach to learning and the value of a formal qualification signifying achievement of a level of competence. The private benefits can be directly measured in the form of the increased earnings of graduates (over what would have been earned in the absence of the training).

Research has direct benefit for the economy providing technological improvements, deeper and broader understanding of social and economic phenomena, skills and experience. There are also important serendipitous spillover effects to research undertaken outside universities.

Social benefits from universities are much harder to define and estimate. They include a wide range of intersecting and indirect benefits that are not included in the private benefits of individuals or are direct research outcomes. They include, for instance:

- increased learning of graduates provides increased learning for non-graduates in the form of knowledge disseminated;
- cultural and social standards set by universities improve the social infrastructure which underpins the harmonious working of society and the economy;
- valuable means of interaction with individuals and groups from other countries with attendant trade, social and cultural opportunities;

[2] Note that the calculations do not assume that all HECS debts will be repaid. In the calculations undertaken in Chapter 5 about 85 per cent of the HECS debt is assumed to be repaid after 10 years.

- the promotion of inquiry and dispassionate debate on public policy issues leads to improved public decision making; and
- a training ground for staff members who may leave university to take up positions in industry, the public service, governance or the community.

Research and social benefits of universities underpin government spending on universities. While it might be argued that increased earnings by graduates would provide sufficient incentive for individual students to pay for their education, problems of ignorance and risk notwithstanding, there is little incentive for the direct beneficiaries of basic research and of the social benefits to pay for these outputs of universities. Left to the market there would be a less than socially desirable level of investment.

While the public good aspects of university output outlined above are not challenged the more pertinent point is the appropriate level of government support. That is, what level of funding will achieve the appropriate social return to government (on behalf of society at large). Should present levels of support be increased or allowed to continue to decrease?

Government can only decide this matter relative to competing social returns from other uses of its fixed budget. While the social returns form other forms of investment are unknown and must be judged by Government it is important to be able to document the likely returns from government investment in universities. This report is presented in the spirit of adding to the information available to government.

In evaluating the benefits we distinguish quantifiable benefits, largely in the form of increased earnings of students, and unquantifiable benefits. Benefits include:

- higher earnings by graduates; and
- higher growth

Costs include:

- the net cost of running universities (costs to government less income from fees, see Baker et al, 1996); and
- fees including HECS fees and fees paid by full-fee paying students from both overseas and local

In many situations it is difficult to separate the value of benefits provided by universities. The two main forms of output, teaching and research, are joint products so that some benefits of research emanate from investment in teaching and vice versa.

In addition the time frame for evaluating public investment in higher education is long. Since benefits accrue over the lifetime of the graduates whereas most of the costs are incurred during the three or four or so years of study the issue of discounting becomes integral to the estimates.

There are also many benefits that are difficult to quantify. These include:

- higher wellbeing through greater knowledge;
- a contribution to culture;
- a contribution to and stimulation of, policy debate; and
- improved international relations through the provision of higher education to overseas students, through formal student and staff exchange programs.

1.2 Private and Social Rates of Return to Higher Education

Graduates receive a substantial wage premium due to their education, on average of the order of 65 per cent over their lifetime. This mainly reflects the effect of higher education on their productivity. This benefit to the individuals in the form of higher post-tax income and to society of higher pre-tax income, has to be weighed against the cost of the education to the individuals and society.

In making the investment the individual incurs tuition costs, and foregoes some income; society incurs the full cost of the education and any lost output while the individual is being educated. Thus the investment in the education can be viewed like other investments, and evaluated for its rate of return.

Individuals can then compare the rate of return with the rate of interest to decide whether it is a good investment, and society can compare the social rate of return to higher education with other possible uses of funds.

Typically, when researchers calculate the private or social rate of return they are calculating an average. Thus some individuals earn a higher rate and some a lower rate.

For society, in principle government policy should be concerned with the marginal rate of return when deciding whether to increase their expenditure on higher education. If the additional expenditure were to enable more students to be educated it is the return from that marginal student that is the issue; if it is higher expenditure per student that is being considered it is the effect of such extra spending on those students, through any improvements in quality that is the issue.

1.3 The Government's Higher Education Balance Sheet

One way of looking at higher education from the government's point of view is in terms of a balance sheet approach; i.e. how much does it spend on higher education and how much does it get back in the form of higher tax revenue from the higher earnings of graduates (a broader balance sheet would also take into effect any flow on effect of graduates on the earnings of others).

Chapter 2: The Private and Social Rates of Return to Higher Education in Australia

2.1 Introduction

Undertaking education is an investment. A decision to 'purchase' extra education incurs costs at the time the education is undertaken, and subsequently upon entry to the workforce, a stream of future benefits. For example, for an individual undertaking a university degree there is a cost of foregone earnings during the period of study, and a benefit of higher expected earnings during the individual's subsequent period in the workforce.

The relative magnitude of the costs and benefits from acquiring a university degree determines the net benefit from the investment. A summary statistic that is generally used to measure the net benefit from investment in education is the internal rate of return - the rate of interest that equates the present discounted value (PDV) of the costs and benefits from an investment. Often a distinction is made between the private and social rates of return to education. The private rate of return takes into accounts the costs and benefits to the individual undertaking the education; whereas the social rate of return encompasses the costs and benefits for society. For example, the private rate of return to education for an individual will depend on the extra after-tax income gained by investing in extra education, whereas the social rate of return should include the gain in both after-tax income and tax revenue (or in other words, the increase in the value of output in society).

In this report the objective is to summarise existing evidence on the rate of return to a university degree in Australia, and to provide some new estimates of the private and social rate of return. Knowing the rate of return to a university degree is useful for several reasons. First, for an individual, information on the private rate of return can assist in making an assessment about whether it is optimal to undertake extra education. Second, for policy-makers with scarce resources to allocate between competing policies, the social rate of return to education provides one measure that can be applied to assess the relative value in providing extra funds for education. Third, the process of calculating the rate of return can provide important information on the main determinants of the return to investment in education. This information can, for example, be used to seek to explain trends in participation in education.

Section 2 provides an outline of the general methodology for calculating the rate of return to a university degree. Section 3 reviews evidence from existing Australian studies of the rate of return to university education. Section 4 presents new estimates of the rate of return to a university degree using data from the ABS Training and Education Experience Survey 1997.

2.2 Methodology

Introduction

The calculation of the rate of return to university education that is undertaken in these notes involves the following experiment – Consider the case of a single individual who has completed high school and is making a decision on whether to undertake a bachelor-level degree. In this exercise the rate of return is the rate of interest that equates the PDV of the costs and benefits of acquiring a university degree. This can be expressed formally as:

$$\sum_{t=1}^{n} C_t/(1+r)^t - \sum_{t=n+1}^{m} B_t/(1+r)^t = 0 \qquad (1)$$

where: C_t = opportunity costs of university degree in year t;

B_t = benefit of university degree in year t;

n = length of education;

m – n = years in workforce; and

r = rate of return.

(In this expression for the rate of return it is assumed that all costs are incurred in years 1 to n, and benefits accrue between years n and m.)

Potential problems with the methodology

It is important to note that the method of calculation of the rate of return to a university degree that has been used in existing research (and is followed in this study) is a 'partial equilibrium' exercise. That is, it is assumed that if one extra individual chooses to acquire a university education rather than leaving education after high school completion, this will not affect either the costs or returns to acquiring a university degree. For example, with one extra individual with a university degree it is assumed that the relative earnings of workers with university degrees compared to workers whose highest education if high school completion are not changed. If instead of examining the return to an extra individual acquiring a university degree, what was being considered was the return from switching a large group in the population from high school completion to having university degree, the assumptions made in the partial equilibrium approach may not be valid. In that case, it might be better to adopt a 'general equilibrium' approach that would, for example, take into account possible effects on relative earnings by education attainment of the increase in the proportion of workers with university degrees.

Results on rates of return that are obtained from this study will represent an average return for all individuals in the population who have undertaken a bachelor degree. For some policy decisions this may not be exactly the appropriate measure of rate of return. For example, suppose that the rate of return to acquiring a bachelor degree differs between individuals in the population, and that the government is interested in the social benefits of expanding higher education from whatever its current level might be. Then the appropriate concept of rate of return to apply would be the marginal rate for those extra individuals who will acquire university degrees as a result of the expansion of higher education. To the extent that this marginal rate is above (below) the average rate of return for individuals who already have university degrees, the type of average rate of return measure derived in these notes will be an under-estimate (over-estimate) of the rate of return that is appropriate for the policy exercise.

Types of costs and benefits from undertaking a university degree

A range of types of costs and benefits are associated with the decision to undertake a university bachelor degree. These costs and benefits are summarised in Table 2.1. From the perspective of an individual making a private decision about whether to undertake a university degree a primary source of costs and benefits relates to labour market activity. During the period of study an individual is likely to forego some labour market earnings, but following the investment, the higher level of educational attainment should mean that the individual has higher earnings than without a degree.

Acquiring a university degree may also increase an individual's probability of employment (or weeks of employment each year). Other costs and benefits are more direct – fees paid to undertake the degree, and the monetary cost of student amenities fees, textbooks and transport

costs, which may be offset to some degree by government benefits for students (for example, Youth Allowance or ABSTUDY). From the social perspective there are three main sources of costs and benefits. First, a source of social benefit is the increase in the value of output from having an individual with a university degree rather than having completed high school. (To the extent that having an extra person with a degree or an extra person studying affects aggregate employment this may also be a source of costs and benefits – This issue is discussed in more detail in the next sub-section.) Second, direct social costs are the total costs incurred in providing the extra person with a degree, the costs of student amenities fees, textbooks and transport costs, and costs of government benefits paid to students. Third, a variety of external benefits of education may exist – for example, the value of having a more educated society.

Table 2.1: Costs and benefits of tertiary education

	Private	**Social**
Benefits	Increase in after tax earnings from labour market activity	Increase in value of output
	Higher probability of employment	Increase in employment?? (cf. Displacement effects)
		External benefits – Educated society; Knowledge spillovers; and Complementarity with technological innovation.
Costs	Foregone earnings from labour market activity during period of education	Loss of output?? (cf. Displacement effects)
	Fees	Cost of provision of education
	Direct costs minus government student benefits	Government student benefits

Assumptions for calculating the rate of return to a university degree

In order to calculate the rate of return to a university degree (that is, to put the formula in equation (1) into practice) it is necessary to be more precise about how to calculate costs and benefits, and to make some assumptions about future outcomes for an individual who has completed high school for the situations where that individual does and does not choose to acquire a university degree. The set of issues regarding measurement of costs and benefits and assumptions relevant to the private rate of return are -

1. What is the effect of having university degree relative to high school completion on annual labour market earnings for each age at which an individual is in the labour force? (The effect on annual labour market earnings equals the composite effect of university degree on hourly earnings, weekly hours of work, and weeks of work.);
2. What income tax rates will apply to labour market earnings?;
3. What is the duration of the university degree, what time will the individual take to complete the degree, and what is the probability of drop-out?;
4. At what age will the individual retire from the workforce?;
5. What are the foregone annual labour market earnings during the individual's period of study for the university degree (equals annual labour market earnings if not undertaking university degree minus annual labour market earnings if undertaking university degree);
6. What fees are paid by the student to undertake the university degree?

7. What government benefits are paid to the individual for undertaking the university degree?;
8. What are the direct costs (eg., books) to the individual of undertaking the university degree?

The set of issues regarding measurement of costs and benefits and assumptions relevant to the social rate of return are –

Issues 1, 3 and 4 plus

9. What is the total cost of the university degree to the government?
10. What is the magnitude of displacement effects on employment from having an extra individual undertaking study for a university degree and having an extra individual with that level of educational attainment?
11. What is the value of external effects from an extra individual with a university degree?

Out of these sets of issues two issues require some more detailed comment –

a) The effect on annual earnings from having a university degree relative to high school completion –

This effect is usually estimated either from data on average annual earnings for workers in disaggregated education attainment and age groups, or from regression analysis of the determinants of individual earnings. But these approaches have several problems. First, there are problems in separating the 'true' increase in labour market earnings from acquiring a university degree from, for example, the fact that it tends to be individuals with higher general intellectual ability who acquire more schooling (see detailed discussion in Appendix). Second, using cross-section data to make predictions on lifetime earnings profiles can be subject to error if age-earnings profiles are changing over time. And third, some part of any increase in labour market earnings from acquiring a university degree may be due to a 'screening effect' rather than from an increase in the productivity or human capital of the individual who acquires the degree. (A screening effect occurs where – independent of any effect of a university degree on productivity - employers use an individual's level of education attainment to estimate the productivity of potential employees, and hence the role of education is as a sorting mechanism. To the extent that the role of university education is as a screening mechanism rather than productivity enhancing, the value to society will be lower.)

Existing Australian research has tended to make a crude type of adjustment for the third type of problem (for example, assuming that screening effects constitute 20 per cent of the estimated effect of education on individual earnings), but have ignored the first and second issues. On the first issue it does seem that there is scope for further work using sophisticated econometric techniques to attempt to derive improved estimates of the effect of education on earnings. (This has not been attempted thus far. The approach in these notes follows existing research.) On the second issue, recent research by Borland and Kennedy (1999) – showing that age-earnings profiles have been relatively stable in Australia during the 1980s and 1990s - suggests that using cross-section age-earnings profiles to derive lifetime earnings forecasts may not impart significant bias to estimates of the rate of return.

b) Displacement effects –

Acquiring a university degree may increase an individual's probability of employment but may not have same effect on overall employment. Even with a fixed level of aggregate labour demand, when an individual acquires a university degree this is likely to increase that individual's probability of employment since – to the extent that employers allocate jobs according to education, or the pool of jobs available to a job-seeker increases with education attainment - an individual with a university degree will 'jump' ahead of the group of individuals

whose highest education attainment is high school completion. (See Vickery, 1999, on evidence that the range of jobs with which an individual can 'match' increases with education attainment.) Hence the effect on employment is likely to be a source of private benefit. However, unless the extra person with a university degree results in an increase in labour demand, or an improvement in labour market matching, there will not be an effect on overall employment and hence a social benefit through this channel. Of course, it is possible to think of ways in which labour demand might increase with the proportion of individuals with university degrees in an economy (for example, the higher proportion of persons with a degree might allow the economy to shift away from production of goods that compete with low-wage labour countries to production of goods that are intensive in high-skill labour with less product market competition). Nevertheless, the effects on overall employment are likely to be less than the probability of employment for an individual. (A similar issue arises with regard to the loss of earnings for an individual undertaking a university degree. This is a private loss but does not necessarily translate into social loss. Some other individual is likely to take the job of the individual who chooses to acquire a university degree.)

2.3 Existing Australian Studies

There are a small number of existing studies that have calculated the rate of return to a bachelor degree. The details of these studies and their main findings are summarised in Tables 2.2 and 2.3. Table 2.2 presents information on studies that estimated returns for a single cohort of individuals completing a degree. Table 2.3 presents findings for studies that estimated returns for several cohorts.

Table 2.2: Annual rates of return to tertiary education in Australia – Single-year studies

Study	Sample	Base year	Type of return	Change in education attainment	Group	Return
Blandy and Goldsworthy (1975)	Males – South Australia	1969	Private	CHS to Bachelor degree	All sample	13.9%
Chapman (1977)	Males – Australian Public Service employees	1974	Private	CHS to Bachelor degree	Zero earnings at school	11.3%
					$2400 earnings per annum at school	16.1%
Miller (1982)	Persons – Australia	1976	Private	Left school at 18 years to Bachelor degree	Males – Australian born	21.1%
					Females – Australian born	21.1%
			Social		Males – Australian born	16.3%
					Females – Australian born	16.3%

Study	Sample	Base year	Type of return	Change in education attainment	Group	Return
Chapman and Chia (1989)	Persons - Australia	1985/86	Private	CHS to Bachelor degree	Males - HEAC	11.0%
					Males - HECS delayed payment	10.5%
					Males - HECS up-front payment	10.0%
					Females - HEAC	15.0%
					Females - HECS delayed payment	14.9%
					Females - HECS up-front payment	13.5%
Chapman and Salvage (1997)	Persons - Australia	1996	Private	CHS to Bachelor degree	Males – HECS (1997) – Delayed payment	9.42%
					Females – HECS (1997) – Delayed payment	5.77%

Table 2.3: Annual private rate of return to tertiary education in Australia – Time-series studies

Study	Sample	Change in education attainment	Year (%)					
			68/69	**74/75**	**78/79**	**81/82**	**85/86**	**89/90**
Miller (1984)	Males – Australia	Left school at 18 to Bachelor degree	24.0	22.4	19.4			
Chia (1991)	Males – Australia	Left school at 18 to Bachelor degree			17.2	16.2	14.9	
Maglen (1994)	Males – Australia	Left school at 17 to Bachelor degree	18.0	18.1	16.1	15.0	13.5	13.5
	Females – Australia	Left school at 17 to Bachelor degree	18.2	19.6	13.7	14.0	13.2	12.0

Most of the studies are now somewhat dated and use earnings data from the 1970s and 1980s (an exception is Chapman and Salvage, 1997). Obviously there have been considerable changes in university financing since that time so that the relevance of the studies may be somewhat limited.

Several main findings emerge from the studies:

1. The most recent studies – using earnings data for the 1980s - tend to find very similar results. That private rate of return to bachelor degree relative to completion of high school (left school at 17/18 years) is between 10 and 15 per cent. The rate of return is similar for males and females. Hence it seems reasonable to conclude that the private return to a university degree is fairly sizeable.

2. The private rate of return to a university degree fell somewhat between the 1970s and 1980s. (Research on changes in average earnings across education categories suggests that this is likely to be explained by two factors – A greater increase in the supply of persons with a degree than in demand for persons with a degree, relative to other levels of educational attainment during the 1970s; and lower rates of return for cohorts of individuals completing university degrees in the 1980s than 1970s (perhaps reflecting a decrease in the average ability of students undertaking university degrees following the significant expansions in university education) – see Borland, 1996 and Maglen, 1994.)

3. The only study that has examined both social and private rates of return (Miller, 1982 using Census data for 1976) finds that the private rate of return is about 5 per cent higher than the social rate of return. (It is important to note that at that time of this study estimation of private rates of return did not incorporate HECS payments.)

4. The main determinants of the private rate of return appear to be –

- The magnitude of the increase in annual labour market earnings from acquiring a university degree; and
- Costs – The size of government allowances to students; Time taken to complete degree/Probability of drop-out; and Method of HECS payment. (The latter factor was relevant for the initial HECS scheme but is likely to be less important in the 1990s following modifications to the relative cost of up-front and delayed payments.)

2.4 New Research

In this section findings from research to calculate new estimates of the rate of return to education in Australia are reported. In the basic case the return is calculated for a hypothetical individual whose options are assumed to be to: a) Commence employment in 1995 at age 18 with education attainment of high school completion; or b) Undertake a 3-year university bachelor degree between 1995 and 1997 and commence employment at age 21 in 1998. The hypothetical individual is assumed to be male (due to difficulties in accurately estimating the effect on earnings of education for females), and to have obtained his highest qualification in Australia. (As well as the basic case, some sensitivity analysis to estimate the rate of return for the case of a 4-year degree is undertaken.)

Methodology

Key assumptions and methods of data construction are –

1. Measures of average weekly earnings for an individual who had completed high school or who has a bachelor degree are derived from the ABS 1997 Training and Education Experience Survey (TEES). The sample used to obtain the estimates is males aged 15-60 years working part-time or full-time. Two approaches were used –
    - Use data on average weekly earnings for males who had completed high school or who have a bachelor degree or above disaggregated by age (age groups in the data set are 18, 19, 20, 21, 22, 23, 24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54 and 55-59 years);
    - Construct predicted weekly earnings for males who had completed high school or who have a bachelor degree disaggregated by years of experience using a regression equation for weekly earnings (including level of education, a quadratic in years of experience, occupation and industry dummy variables, a dummy variable for whether disabled, a dummy variable for whether in a casual job, a dummy variable for whether a trade union member, a dummy variable for marital status, and dummy variables for size of business, country of birth, state of residence and English proficiency) – see Appendix 2.A for further details. Predicted weekly earnings are constructed using as weights

sample averages in each category (i.e., the weekly earnings are intended to represent an 'average' male working in Australia).

It is assumed that age-earnings or experience-earnings profiles derived using the 1997 ABS TEES data apply over the future time period that an individual ceasing education in 1994 or 1997 would be in the workforce. Real earnings growth is assumed to be 2 per cent per annum, and it is assumed that 80 per cent of the earnings difference between a male who has completed high school and with a university degree is due to increased productivity or human capital. (These are the same assumptions as made by Miller, 1982). The weekly earnings variable in the TEES is classified into 29 categories. For the upper category of $1160 and above it is assumed that average weekly earnings are $1542.80 (equal to 1.33 times the upper bound). Data from the ABS 1996/97 Income Distribution Survey suggests that this is an appropriate assumption. For all other categories weekly earnings are set equal to the mid-point of the category. Calculations of average earnings for persons with a bachelor degree are made using all persons with a bachelor degree or above. To the extent that this group includes some individuals with post-graduate qualifications, whose earnings have been increased by the acquisition of those qualifications, estimates of the rate of return to a bachelor degree may be upward-biased. (But omitting persons with post-graduate qualifications would be likely to have the opposite effect since that group are likely to be of higher average ability than the group whose highest qualification is a bachelor degree.)

2. Effect of education on employment – The probability of employment (given participation in the labour force or marginal attachment to the labour force) is estimated for males who had completed high school or who have a bachelor degree disaggregated by age. The estimate is derived from a probit regression equation for the determinants of employment (including level of education, dummy variables for age, a dummy variable for whether disabled, a dummy variable for marital status, and dummy variables for country of birth and English proficiency) – see Appendix 2.B for details. The estimated probability of employment for a male who has completed high school and with a university degree is multiplied by 52 to obtain an estimate of the annual weeks of employment for each case. The estimates of the probability of employment are constructed using as weights sample averages in each category. It is important to note that estimates are derived from 1997 data when the aggregate rate of unemployment was about 8 per cent. To the extent that the average rate of unemployment over the next 40 years will be below the rate in 1997 – and that the effect of a degree on the probability of employment will therefore be lower – estimates of the rate of return to a university degree may be slightly upward biased.
3. Earnings during the period undertaking the university degree are calculated from the ABS TEES 1997 as average weekly earnings for full-time male students aged 18-20 years.
4. Marginal income tax rates for 1997-98 - $1 to $5400 – Zero; $5401 to $20700 – 20%; $20701 to $38000 – 34%; $38001 to $50000 – 43%; Over $50001 – 47% - are assumed to apply throughout all periods of employment.
5. It is assumed that it takes the hypothetical individual three years to complete a three-year degree, and four years to complete a four-year degree.
6. Retirement age is assumed to be 60 years.
7. The HECS payment per annum is assumed to $4215.80 (estimated average HECS payment in 1996 – Williams, 1997, Table 7). The payment in each year is assumed to be made up-front.
8. The total cost per student per annum to the government of providing a bachelor degree is assumed to be $10,881 (estimate provide by Ross Williams derived from the DEETYA 'Higher Education Funding report for the 1997-99 Triennium' – Operating grant in 1996 = $4538.194 million divided by student funded load of 417,080.) This total cost measure

excludes any estimate of the opportunity cost of capital resources utilised in providing the bachelor degree (such as rental cost of land and buildings).

9. Government benefits – It is assumed that the student is not eligible for any benefit payments such as the Youth Allowance.
10. Direct costs are assumed to be $1100 per annum (Based on an estimate of $300 for student amenities fee plus $100 cost of books etc. per semester-length subject).
11. Displacement effects are assumed to vary between 75% and 100%.
12. External effects – The external benefits of an extra individual obtaining a bachelor degree are assumed to be zero.

Preliminary analysis

Preliminary to reporting findings on the rate of return to a university degree the exercise of presenting information on the magnitude of the monetary costs and benefits underlying the private rate of return is undertaken. The exercise is performed for the case of an individual acquiring a 3-year degree using data on average earnings and not making an adjustment for employment effects. (This is intended to correspond to the analyses undertaken by Miller, 1982 and Maglen, 1994.)

The findings are presented in Table 2.4. Assuming a zero rate of discount it is shown that the total cost of undertaking a degree is $24,368 over the three years of study (or $8,123 per annum), and that the total gain in earnings is $297,681 over the 39 years prior to retirement (or $7,632 per annum). The total lifetime gain from undertaking the degree is therefore $273,203. Assuming a four per cent rate of discount the total cost during the period of study is $22,395 and total benefit during period in the workforce is $112,828. The total lifetime gain from undertaking the degree with the four per cent rate of discount is $90,433. Benefits are reduced by a much greater magnitude than costs by discounting because all costs are incurred over the first three years of the time horizon, whereas benefits are spread over the next 39 years.

Table 2.4: Private monetary costs and benefits of a 3-year university degree

	Total	**Annual**
A. Zero rate of discount		
Age 18-21:		
Foregone earnings	8,421	
Cost of fees and direct costs	15,947	
Total cost	24,368	8,123
Age 22-60:		
Increase in earnings	297,681	7,632
Total lifetime gain	**273,203**	
B. Rate of discount – **4 per cent**		
Age 18-21:		
Foregone earnings	7,643	
Cost of fees and direct costs	14,752	
Total cost	22,395	7,465
Age 22-60:		
Increase in earnings	112,828	2,893
Total lifetime gain	**90,433**	

Main findings – Rate of return

The findings on the rate of return to acquiring a bachelor degree are summarised in Tables 2.5 and 2.6. Table 2.5 presents a range of estimates of the private and social rate of return for alternative assumptions on - the private effects on employment of a university degree, displacement effects, duration of degree, and methods of calculating the effect of a university degree on weekly earnings. Table 2.6 presents a comparison of the results from two earlier studies – by Miller (1982), Maglen (1994), and Chapman and Salvage (1997) – with results from this study using a comparable methodology.

Table 2.5: New estimates of the annual rate of return to university degree in Australia

	Private rate of return	Social rate of return
A. Average earnings – 3 year degree		
No adjustment for employment effects	15.0	
Adjustment for employment effects	22.0	
Displacement = 100%		16.5
Displacement = 90%		20.5
Displacement = 75%		25.5
B. Average earnings – 4 year degree		
No adjustment for employment effects	12.0	
Adjustment for employment effects	17.0	
Displacement = 100%		14.5
Displacement = 90%		17.5
Displacement = 75%		22.0
C. Regression adjusted earnings		
No adjustment for employment effects	9.5	
Adjustment for employment effects	13.5	
Displacement = 100%		18.5

Table 2.6: Comparisons of estimates of rate of return to university degree – Australia

Study	Year of data	Private rate of return	Social rate of return
Miller (1982)	1976	21.1	16.3
Maglen (1994)	1989/90	13.5	
Chapman and Salvage (1997)	1996	9.4	
This study – 3 year degree	1997	15.0	16.5
This study – 4 year degree	1997	12.0	14.5

The main findings are:

1. Both private and social rates of return to a university degree remain high – at around 15 per cent.
2. Estimates of the rate of return from this study using the same methodology as in previous studies obtain comparable results. The private rate of return is about 15 per cent which is close to what was found by Maglen using earnings data from 1989/90, and slightly above the rate of return found by Chapman and Salvage. The main explanation for the difference between the findings of Chapman and Salvage and this study appears to be a higher estimate of earnings during the period of study obtained from the TEES data source used in this

study than from the 1995 Drug Strategy National Survey used by Chapman and Salvage. The estimated social rate of return is about 16-17 per cent which is almost the same as was found by Miller (1982) using 1976 data. Interestingly, the social rate of return is now above the private rate of return (whereas Miller finds the opposite). The introduction of HECS payments seems likely to be an important explanation for this finding.

3. The magnitude of private rates of return increases significantly once account is taken of the effect on the probability of employment of having a university degree. Previous studies have not allowed for this effect and hence might be considered to have under-estimated the private return to a degree.
4. Increasing degree length from 3 years to 4 years (assuming the change in degree length does not affect the earnings gain from a degree) lowers the private rate of return to a university degree by about one-fifth, and the social rate of return by about one-eighth.
5. Allowing that having an extra person with a university degree might to some degree expand total employment significantly increases the magnitude of the social rate of return to a university degree. For example, if aggregate employment expands by one for every extra ten persons who acquire a university degree then (under scenario A in Table 5) the social rate of return increases from 16.5 to 20.5 per cent.

2.5 Future Work

Future work will extend the research reported in these notes in two main ways. It will calculate rates of return for disaggregated groups – specifically:

1. Disaggregated groups by Bachelor degree/Postgraduate diploma/Higher degree; and
2. Disaggregated groups by Field of Bachelor degree – for example, Business; Health; Education etc. (Chapman and Salvage, 1997, find large differences in private rates of return between some selected occupation groups – for example, nurses and lawyers).

Second, further sensitivity of estimates of rate of return to university degree of changes to method of calculating effect on earnings, and other assumptions, could be undertaken.

Chapter 3: Returns to Quality in Higher Education

3.1 Introduction

In practice the quality of education must necessarily be measured by a money metric, most usually expenditure per student. Alternative measures of quality such as improvements in knowledge, problem solving abilities etc, are difficult to combine into a single measure which can be tracked over time. Quality will also be higher if teaching is done by dedicated and inspirational staff teaching up-to-date material, but expenditure in the form of staff salaries is a major determinant of this.

Increases in expenditure per student can be allocated in three ways: improvements in the ratio of students to academic staff, additional facilities such as computing, and increased remuneration to staff.

How are these three uses of funds likely to contribute to future income levels and national economic growth? Improvements in student-staff ratios facilitate the imparting of work and social skills such as the ability to communicate and to work in teams. At low levels of funding per student, there is a tendency for education to be narrow defined and technically based, whereas employers are demanding wider skill sets. Lower student-staff ratios also allow additional time for academic staff to undertake research and here the social rate of return is relatively high. Improved facilities, particularly access to computing and the internet facilitate learning and enable the university to more closely resemble the work environment and hence raise the productivity of new entrants to the workforce. Increased remuneration to staff will attract more highly trained and competent staff thus tending to raise the quality of teaching and research training and research. There exists a global market for good academics and researchers and if Australian education is to be international competitive, rates of remuneration must be international competitive.

The method by which universities are funded in Australia by the Commonwealth government and the near absence of private universities means that expenditure per student in Australian universities is very similar within disciplines, at least at the undergraduate level. This means it is not possible to examine the effects of different expenditure levels, at least in a comprehensive manner.

It is interesting to note, however, in their study of research output of academic economists in Australia, Fox and Milbourne (1999) find a significant negative effect of teaching hours on research output. They estimate that a 10 per cent increase in the number of teaching hours reduces research output by as much as 20 per cent. A decrease in teaching hours brought about by increases in government funding used to reduce student-teacher ratios might be expected to have a similar effect. Fox and Milbourne also find that research output is positively related to the degree of research training undertaken by an academic, including a coursework component in the Ph.D.

For more detailed evidence of the effects of expenditure levels per student it is necessary to look to other systems.

3.2 International Evidence

Brewer and Ehrenberg (1996) summarise the historical U.S. literature on returns to quality in higher education. A range of quality measures are used, including expenditure data (average salaries, expenditure per student etc). After reviewing the literature, Brewer and Ehrenberg conclude: "In general this research finds that attending a higher quality college raises earnings, ceteris paribus, though the magnitude of the estimated effect varies from negligible to large". Some specific findings of the effect on earnings of quality as proxied by expenditure are: Solmon (1973,1975) included as the explanatory variables instructional expenditures per student and average academic salaries which were found to be statistically significant; Wachtel (1976) used expenditure per student which was statistically significant but the effect was numerically small; in the studies of Morgan and Duncan (1979), James et al (1989) and James and Alsalman (1993) expenditure per student was insignificant.

In a detailed study of twins data, which controls for family effects, by Behram, Rosenzweig and Taubman (1996) the strongest empirical finding was that significantly higher earnings were enjoyed by those who had attended PhD granting, private universities with well-paid senior faculty members. These results were net of individual and family endowments. Interestingly, the expenditure component which mattered was academic salaries, presumably measuring the quality of staff. Compared with a high school graduate, the earnings for a B.A. graduate from a large private research university were on average 56.6 per cent higher, with a present discounted value of earnings differential of over $170,000.

A weakness of this earlier research is that the quality of education is taken as an exogenous determinant of earnings. This does not take account of individuals using expected labour market payoff in choosing a college. While the empirical studies usually include measures of ability and family characteristics as explanatory variables (along with quality) they do not allow for endogeneity of college selection in an appropriate statistical manner, i.e. there is selectivity bias in the parameter estimates.

A recent paper by Brewer, Eide and Ehrenberg (1999) extends the conventional analysis by specifically correcting the estimated earnings equations for selectivity bias. The procedure is to first estimate a college choice model, where the choice of college type (private/public, high/medium/low status) is made a function of net costs, high school grades, parental income etc. The results from this are fed in to the wage equation to purge it from selectivity bias. They find that (p.104) "Even after allowing for selection effects, strong evidence emerges of a significant economic return to attending an elite private institution, and some evidence suggests this premium has increased over time."

Dale and Krueger (1999) examine the effect of university quality on students' subsequent earnings using data on sets of students who had offers and rejections from similar institutions. In this way they aim to control for those unobserved characteristics which influence selection. They find that with this control, future earnings for comparable students are not related to the selectivity of the institution (measured by average SAT score of institutions) actually attended. They do find, however, that the average tuition charged by the institution is significantly related to future earnings. The results are less clear cut when expenditure per student is used instead of average fees. Taken together, these findings again suggest a high return to attending high quality private institutions.

Heckman (1999) argues that what matters most is competition between institutions which ensures that institutions deliver the type of education demanded by students, parents and employers. The higher returns to those educated in private institutions in the U.S. might therefore in large part be reflecting the responsiveness of these institutions to community needs. Presumably some of these benefits could be obtained through the alteration of institutional

arrangements in the public sector. In the Australian context this suggests that giving greater autonomy to universities will increase life-time earnings of graduates.

In their survey of expenditure trends in U.S. universities, McPherson and Schapiro (1998, p.59) observe that in private research universities the growth in expenditure has been far greater than in public universities but the growth has been concentrated in areas such as libraries, student services and general institutional support. This might again be reflecting community demand for a broader based educational experience.

At the school level there is a considerable body of research in the U.S. on the effects of higher expenditures per student on academic performance and on lifetime earnings. Convenient recent summaries are contained in Burtless (1996) and Quiggin (1999) and the Symposium in *The Journal of Economic Perspectives*, Fall, 1996. The most quoted work is that of Card and Krueger (1992, 1996) who conclude that added school resources have a positive and measurable impact on students' earnings as adults. This arises in two ways. There is a direct effect on returns to each year of schooling and the indirect effect whereby students at well-resourced schools tend to attend school for a greater number of years. The Card and Krueger (1996, p.133) literature survey "suggests that a 10 per cent increase in school spending is associated with a 1 to 2 per cent increase in annual earnings for students later in their lives". Using data on siblings, Altonji and Thomas (1996) concluded that "teachers' salaries, expenditures per pupil and an composite index of school quality indicators have a substantial positive effect on the wages of high school graduates". Other researchers, most notably Hanushek (1996) and Betts (1996) believe the evidence on the relationship between school expenditure and earnings to be weak. All researchers acknowledge that extra resources will improve quality only if the right administrative and incentive structures are in place.

The literature on the effect of resources on *performance at school* suggests that the relationship is weak. Taken together, the two findings either imply that test scores are a poor predictor of future earnings or that the relationship between schooling quality and future earnings is spurious, possibly because of the correlation between schooling quality and unobservable characteristics of family background.

Evidence is accumulating that those who are better educated while young, are more willing and able to partake of further training during their lifetime. The better educated are also more willing and able to adapt to new techniques and ways of doing things. Maglen (1990, p.21) concludes in his survey that “efforts to discover positive links between education and technical change have been more encouraging, especially at the micro level”. The detailed studies of Prais and associates at the British National Institute of Economic Research (summarized in Maglen) emphasise that productivity gains are particularly associated with the *quality* of training received in mathematics, sciences and languages.

3.3 Who Should Finance Quality?

If equity issues are ignored, increases in the quality of education which lead to social returns which are greater than the private returns should be subsidised by government. The empirical studies in the U.S. show that two variables in particular increase the earnings of graduates: attendance at a private university (where resources per student are high and competition is intense) and the quality of staff (as measured by salary levels). High quality staff are correlated with good research performance where externalities are high. Private universities, other things being equal, impart to students through their range of co-curricular activities generalists skills which might be expected to lead to externalities.

Dale and Krueger (1999) conclude that the returns to institutional characteristics such as average SAT score or the costs of tuition are greatest for students from more disadvantaged

backgrounds. It follows that government and institutional assistance to these students will raise national income.

If students pay the full price of quality education then the benefits will accrue more to the well off. In their study of U.S. tertiary institutions, McPherson and Schapiro (1998) conclude (p.14) that "there is persuasive evidence that reducing the price lower-income students must pay significantly influences their decisions about attending college; indeed it is clear that lower-income students are more sensitive to prices than other groups of students". They find (p. 39) that a $150 increase in student costs (1993-94 prices) results in a 1.6 per cent decline in enrolment. They note (p.39) that this evidence "provides an economic foundation for the considerable investments in financial aid made by federal and state governments as well as by institutions". An extension of the argument is that able students from low income households will be forced to undertake an education which is of lower quality than that undertaken by students of comparable ability from high income families and therefore on average they will earn lower earnings during their lifetime.

Chapter 4: Evidence on Returns to Expenditure on University Research

4.1 Introduction

Universities provide two main types of service; educational services and research services. We have been concentrating so far on the value of educational services to individuals and the community. In this chapter we turn our attention to the return to investment in university research.

There is a very substantial literature on the economics of research and development, including studies of the rate of return to research and development and the role of research and development in stimulating economy wide productivity growth and GDP growth. We will be providing a brief review of that extensive literature in section 3 of this chapter.

Meanwhile, let us review such evidence as exists in the international literature, about the role of university research and development relative to industrial research and development. Does one of them help to foster the other? Is the return to one higher than the return to the other?

4.2 Economic Effects of University Research

In general university research tends to be more toward the basic end of the research and development spectrum relative to industrial research and development which tends to be more focussed on gaining private benefits for the enterprise in question. It is thought that there are some "spillover benefits" from one firm's industrial R & D to other firms, thus tending to provide a disincentive for firms to invest. Such spillover benefits can be expected to be substantially larger from university research since they have less incentive to keep their research private. Indeed academics face strong incentives to publish their findings.

We might therefore expect to be able to find evidence that the benefits from university R & D, spillover to private industry. Let us review the evidence about this in published studies. Such evidence emanates primarily from the US.

As Jaffe (1989) pointed out

> 'It is conventional wisdom that "Silicon Valley" near San Jose, California and Route 128 around Boston owe their status as centers of commercial innovation and entrepreneurship to their proximity to Stanford and MIT. Several case studies of these two areas confirm the important roles played there by universities, (Dorfman 1983, Shimshoni 1966, Teplitz 1965, and Waisner 1965).'

There have also been statistical and econometric studies, Bania, Eherts and Fogarty (1987) found a significant effect of university research spending on the opening of new firms in a cross-sectional analysis of Standard Metropolitan Statistical Areas.

Jaffe (1989) undertook the most rigorous US study of this issue. He explored the existence of "geographically mediated spillovers" from university research to commercial innovation, using sophisticated econometric techniques with state-level time-series data on corporate patents, corporate R & D and university research.

To quote Jaffe (1989)

> 'A significant effect of university research on corporate patents is found, particularly in the areas of Drugs and Medical Technology, and Electronics, Optics and Nuclear Technology. In addition university research appears to have an indirect effect on local innovation by inducing industrial R and D spending (Jaffe 1989, p957).'

Feldman (1993), Audrestch and Feldman (1996), Feldman and Audrestch (1999), have examined the this issue of the role of universities (and science parks) in helping to foster industrial innovation through geographical "clustering". Audrestch and Feldman (1996) find that industries where R & D., skilled labour and university research are important, tend to cluster more. Feldman and Audrestch (1999) examine whether having a cluster of industries with a common technology base is good for innovation. They find in the affirmative.

In Australia, the Industry Commission produced a Report on Research and Development, Industry Commission (1994), in which they analysed the effect of the "public stock" of R & D on multi-factor productivity at the sector level. Public R & D is broader than, but includes university based R & D The results showed that public R & D has a positive impact on all sectors (apart from wholesale and retail). For example, a 1% increase in the public stock of R & D was found to raise productivity in agriculture by 0.1%. Their analysis also suggests that public R & D may be an important source of productivity growth.

A US study by Mamuneas (1999), examined evidence for six high-tech industries and also found that public R & D has a positive benefit.

Adams (1990, 1993), has used data on the number of world-wide publications of scientific articles and investigates whether these data are related to productivity in 18 US manufacturing industries. This research, therefore, was seeking to examine whether the link between fundamental knowledge, primarily generated by academics and funded by public expenditures, has any influence on productivity. The results suggested that basic science is important though the lags involved are long (around 20 years for some science, but around 10 years for more applied science)

4.3 The Economic Benefits of R & D in General

Rogers and Dowrick (1999) have reviewed the international research evidence on the economic benefits of R & D in general.

They find that that firm level studies of the effects of R & D suggest the following;

- Estimates of the private rate of return to investment in R & D by firms are high (around 20 to 30%);
- Firm level studies only show the private value of innovative activities. The presence of spillovers means that social rate of returns are much higher; and
- Small and medium enterprises (SMEs) appear to be more productive in their innovative activities. SMEs also appear to rely more heavily on external sources of knowledge, such as other firms' R & D, university or government R & D.

Industry and economy level studies suggest a further set of conclusions, as follows;

- Social rates of return to R & D investment appear to be high (between 20 and 150%). Comparing this to the returns to capital investment, one study found returns to R & D to be 1.2 to 2 times as high;

- Patent activity and innovation count data also show positive links to productivity and growth;
- Public R & D does benefit private industry, but there is uncertainty of how large these benefits are and in particular, there is a lack of evidence for Australia;
- There are potentially long lag times between private innovative activity and the full benefit of the innovation(s) to other sectors of the economy;
- Similarly university based pure research (i.e. scientific publications) appear to have positive links to industry level productivity, although the lag times are long (between 10 and 20 years). This result is based on US studies;
- There is empirical evidence of geographical clustering of innovative activities;
- There is strong evidence of the existence of international knowledge spillovers. This means that R & D activity in say, the US, will affect the productivity of other OECD countries. The evidence suggests that around one quarter of the benefits of the R & D of the G7 countries accrues to other economies. This implies that small countries can gain substantial benefits form foreign R & D and innovation; and
- International studies show that Australia has a relatively low ability to benefit from R & D in other countries. The evidence for this relates to the 1970s and 1980s and is associated with Australia's then low (relative) level of trade with other countries.

4.4 What about Research in the Social Sciences and Humanities?

Introduction

The evidence presented in section 4.2 was concerned essentially with the benefits of science, engineering and medical research for industry. This leaves open the question of the value of research in the social sciences and humanities. In considering the benefits of university research, this is an important issue to consider. In so doing we should consider the extent to which such research does derive direct benefits for Australian industry. Second we should consider the benefits for public policy. Third we should discuss the social benefits of what is sometimes called "curiosity research".

Research Benefits to Australian Industry

Sligar (1998) has outlined a range of ways in which social science research is important for private industry as well as for the government sector.

The Industry Commission's report on R & D, Industry Commission (1995), noted the OECD definition of R & D as:

> 'Creative work undertaken on a systematic basis in order to increase the stock of knowledge-including knowledge of man , culture and society- and the use of the knowledge to devise new applications, (Industry Commission 1995, p1).'

It went to emphasise innovation in management, marketing and distributional processes and changes on organisational structures, in addition to changes in technology.

Public Policy Research

It is important to note that research in the social sciences also contributes significantly to public policy development. It would be an interesting and challenging project to seek to get a measure of the benefits of such research

Curiosity Research

It is also generally recognised that there is a place for curiosity research which may not be expected to produce highly tangible social benefits. It would be a challenge to seek to quantify the benefit of this.

4.5 The Linkages between Research and Teaching

There are a number of points to be made here.

First, industrial R & D as well as university R & D , is largely conducted by university graduates. As there is a high social rate of return to R & D due partly to substantial spillover effects to firms other than where the research is done, this can be viewed to some extent as an external benefit of graduates of higher education, that is not typically accounted for in estimates of rates of return to higher education.

Secondly, we saw in chapter 3 that US evidence suggests that rates of return to education tended to be higher in elite universities, who employ higher paid higher achieving academics. This suggests a positive spillover from research to the quality of education.

We also saw, however, that increases in the number of hours of teaching undertaken, can have seriously detrimental effects on research productivity.

4.6 What Determines the Research Productivity of Academics?

As we saw in chapter 3, Fox and Milbourne (1999) have recently undertaken an econometric study of the determinants of research output, among academic economists in Australia. They found the following results.

Human capital variables help to explain research productivity, especially the grade of honours and, the possession of a Ph.D. The possession of a Ph.D with coursework, interestingly was found to be a positive benefit also, especially for producing research output in the top international journals.

The number of hours of teaching is also a significant influence. Thus a 10% increase in teaching hours is found to reduce research output by 20%. Also a 10 per cent increase in the number of research grants was found to raise output by as much as 15%. There is a question about the direction of causation between grants and output, but the finding that excluding grants from the model did not bias the results of the other variables, gave the authors more confidence in the idea that the causation probably flows form grants to output.

Interestingly, while teaching hours was found to be an important variable, staff student ratios did not turn out to be significant.

4.7 Policy Implications

The social rate of return to R & D tends to be substantially higher than the private rate of return, because of spillover benefits to other parties than the one being funded; this provides a strong rationale for public support for R & D;

Such spillover benefits are thought to be especially important in the case of university research, because academics have a strong incentive to make their findings public; as well as highlighting the importance of government funds directly into university research. This research provides a rationale for larger tax concessions for industry expenditure on R & D in universities, than for R

& D, in general, especially where the intellectual property rights are not given solely to the sponsor.

The importance of encouraging strong links between universities and industry, in such ways, suggests that such mechanisms as ARC “SPIRT” grants and cooperative research centres (CRCs), are good ideas; (it would be good to undertake research evaluating the economic benefits of such schemes);

Contributions of university research to industry are not confined to science, engineering and medicine; since industry can gain from social science, management science and humanities research, there is a case for extending CRCs to these discipline areas just as ARC SPIRT grants are.

In a relatively small country like Australia, compared say with the United States, a high proportion of new knowledge comes from overseas; however, domestic R & D is an important mechanism for accessing knowledge from overseas. Evidence suggests that Australian industry has not traditionally been very good at obtaining overseas knowledge, partly because of our tradition of protecting industry from international competition. Encouraging international openness is an important policy implication; in this regard universities that are active in the international research community can play an important role.

Chapter 5: Government Expenditure on and Income from Higher Education: a balance sheet

In Chapter 2 we have estimated private and social rates of return to higher education. One of the goals of government is to enact and pursue policy in behalf of society to maximise the social return. Consequently the social return might be seen as the governments policy goal. However government is also conscious of the need to balance its budget so a shorter term concern is the implications of government spending on education for its balance sheet. We may ask what is the impact of government investment in higher education on the government bottom line. The task of this chapter is to explore this issue. In doing so we shall employ the same methodology as described in Chapter 2 though to maintain an appropriate perspective, possibly at the risk of repetition, we shall reiterate some of the most pertinent assumptions.

5.1 Introduction

The cost of higher education to government is the opportunity cost of public expenditure on it. This is the value of expenditure on the next best alternative. While this value is either unknown or at least subject to considerable dispute what is known with certainty is the outlay by government on higher education.

The benefits to government from higher education include both quantitative and qualitative components. The main quantifiable benefits emanate from the enhanced earnings of graduates. Graduates pay higher tax on these increased earnings providing revenue for government.

Qualitative benefits include:

- Improved equity – equality of educational opportunity is generally a prime objective of society so public expenditures which equalise opportunity are a very important part of government equity objectives;[3]
- Spillover effects – increased productivity of graduates has positive external effects on other workers; and
- Direct external benefits to the community in the form of enhanced debate about government and social policy, improved social values and understanding and appreciation of tradition, culture and knowledge.

In this chapter we focus on the quantifiable costs and benefits to the government as it affects their income and expenditure. Some of what we have termed ‘quantifiable benefits’ above, could lead to qualitative effects on the government budget (for example through higher earnings of non graduates leading to higher tax revenue), but here we restrict discussion to the more obvious quantifiable benefits and costs.

[3] More equality of opportunity may occur with less equality of outcome. Persons undertaking higher education including those from low income backgrounds will have generally high lifetime earnings. Income inequality will increase.

5.2 A Quantitative Assessment: The Framework

Government outlays on (or investment in) higher education can be compared to the increased returns from higher education in the form of increased tax. A simple example illustrates the method.

The government pays $10,000 per year to enable a student to graduate after four years with a degree. Using this degree the graduate then commands a premium in the labour market of 40 per cent of salary. The graduate is employed for 30 years and pays a marginal tax rate of 40 per cent. The average salary for the work undertaken by non-graduates is $50,000.

Government Costs (or investment)

Investment per pupil is $10,000 for say 4 years; total investment by government is $40,000.

Benefits

Increased taxes at a marginal rate of 40 per cent on increased earnings of 40 per cent per year and an average income of say $50,000 over 30 years.

Total increased government revenue is (50,000 * 0.4 * 0.4 = 8,000) per year for 30 years, a total return of $240,000.

If we were to assume that there were no change in the value of a dollar (i.e. no inflation) over the period then we could just compare the costs and benefits and in this case there would be a net benefit to the government of $200,000. The average annual increased government revenue of $8,000 represents a return of 20 per cent per year.

However to assume the value of a dollar today is the same as its value next year is unrealistic. A better measure of the return on the investment is obtained by requiring both the benefits and cost streams to be discounted by an amount each year. A device to achieve this is known as the internal rate of return (IRR) – this is the rate which discounts each dollar of benefit or cost each year to equate the sum of the discounted costs and revenue streams. The algebraic expression is shown as equation 1 in Chapter 2 where *i* is the IRR.

Applying the formula to the example, the IRR is calculated as 16 per cent. Because the IRR does not need to presume a social discount rate it is a convenient methodology to examine the likely returns to government from expenditures in higher education. Policy makers can then view the IRRs under different assumptions and in considering which is most appropriate, take into account the many aspects of investment in higher education which are not quantifiable and are therefore not included in the calculations. For instance the IRR can then be compared with alternative uses of government funds. While private investments need to match long term bond rates after tax there are good arguments for using lower points of comparison in relation to government investment.

As in chapter 2 the calculation of the government rate of return requires some assumptions about the following variables:

- The average salary of the graduate over his lifetime;
- The earnings pattern of the graduate over his or her lifecycle;
- The premium earned by the graduate;
- The probability of the graduate obtaining work;
- The marginal tax rate of the graduate; and

- The cost to the government of the graduate net of any other benefits paid by government (such as research or other public good aspects of higher education)

Each of these is now discussed leading to the generation of a range of different assumptions which are then used to construct tables of internal rates of return for government investment in higher education.

Level and pattern of lifetime income

Individual incomes follow a general pattern; starting at zero and remaining very low during childhood and during the period of formal education. Income rises quickly as the individual enters the workforce, and continues to rise as the accumulation of skills, knowledge and experience are rewarded by higher salary reaching a peak around middle age and holding constant for a number of years then dropping suddenly upon retirement. The shape of the income-age profile varies with gender (women may have an interrupted pattern during early parenthood), level of education (the profile of more educated people rises longer and peaks later and higher), health and lifestyle choice (some people leave the workforce earlier or reduce hours of work as a result of ill health or lifestyle choice) and possibly employment status (self employed and employers may have a much more variable pattern). However graduates in general can be expected to follow the pattern of income described as they grow older.

Table 5.1 reports the average weekly earnings of graduates and non-graduates (those with year 12 completion) at various age groups. The final column show the premium or markup in wage rate for those with degrees. The table shows that those with degrees earn considerably less while studying but after graduation the premium for having a degree increases steadily to reach a peak of close to 55 percent at age 45 to 49.

Table 5.1 Income of males with a high school highest qualification and degree, $ per week

Age	High school	Degree	Markup
18	199.2	187.7	0.942
19	266.4	187.7	0.705
20	290.4	187.7	0.647
21	422.5	403.3	0.955
22	441.5	495.3	1.122
23	499.5	642.9	1.287
24	566.9	730.0	1.288
25-29	633.1	849.3	1.342
30-34	747.5	987.4	1.321
35-39	850.5	1092.3	1.284
40-44	866.1	1109.5	1.281
45-49	742.6	1149.5	1.548
50-54	956.7	1063.0	1.111
55-64	806.1	1040.3	1.290

Source: data extracted from the ABS Training and Education Experience Survey, 1997

The premium earned by a particular individual is likely to vary from the average according to a number of different factors including:

- The subject of the degree – vocational training such as law, medicine and accountancy is likely to be more rewarding than general degrees such as arts and humanities degrees;
- The level of the degree – higher degrees such as Masters and PhDs are likely to attract different (higher) premia than pass degrees; and

- The quality of the degree – arguably more prestigious institutions award higher quality degrees which are reflected by greater rewards.

The table of weekly income includes only part of the private bonus for having a degree because persons with degrees also have a higher rate of employment at all ages. Thus the annual income of graduates will be substantially higher than shown in the final column of table 5.1. On the other hand as we have noted in Chapter 2 some part of the difference in income may be attributed to the higher natural ability of those persons achieving a degree. This is the so-called screening effect and has been often assumed to account for perhaps 20 percent of the premium.

In our base case we assume that the increased employability and the screening effect balance out.

The probability of work

Some proportion of graduates do not obtain regular work nor receive regular income from market based activity. Many females have children and have interrupted careers which do not follow the pattern suggested above. Other graduates of both sexes are unable to obtain work because of disability, ill health or for other reasons. In calculating the balance sheet for the government some account needs to be taken of the less than full utilisation of the degrees obtained by graduates, those that fall by the wayside.

There are also a proportion of students who commence degrees and in so doing incur government support but do not complete their degree. Perhaps the simplest way to treat these people is to assume that they gain benefit to the extent of their exposure to tertiary education and enjoy concomitant but lower premia in the job market as a consequence.

Since government only benefits from their investment in graduates when they earn higher taxable income and indeed will only be repaid the HECS contributions once a threshold income is reached, the assumption about work also affects, and is used to determine, the extra revenue to government.

The marginal tax rate of graduates

Individuals pay direct tax in the form of personal income tax with a statutory marginal rate dependent on gross income, various allowable deductions and rebates and family circumstances. Individuals also pay indirect taxes on their expenditures, on financial transactions, on capital gains and on property. Thus increased earnings by graduates will be taxed both directly as the money is earned and indirectly when it is spent. The appropriate marginal rate of taxation includes both forms of tax.

Graduates are likely to have earnings in the upper end of the income distribution so their marginal tax rates are likely to be high. On the other hand their extra income is more likely to be saved and they are more likely to take advantage of various devices to both minimise direct and indirect tax.

The net cost of government support

Government provides support for universities in a number of ways. Support is provided for the salaries of academic and general staff at universities, for infrastructure funds to support library collections, laboratories and the like, and to pay for capital works such as new office blocks, lecture theatres and other structures. The funds provided to each institution are documented in DETYA publications and on the web and may be obtained readily.

However the output of universities is not restricted to degrees. Universities have two other distinct and very important roles, the undertaking and dissemination of research including scholarly debate, and the production of general public goods. This latter output includes work in relation to furthering cultural and artistic achievement, involvement in public policy debate about matters of general interest, and the provision of an independent and impartial commentary on many aspects of living. In assessing the benefits and costs of degrees it is necessary to net out the value of these other outputs of universities. While there is some data which may enable a reasonable estimate to be made of the research cost of universities the value of the public good elements is unknown and may only be guessed.

5.3 Some Provisional Estimates

In this section we employ the basic methodology described in the previous section to determine a best estimate of the return to the government of investment in higher education. The method involves the selection of the appropriate assumptions concerning lifetime earnings patterns of graduates and the associated premia earned by graduates, probabilities of obtaining work, the marginal tax rates of graduates and the net cost to the government of the graduate. We report a best estimate and a range of variations covering plausible selections for the key variables.

Average earnings and the premium for a degree

Table 5.1 has shown the average earnings for males at different ages based on information from the 1997 ABS training and education experience survey. We assume that this is a reasonable representation of the lifetime earnings patterns for all graduates.[4] We vary the premium for a degree by multiplying the graduate incomes by a factor which is greater than one when we wish to represent a higher premium and lower than one when we wish to represent a lower premium.

There may be several rationales for varying the premium but an important one is doubt about the extent to which we have adequately measured the effect of screening, the innate difference in ability between those who obtain a degree and those who don't.

Net government cost

In Table 1.3 we have shown the contributions of various sources of funds to university total expenditure for 1997 (from DETYA, 1999a). In Table 5.2 this information is presented in a slightly different way with contributions to research netted out in order to calculate the cost to government of the teaching component. DETYA (1999), using information based on a census of operational divisions (generally academic departments) within universities, has estimated that about $2.3 billion of the aggregate university budget is spent on research related activity. This includes research funds, a self-selected component of academic salary time and an apportionment of support staff.

There are four columns of figures in the table the first two reflecting the situation in 1996/7 (the time of the most recent available data) and the second two columns provide estimates of the situation likely to pertain in 2007-8.[5] The figures in the second two columns differ markedly

[4] The patterns for females is similar for both graduates and non-graduates but, compared to males there are lower participation rates and work interruptions to fulfill family duties. Since we are interested in the difference between graduates and non-graduates using the information for males to represent the situation for all graduates will provide a reasonably reliable picture of the premium for a degree.

[5] There will undoubtedly be other major changes in the source of university funding by this time. In particular the proportions of full fee paying students are likely to be higher as both overseas and domestic full fee paying student numbers increase and also under pressure from government universities are

from those in the first two in one crucial respect. They show a doubling of the contribution from HECS fees reflecting the increases in fees that applies to all new students after January the 1st 1997. [6] Because typically undergraduate courses take 4 years or so to finish, and since DETYA estimates that at current graduate salaries it will take about 9 years for graduates to repay their loan, it will not be until towards the end of the first decade in the next millennium before a steady state is reached. At this point HECS fees are likely to double their current contribution to the national aggregate costs of higher education. Since the HECS repayments feed straight into government revenue the effect of this will be to reduce the government net contribution by the extent of the HECS repayments. Holding other changes constant (see footnote 1) the pattern of funding by source would be as shown in the last two columns.

Table 5.2: Contributions to teaching costs

	1996–7		2007–8 estimate(a)	
	$ bill	%	$bill	%
Fees and charges	1.3	22	1.3	22
HECS	1.2	23	2.4	41
Total student	2.5	45	1.2	63
Comm. Gov	2.4	41	1.2	20
Other	1.0	17	1.0	17
Total Teaching	5.9	100	5.9	100
Research	2.3		2.3	2.3
Total higher education	8.2		8.2	8.2

Here the Commonwealth government net contribution to university funding is reduced to 20 per cent or $1.2 billion in 1996-7 dollars.

In practice not all students will repay their HECS debts and in the more detailed analysis below we consider the situation in which varying amounts of the debt are repaid. There are also other contributions to education that are made by the Commonwealth. In particular the Commonwealth provides a youth allowance to all individuals either studying, in training or looking for work. The counterfactual situation for students used here is a situation in which they work so the payment of youth allowance is a further contribution by government. However in a comparison with training or unemployment it would not be relevant to add youth allowance. Also the youth allowance is subject to a means test so only a proportion of students receive it.

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pursuing active policies to diversify funding sources. However the purpose of this exercise is not to predict the future pattern of university funding sources so the table abstracts from these likely developments.

[6] In these table we report the funds received by universities from government attributed to HECS fees. This amount is the liability incurred by current students. However, Government does not necessarily receive this amount of cash in payments from students. There are long lags before many fees are paid and for those students whose income never exceeds the thresholds no fees will ever be repaid. The amount of HECS fees received by Government, in any year is made up of up-front payments from current students plus repayments through the tax system from past students and other direct payments. DETYA (2000, Table 2.12) shows the governments balance sheet in relation to HECS receipts for recent years with projection out to 2002-3. The DETYA table confirms the main point made in Table 5.2. There is a very large spending increase in government receipts as a results of HECS fee increases in 1997 that will result in a doubling of student payments. The HECS students liabilities, what are reported in Table 5.2 also increase sharply in the manner suggested.

5.4 Government Higher Education Balance Sheet and Rate of Return

We use two different approaches to estimate the position of the government in relation to higher education:

- A balance sheet of actual and projected annual government expenditure and income from 1981-2 to 1996-7 with some projections for future years; and
- A calculation of the rate of return to government of a new cohort of students, commencing in 1999.

The higher education balance sheet

In Table 5.3 we have constructed a time series of outlays by government from 1981-2 on higher education. The estimates are the spending of all levels of government with transfers between government levels netted out. The estimates for current and capital spending have been obtained from data series provided on request from the ABS. The estimates of research expenditure are obtained from ABS catalogue 8111.0 and show the self reported cost of spending on research in higher education institutions. The outlays on the teaching component are obtained by deducting the research expenditure from the total government outlays on universities. The final column of the table reports direct payments to students as personal benefits. The main payment is the Youth Allowance for students formally the Austudy allowance.

Table 5.3: Government outlays on higher education, $millions

Year	Current spending	Capital spending	Total spending	Research expenditure	Spending on teaching	Personal benefit payments
1981-82	1717	101	1984	443.5	1540.5	166
1982-83	1868	125	2172	524.2	1647.8	179
1983-84	2019	148	2382	605.0	1777.0	215
1984-85	2135	169	2540	685.7	1854.3	236
1985-86	2394	169	2822	783.7	2038.3	259
1986-87	2500	290	3114	881.7	2232.3	324
1987-88	2747	257	3377	983.6	2393.4	373
1988-89	2772	446	3662	1076.8	2585.2	444
1989-90	2954	688	4130	1204.8	2925.2	488
1990-91	3211	783	4619	1332.8	3286.2	625
1991-92	3636	904	5330	1514	3816	790
1992-93	3672	1046	5586	1695.2	3890.8	868
1993-94	4411	939	6129	1762.4	4366.6	779
1994-95	4749	688	6265	1829.6	4435.4	828
1995-96	4994	881	6785	2068.6	4716.4	910
1996-97	5009	973	6874	2307.6	4566.4	892
2001-2 (est.)	5009	973	6874	2307.6	4566.4	892
2010-11 (est.)	5009	973	6874	2307.6	4566.4	892

Source: unpublished public finance data from ABS and ABS (various issues) Catalogue 8111.0

The total cost to government of the teaching component of higher education is the sum of the expenditures on teaching and the personal benefit payments.

In the last two rows of the table we report prospective results for the years 2000-01 and 2010-11 in which the level of nominal spending on all categories remains the same as in the last year for which we have firm data (1996-7). These two years are chosen because they enable the depiction of the situation in which respectively government expenditures and receipts will have reached a steady state with respect to HECS loans following the large increases in fees in 1997.

The income to government is the increased taxation receipts from persons with higher education who generate higher income as a result of their degree. Increased receipts emanate from personal income tax, from the repayment of HECS debts and from the indirect tax on expenditures from the net increase in disposable income. In Table 5.4 we estimate these components of increased government earnings. The increased income tax generated by graduates is the product of the number of graduates in the workforce, their increased income and the marginal rate of tax.

Table 5.4: Increased revenue to government from increased earnings as a result of higher education

Year	Share of those aged 15-64 with degrees, % (a)	Equivalent full time employment, thousands (b)	Average weekly earnings, $/week (b)	Income with degree, $/week (c)	Increased income tax on income, $mill/yr (d)	Increased expenditure tax, $mill/yr (e)	Estimated receipts from HECs repayments, $ mill (f)	Total increased revenue from investment in higher education, $mill
1981-82	7.0	5811	300	440	1231	173	0	1404
1982-83	7.0	5815	321.1	471	1391	178	0	1569
1983-84	7.0	5984	346	507	1618	190	0	1808
1984-85	7.3	6236	375.3	550	1898	223	0	2121
1985-86	7.6	6352	396.9	580	2140	247	0	2386
1986-87	7.4	6453	427.2	625	2302	262	0	2564
1987-88	7.6	6751	450.1	658	2220	333	0	2553
1988-89	7.9	7034	484.9	708	2669	378	0	3047
1989-90	8.4	6976	516.6	752	2995	419	28	3442
1990-91	9.0	6746	555.6	807	3430	450	61	3941
1991-92	9.6	6692	578.8	838	3817	484	96	4397
1992-93	10.1	6838	586.8	847	4152	521	139	4812
1993-94	11.5	7051	604.2	867	4470	659	187	5315
1994-95	11.9	7299	629.2	901	4859	740	240	5839
1995-96	12.8	7329	659.9	940	5574	811	300	6685
1996-97	13.6	7414	685.6	973	6298	879	356	7533
1997-98	14.3	7521	685.6	970	6630	927	425	7983
2001-02 (est)	14.3	7521	685.6	970	6630	927	715	8273
2010-11 (est)	14.3	7521	685.6	970	6630	927	1500	9058

Sources and Notes: (a) ABS (1998) Social Trends; (b) ABS time series data available on Austats (gopher.statistics.gov.au)- Employment, November Table 620201, Average weekly earnings, November Table 630101; (c) those with degrees earn a premium of 65 per cent but 20 per cent of this is considered to be due to greater ability so the markup for a degree is 1.52; (d) using current personal income tax rates for 2001-02 and 2010-11; (e) calculated at ten percent of the increase in disposable income; (f) based on 70 per cent of debt repaid over ten years

Over much of the period in Table 5.4 there were no HECS repayments but in recent years government receipts from HECs repayments are likely to have increased sharply. By 1996-7 HECS commitments and up-front payments by students amounted to about $1.2 billion and were growing. Given the income contingency nature of the loan and the generous terms for repayment tax receipts received by government for HECS debts is some proportion of this. DETYA (2000), Table 2.12 suggests the size of the repayments and it is possible to estimate the likely level of such payments in the future with some plausible assumptions.

Government outlays on the teaching component are about $5700 per student per year (compared to close to $11000 if the research component is also included – see Chapter 2 for calculations). The average HECS commitment is $4215 per student per year. In a steady state where there was constant government outlays, student numbers and rates of repayments then HECs repayments would be expected to be 62 per cent of government outlays on the teaching component (or a third of government outlays on teaching and research) in each year. However because of the very long lags in 1996-7 HECS receipts were only about 8 per cent of government outlays (from Tables 5.3 and 5.4). Over time this proportion will grow sharply. We have assumed that by 2010

HECS repayments reach the steady state of 33 per cent of government outlays on teaching and research.

The HECS commitments have been rising because of an increase in participation and because in 1997 government announced increases in HECS fees which would roughly double the cost to new students entering in 1997 and thereafter. By around 2001-2, all students would be subject to the new HECS rates. However, given a ten year repayment period it would not be until around 2010 that the repayments of students would fully reflect these increased rates.

In Table 5.5 we compare the cost of provision of higher education shown in Table 5.3 with the expected returns received from increased taxation in Table 5.4 to calculate the real net benefit of the provision of higher education to government. We deflate the series by the consumer price index to calculate the real value of the benefit to government.

Table 5.5: Estimated Real net benefit of higher education to government

Year	Increased government tax receipts, $mill/yr (a)	Less cost of government expenditure on higher education, $ mill (b)	Net benefit of investment in higher education, $mill	Consumer price index, June 1998 = 1.0 (c)	Real net benefit of higher education, $mill
1981-82	1404	1707	-302	0.454	-666
1982-83	1569	1827	-258	0.506	-510
1983-84	1808	1992	-184	0.540	-341
1984-85	2121	2090	30	0.564	54
1985-86	2386	2297	89	0.611	145
1986-87	2564	2556	8	0.668	11
1987-88	2553	2766	-213	0.717	-297
1988-89	3047	3029	17	0.770	23
1989-90	3442	3413	29	0.831	34
1990-91	3941	3911	29	0.875	34
1991-92	4397	4606	-209	0.892	-234
1992-93	4812	4759	53	0.901	59
1993-94	5315	5146	170	0.918	185
1994-95	5839	5263	576	0.947	608
1995-96	6685	5626	1058	0.987	1073
1996-97	7533	5458	2074	1.000	2074
1997-98	7983	5249	2734	1.012	2701
2001-02	8273	5249	3024	1.012	2988
2010-11	9058	5249	3809	1.012	3764

Source: (a) Table 5.4; (b) Table 5.3 (c) from ABS (1999) Table 610401

The table suggests that the value of extra tax earnings from higher graduate income exceeds the cost of higher education to government in all of the last twenty years and in the foreseeable future, and that the net real benefit to the government has been increasing. By 2010-11 increased revenue is likely to be nearly double the cost of higher education.

Because of the lags in the repayment schedules of students the net gain of the government in 2010 is likely to increase further in later years.

It is also important to note that the values in the table are likely to underestimate the net benefits of higher education as only the extra incomes of graduates are included. It is likely that the

value of higher education will have flow-on benefits for non-graduates and that their incomes will rise as a consequence leading to further sources of tax revenue for government.

Rates of return

Employing various assumptions about graduate markup, the extent of HECS repayment, the government spending on higher education, the marginal tax rate and the indirect tax rate we estimate the internal rate of return accruing to government investment in higher education. From the discussion in regard to these assumptions in Chapter 2 and the earlier part of this chapter we have constructed Table 5.6.

Our best estimate of the rates of return for individuals and for government is shown in assumption set (A) which also corresponds (with some slightly more developed assumptions) to the results presented in Tables 2.5 and 2.6. We assume an age earnings profile in which graduates achieve average weekly earnings which peak at a premium of 54 per cent higher than non-graduates (see Table 5.2 for pattern). This corresponds with higher levels of employment for graduates but allows for a screening effect. Eighty per cent of the higher income of graduates is attributed to the knowledge learned while a student. The remaining 20 per cent is attributed to the higher ability level of students undertaking degrees.

On average 85 per cent of students have full-time jobs and both earn higher income at the multiple shown and incur HECS fees repayments. Of course in practice almost all graduates will have jobs at some time and some will earn income at a lower multiple of income and others at higher multiple. Other graduates will have full-time work for only part of their life-cycle (for instance most women will probably interrupt their careers to have children). Nevertheless the results shown in assumption set A is a reasonable representation of the average situation and is the basis for calculating the return to government.

Table 5.6: Rates of return to individuals and government under various assumptions

Assumption set	*Private*	*Government*
A. 54% peak graduate markup; teaching only; 85% with jobs; 10% indirect tax	12	13
B. 27% peak graduate markup; teaching only; 85% with jobs; 10% indirect tax	6	8
C. 80% peak graduate markup; teaching only; 85% with jobs; 10% indirect tax	16	17
D. 54% peak graduate markup; teaching and research; 85% with jobs; 10% indirect tax	12	8
E. 54% graduate markup; teaching only; 85% with jobs; no indirect tax	12	13
F. 547% graduate markup; teaching only; 70% with jobs; 10% indirect tax	12	11

Source: calculations by Melbourne Institute

We investigate the sensitivity of our assumptions with the results shown in sets (B) to (F). In (B), the markup peaks at only 27 per cent, corresponding to a higher screening effect. With this markup the private return to the degree falls to 6 per cent while the return to government falls to 8 per cent. In (C) the markup is 80 per cent corresponding to almost no screening effect. The effect is to raise the rate of return to individuals to 16 per cent and to government to 17 per cent.

In (D) we assume that the cost of research activity has also to be covered by the funds allocated to teaching. This is the equivalent of requiring government to provide more funds but with no

extra benefits (effectively the benefits of research are discounted entirely). With this assumption the return to individuals remains at 12 per cent but the return to government falls to 8 per cent.

Discounting any extra revenue from indirect taxes has almost no effect on the rate of return. This is shown in set (E) where, with no increased revenue from indirect taxes the rates of return for both individuals and government remain at 12 and 13 per cent respectively.

In set (F) we consider a situation in which the equivalent of only 70 per cent of graduates obtain full-time jobs which earn the premium which peaks at 54% above what they would have earned without a degree. With this assumption the individual return remains at 12 per cent but the government return falls to 11 per cent.

Chapter 6: The Value of Higher Education as an Export

Table 6.1 shows the dramatic growth in foreign higher education in Australia since 1988. Growth has been strong across all source areas with Asia consistently providing over 80 per cent of students.

Table 6.1: Foreign higher education students studying in Australia by major source region, 1988 to 1998

	Major source region					
Year	*Asia*	*Oceania*	*Europe*	*Other*	*Not available*	*Total*
1988	14,152	1,739	603	1001	712	18,207
1990	19,461	1930	464	1,262	5,876	28,993
1991	23,597	2,459	578	3,136	4,638	34,408
1993	30,927	2,623	875	2,897	5,249	42,571
1995	39,030	2,802	1,184	2,661	1,228	46,905
1997	54,586	2,073	1,813	3,096	924	62,492
1998	62,415	1,999	2,441	3,920	1,406	72,183

Source: DETYA (various issues) Selected higher education student statistics

Education exports are largely concentrated in higher education but there has also been growth in other post secondary school education. Table 6.2 shows the distribution of all full fee paying foreign students in 1994 by type of institution and source region. Higher education comprised by far the most important part of the foreign student enrolments, comprising 71 percent of all students. More than 84 percent of students were from Asia. In 1994 there were over five thousand students in post-secondary courses other than higher education (predominantly Technical and Further Education [TAFE] courses), nearly nine thousand foreign students at primary and secondary school and over six thousand undertaking English language courses (at English language intensive courses for overseas students [ELICOS] institutions).

Table 6.2: Full fee foreign students by source region and type of institution, 1994

	Major source region					
Type of institution	*Asia*	*Oceania*	*Europe*	*Other*	*Not identified*	*Total*
Higher education	42,401	1,884	1,188	2,046	1,721	49,240
Other post-secondary	4,643	157	191	194	75	5,260
Secondary and primary	7,471	678	315	268	114	8,846
ELICOS	5,636	1	734	61	41	6,477
All	60,151	2,720	2,428	2,577	1,951	69,819

Source: DEET (1995, Table 8).

Over the past decade, the ‘export’ of Australia’s education services to overseas students has developed into an important source of export revenue. Overlaying this ‘trade’ rationale in

overseas student policy is the relatively recent recognition of the mutual benefits of internationalising the education and training systems of the Australasian region within the context of an emerging globalised economy. Nevertheless, because of the interaction of this private overseas student market with a (mostly) publicly funded education system providing services to the domestic population, a careful weighing of the costs and benefits of the effects of the internationalisation of higher education from an economic perspective is important.

Evaluation of costs and benefits of overseas students to society

Measurement problems associated with the evaluation of the costs and benefits of overseas students are severe. Some elements of costs and benefits, while in principle measurable in money units, cannot be directly observed so that some kind of counterfactual has to be used. Other costs and benefits are of a non-pecuniary form though it might be possible to think of ways of attaching a money measure to such costs and benefits. For example, a measure may refer to the amount of money that would just compensate an individual for the imposition of a specified cost (or receipt of a particular benefit), so that welfare would be unchanged. However, in the absence of direct answers to such questions, the construction of these welfare measures requires a prohibitively large amount of information about individuals' preferences. Thus no attempt is made to carry out the extremely difficult task of drawing up a balance sheet reflecting the costs and benefits to society as a whole. Rather, some of the issues involved are discussed, and some likely orders of magnitude are provided for some items.

The elements of the society cost and benefit evaluation are given in Figure 6.1. Four costs are identified: administrative costs, job losses due to the displacement of domestic workers, congestion costs, and opportunity costs. Opportunity costs include costs associated with reductions in domestic intake that otherwise might have occurred, and tax revenue foregone resulting from those reductions.

Figure 6.1: Costs and benefits to society

Costs	*Benefits*
1. Administration ▪ Handling of visa applications (staff and overhead). ▪ Costs of regulation of visa restrictions. ▪ Cost incurred by DETYA or other gov't departments. ▪ Associated aid programs. 2. Job displacement ▪ Possible displacement of domestic workers by student workers. 3. Congestion costs 4. Opportunity costs ▪ Displacement of domestic students by overseas students (by lowering the quality of intake it would otherwise be possible to increase the number of domestic students, who may then produce increased domestic earnings). ▪ Reductions in tax revenue from both the foregone flow of extra tax revenue over working life from those extra students; and from foregone increases in the tax base from growth.	1. Aggregate net benefits to institutions 2. Unmeasured pecuniary benefits ▪ Expenditure of students on living costs net of income earned in Australia. ▪ International air travel associated with study. ▪ International and domestic tourism of students and family during and after period of higher education. ▪ Revenue from visa applications. ▪ Tax revenue (direct and indirect) during residence. 3. Trade effects ▪ Possible source of educated immigrants (giving rise to domestic growth and a stream of tax payments and capital transfers). ▪ Possible growth from trade links. 4. Unmeasured non-pecuniary benefits ▪ Cultural links. ▪ Diplomatic relations. ▪ International friendships and understanding of other cultures.

Apart from the aggregate net benefit (or cost) of institutions providing higher education there are pecuniary and non pecuniary unmeasured benefits. Pecuniary benefits are associated with expenditures by overseas students and the associated tourism. International trade may also be fostered by the presence of the students and other benefits which might emerge from migration of ex-overseas students to Australia. Non-pecuniary benefits include cultural links, diplomatic relationships, international friendships and internationalisation of the curricula.

Administrative costs of providing higher education to overseas students is dominated by aid and scholarships and would not exceed $100 million per year (Baker et al 1996).

Baker et al (1996) estimated that jobs created by demand generated by overseas students and their dependants exceed those taken by overseas students and their families. This contention was also supported by information from overseas student respondents in a questionnaire reported in Baker et al (1996). Domestic student respondents to the questionnaire also indicated that they did not perceive significant congestion from the addition of overseas students.

Current legislation requires that no local student be displaced by overseas students, but it is possible that a greater amount of higher education could be provided to local students with a net gain from increased productivity. That is, even if all international students are regarded as being in addition to all local students who meet a required level of achievement, there is an opportunity cost to consider. This is because the resources could instead have been used elsewhere, for example to enable more local students to be educated by lowering entry standards for such students. An increase in the investment in local human capital which results may generate a positive and significant rate of return. This can include higher earnings than otherwise would be obtained by those individuals, over their working lives. This in turn increases the tax base.

Furthermore, not all of the positive externalities generated by the increased number of university educated persons accrue to the individuals themselves, so social benefits of a public good nature arise. Such benefits are obtained by the countries of origin to which the international students return. If, however, some of the international students ultimately migrate to Australia, then these extra benefits accrue to Australia. Nesdale et al (1995) have reported that 50 per cent of international students and 20 per cent of those intending students who have not yet arrived in Australia plan to migrate. Some evidence on migration intentions, provided by the questionnaire responses discussed in chapter 5 of Baker et al (1996), suggest slightly lower proportions but of much the same magnitude.

In terms of society, the net benefit to institutions is the most obvious benefit of the provision of higher education. The illustrative results reported earlier in this chapter suggest that, based on the application of the fee structure suggested in IDP (1994), there is an aggregate benefit which is about the same as the institutional costs (but which excludes the value of imputed rents) implying that the net benefit is close to zero. In this case the issue from the point of view of the society must be decided on the basis of whether the unmeasured benefits outweigh the costs previously discussed.

The second major benefit item in Figure 6.1 is the pecuniary benefit from various non-educational expenditures. These expenditures include living expenses, international travel and tourism travel within Australia, health insurance and visa fees. For discussion of these expenditures and further references, see for example IDP (1994) and Baker et al (1996). The annual expenditure on all non-education and education has, in 1994, prices, been estimated at $1068.8m. In considering such figures, it must be borne in mind that these relate to the expenditure on private goods and services. If the resources used in supplying those goods and services are priced to reflect their opportunity costs, and there are no externalities involved, then there are no further policy implications from the point of view of society as a whole. One distortion involves indirect taxation, and it has been estimated that this amounts to $89.3m per year. Such expenditure may be concentrated in certain geographical areas and economic activities, and it is possible that such concentration can generate external effects.

The extent to which net benefits to society may arise from such non-educational expenditures depends to a large extent on the state of the economy. If there are substantial unemployed resources, then the opportunity cost of providing the goods and services is much lower than if there is full employment. A further effect may arise from any concomitant growth in the countries of origin of the international students, and the associated interdependencies through trade.

There may be direct implications for overseas trade. Baker et al (1996) report that overseas exchange earnings in 1992 amounted to $1287m (in 1994 prices). In terms of future trade flows, it is argued that the contacts and knowledge acquired may lead to higher Australian exports in the non-education sector. Some indication of the students' expectations of such trade flows have been reported in chapter 5 of Baker et al (1996).

The argument is often made that internationalisation gives rise to non-pecuniary externalities in the form of cultural and diplomatic links, international friendships and increased understanding of other cultures. As suggested earlier, it is difficult to attach a money value to such benefits. The questionnaire surveys discussed in Baker et al (1996) found that such non-pecuniary benefits are indeed regarded by a substantial proportion of the students as being important.

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Appendix

Appendix 1: Estimating the return to a university degree

Suppose that the 'true' relation between earnings and schooling can be expressed as:

$$w_i = \alpha + \beta S_i + \eta (S_i)^2 + \delta A_i + \varphi F_i + \gamma X_i + \varepsilon_i \qquad \text{(A.1)}$$

where w_i = log earnings, S_i = years of schooling, A_i = 'ability', F_i = a vector of family background characteristics, X_i = vector of other explanatory variables for earnings, and ε_i = random error term. (For example, Card (1999) shows that this type of specification – log earnings as a quadratic function of years of schooling - can be derived from a simple model where individual decision-makers choose years of schooling to maximise the PDV of lifetime net income.) Suppose in addition that the determinants of years of schooling can be expressed as:

$$S_i = \pi + \lambda Z_i + \mu_i \qquad \text{(A.2)}$$

where Z_i is a vector of explanatory variables for schooling, and μ_i = random error term.

A number of issues of methodology arise in using regression analysis to estimate the returns to schooling (i.e., estimating the parameters β and η). These problems can be illustrated by supposing that in order to estimate the returns to schooling the following equation is estimated using ordinary least squares (OLS):

$$w_i = \theta + \phi S_i + \tau (S_i)^2 + \nu EXP_i + \omega (EXP_i)^2 + \upsilon_i \qquad \text{(A.3)}$$

This equation includes a quadratic in years of schooling and years of potential labour market experience as explanatory variables for earnings. It represents what would generally be considered as the 'core' elements of a human capital earnings regression (see for example, Murphy and Welch, 1990).

There are a number of reasons why the returns to schooling derived from estimating equation (A.3) (i.e., the parameters ϕ and τ) will not equal the true return (derived from the parameters β and η):

1. Omitted variable bias – Equation (A.3) excludes the ability and family background variables. To the extent that these variables are correlated with years of schooling the estimated effect on earnings of years of schooling will incorporate effects both from schooling and from those other variables. For example, suppose that ability is positively correlated with years of schooling, and has a positive effect on earnings. Then where ability is the only omitted variable it is possible to conclude that the estimated returns to schooling from equation (A.3) are upward-biased.
2. Endogeneity – Endogeneity between an individual's earnings and years of schooling exists where there is correlation between the error terms in equations (A.1) and (A.2) (i.e., $\rho_{\varepsilon\mu} \neq 0$). For example, suppose that there is heterogeneity between individuals in the return to schooling, and that individuals with higher returns acquire more years of schooling. In this situation the error terms in the equations will be positively correlated and hence the estimated return to schooling will be upward-biased. (Selection bias can operate

in either direction – hence, it is also possible that the error terms are negatively correlated so that OLS estimates of the returns to schooling are downward-biased.)

3. Measurement error – Often it might be expected that individuals' reports of their years of schooling or educational attainment will incorporate some measurement error. For example, observed schooling might differ from actual schooling by an additive error. In this case the estimate of the return to schooling will be downward-biased. (Previous research suggests that the reliability of self-reported schooling outcomes is about 90 per cent – see Card, 1999 – so that the bias would be in the order of 10 per cent.)
4. Heterogeneity in returns to schooling – Where there is heterogeneity in returns to schooling (for example, due to differences in the opportunity cost of schooling between individuals) then estimates of the returns from regression analysis will represent an average of the marginal return to schooling across individuals. However, for policy purposes it is likely to be of most interest to know the distribution of marginal returns to schooling across individuals (or at least the marginal return for groups of individuals who may be affected by policy changes) rather than an estimate of the average marginal return (for example, Heckman, 1997, and Ichino and Winter-Ebmer, 1999).
5. Mis-measurement of actual years of labour market experience – In the basic human capital earnings regression years of labour market experience is the other explanatory variable – apart from years of schooling – for earnings. In this framework years of experience captures general on-the-job skill acquisition by a worker. In most empirical analysis of the determinants of earnings, years of labour market experience is proxied for by years of potential labour market experience (i.e., age minus years of schooling minus five) because data on actual labour market experience is unavailable. As the difference between potential and actual labour market experience is likely to be inversely related to years of schooling, therefore estimates of the return to schooling may be downward-biased by using potential instead of actual labour market experience. Differences between actual and potential experience are likely to be particularly pronounced for females due to their spending time out of the labour force in child-birth and child-rearing.
6. Heterogeneity in on-the-job training – Where on-the-job training varies across individuals with different levels of schooling (such as would occur, for example, where the return to on-the-job training increase with educational attainment) then estimation of a regression equation of the form of equation (A.3) may result in biased estimates of the return to schooling. The source of the bias is correlation between an individual's schooling level and the difference between that individual's true experience-earnings profile and the average experience-earnings profile (Psacharopoulos and Layard, 1979).

A number of alternative estimation methods have been used to attempt to overcome the problems involved in estimating the returns to schooling that have been described above:

1. Inclusion of explanatory variables for ability and family background – To overcome the problem of omitted variable bias one approach has been to seek to include variables that proxy for those factors. For example, Karmel (1995) uses data from the Youth in Transition Survey on a cohort of individuals working in Australia and aged 30 in 1991 to estimate the effect of including ability on the returns to schooling. The measure of ability that is used is a linear combination of results in achievement tests in basic reading and mathematics taken at age 14. Karmel's analysis finds that the return to a university degree (compared to leaving school at year 10) for males is 36.2 per cent without controlling for ability and 25.6 per cent with the control; and the corresponding returns for females are 50.5 per cent and 37.8 per cent. More recently, Miller and Mulvey (1997) use data from the 1993 Training and Education Experience Survey to examine the effect on estimates of the return to schooling of including a control for computer skills as an explanatory variable for earnings. The rationale for this exercise is an argument that computer skills are likely to be positively

correlated with cognitive ability. This study also finds that the return to schooling is decreased by the inclusion of a control for ability. Relative to individuals who left school aged 15 years or less it is found that for males the return to a university bachelor degree is 36.9 per cent with no control for computer skill, and 31.2 per cent with a control for computer skill. For females the corresponding returns are 32.2 per cent and 28.8 per cent.

2. Selection correction methods – The application of selection correction methods to estimate the returns to schooling is intended to overcome the problem of endogeneity. This method involves including as an explanatory variable in the earnings equation a correction term that is intended to control for the correlation between the error terms in the earnings and schooling equations (see Vella, 1998 for a general description). Vella and Gregory (1996) use this approach to estimate returns to schooling for a sample of males aged 15 to 26 years employed in Australia in 1985. They find that failure to correct for selection effects causes downward-biased estimates of the returns to education. The return to a bachelor degree relative to completing high school is 25 per cent without controls for selection effects and 37 per cent including a control for selection effects.

3. Instrumental variables (IV) methods – IV methods have been used in studies of the return to education to overcome problems of omitted variable bias, selection effects, and measurement error. This method involves finding an instrument (or instruments) that is correlated with education attainment but uncorrelated with the residual term in the earnings regression. (Examples of instruments might be the level of government benefits for individuals undertaking study, or state-level compulsory school ages.) Recent research has shown that the IV method will identify the average return to schooling for those groups whose decision on education acquisition is affected by the instrument. Hence, alternative instruments that affect the schooling choices of different groups are likely to identify the marginal return for those groups, and will provide information on the extent to which the marginal return to education varies across the population (see Ichino and Winter-Ebmer, 1999).

4. Siblings/Twins models – First, samples of siblings and twins allow family background factors to be controlled for in estimating the return to schooling; moreover in twins models by distinguishing between identical and non-identical twins it is possible to identify family background and ability effects on earnings. For example, estimates of the effect of differences in educational attainment on the difference in earnings between identical twins will not be biased due to correlation between ability or family background factors and schooling (as these factors will have been differenced out). Second, samples of twins or siblings where each report information on the education of other family members allows those reports to be used as instruments in an attempt to control for measurement error in the schooling variable. Miller et al (1995) estimate earnings regressions using twins data for Australia. They find – i) The OLS estimate of the return to schooling of 6.6 per cent; ii) Controlling for ability and family background effects the return to schooling is 2.5 per cent; and iii) Controlling for ability and family background effects, and potential measurement error in the schooling variable, the return to schooling is between 5 and 8 per cent. Hence it is concluded that the OLS estimate of the return to schooling is quite close to the estimate that controls for omitted variables and measurement error.

5. Use of actual years of experience – Data on workers' actual years of labour market experience (or constructed data to proxy for actual experience) can be used to reduce biases that might occur in estimates of the return to schooling where potential labour market experience does not equal actual experience. Some Australian studies such as Rummery (1992) estimate earnings regressions using data on actual experience. Generally these studies do not seem to find a significant difference in estimates of the return to schooling where potential and actual experience are used as alternative explanatory variables.

6. Modelling schooling/experience interaction effects – To overcome the potential problem of biased estimates of the return to schooling that occur due to correlation between individuals' levels of schooling and on-the-job training one possibility is to estimate an earnings regression that includes interactions between each schooling and each experience variable. Such a specification allows a separate experience-earnings profile for each schooling group and hence removes the possible source of bias (Psacharopoulos and Layard, 1979). Borland and Suen (1989) estimate this type of model using earnings data for Australia and find that it is not possible to reject a model that allows a separate experience-earnings profile for each schooling group against a model that restricts all schooling groups to the same profile.

Appendix 2.A – Regression results – Weekly earnings in current job

Variable	Coefficient	Standard error
Constant	506.87	27.78
Experience	24.38	1.20
Experience squared	-0.4420	0.026
Immigrant – ESB	49.73	15.23
Immigrant - NESB	-38.96	15.41
Married	57.22	8.72
Mining	481.32	33.04
Manufacturing	79.26	23.83
EGW	126.89	34.85
Construction	146.10	25.56
Wholesale and retail trade	17.83	23.77
Transport and storage	113.20	26.66
Communication	104.43	33.63
Finance, property, business services	171.90	25.28
Public administration	-18.07	26.99
Community services	-66.30	25.36
Recreation and personal services	4.93	26.55
10-19 employees	47.89	15.61
20-99 employees	115.11	12.79
100+ employees	161.07	11.25
Professionals	-176.65	15.23
Para-professionals	-181.30	17.73
Tradespersons	-263.35	14.87
Clerks	-294.43	17.11
Salespersons	-266.12	15.96
Plant and machine operators	-272.30	16.81
Labourers and related workers	-344.53	15.27
Casual worker	-106.21	10.85
Trade union member	1.81	8.45
Has disability	-23.99	9.17
Bachelor degree+	218.00	14.41
Certificate/diploma	67.85	15.60
Trade qualification	-16.65	12.07
NCHS - Left school 16+ years	-77.57	12.87
NCHS - Left school 15 or less years	-67.92	14.45
English poor	-109.81	58.82
Non-English speaking	-47.35	29.06
Victoria	-12.04	9.38
Queensland	-32.94	10.16
SA	-34.49	13.96
WA	4.68	13.21
Tasmania/ACT/NT	-4.86	16.30
R-squared	0.516	

Note: a) Omitted category is for person who has completed high school, is Australian-born, does not have a disability, is not married, speaks English fluently, works in the agriculture industry, works as a manager/administrator, works at an organisation with less than 10 employees, and lives in NSW; b) Dependent variable is weekly earnings in current job; and c) Sample is employed males aged 18-60 years.

Appendix 2.B – Probit regression results – Determinants of whether employed

Variable	Coefficient	Standard error
Constant	0.676	0.070
20-24 years	0.171	0.068
25-29 years	0.399	0.075
30-34 years	0.439	0.080
35-39 years	0.644	0.086
40-44 years	0.529	0.086
45-49 years	0.559	0.089
50-54 years	0.553	0.094
55-59 years	0.373	0.099
Bachelor degree+	0.325	0.076
Certificate/diploma	0.194	0.090
Trade qualification	0.106	0.057
NCHS - Left school 16+ years	-0.052	0.060
NCHS - Left school 15 or less years	-0.349	0.061
Immigrant – ESB	-0.125	0.076
Immigrant – NESB	-0.349	0.061
Married	0.495	0.043
Has disability	-0.447	0.041
English poor	-0.687	0.155
Non-English speaking	0.265	0.136
Victoria	-0.071	0.056
Queensland	-0.005	0.057
SA	-0.089	0.064
WA	0.052	0.066
Tasmania/ACT/NT	0.022	0.062
Pseudo R-squared	0.118	

Note: a) Omitted category is for person aged 18-19 years who has completed high school, is Australian-born, does not have a disability, is not married, speaks English fluently, and lives in NSW; b) Dependent variable is whether employed; and c) Sample of observations is males aged 18-60 years who were employed, unemployed, or had a marginal attachment to the labour force.