The Impact of the Tax-Transfer System on Education and Skills in Australia[*]

Andrew Leigh
Economics Program
Research School of Social Sciences
Australian National University
http://econrsss.anu.edu.au/~aleigh/
andrew.leigh@anu.edu.au

A Report prepared for the Australian Treasury's
Australia's Future Tax System **Review**

Final Version
29 May 2009

Table of Contents

Figures and Tables

Executive Summary

Human capital theory suggests that in considering whether to undertake education, individuals weigh up the costs and benefits. On the cost side, this includes direct costs (such as tuition and textbooks) and indirect costs (which largely take the form of foregone earnings). On the benefit side, individuals should consider the additional earnings that will accrue from having higher educational qualifications.

The tax-transfer system can affect both costs and benefits of higher education. For example, more generous student income support should increase educational participation rates, while more progressive taxes should reduce educational participation rates. However, the magnitude of these impacts is an empirical question.

With some exceptions, the literature on taxes and educational participation generally concludes that taxation can have a substantial impact on human capital acquisition. However, one of the features about the empirical studies on taxation and human capital is that it consists almost exclusively of simulation studies, which model behaviour according to a set of parameters that are drawn from previous studies. A limitation of these studies is that they generally assume no uncertainty and full information, which may not hold in practice. For example, one survey suggests that a majority of respondents to one United States survey wrongly believed that their country's income tax system was regressive. It is possible that misinformation may be even higher among the cohort who are choosing whether or not to stay in school, attend TAFE, or complete a university degree.

The literature on subsidies and human capital tends to consist largely of natural experiment studies, which have the advantage that they are estimated from real-world policy changes. These studies tend to suggest that subsidies can affect participation, but that the effects are larger for low-income students, and that the impact of grants is larger than the impact of loans. Since educational subsidies are generally marketed directly to young people, it is not unreasonable to think changes in subsidies may be more salient than the degree of progressivity in the taxation system.

In trying to set optimal education taxes and subsidies, it is useful to have regard to the literature on social returns to education. This suggests that social returns are present, particularly in the areas of crime (from higher school completion rates) and productivity (from higher university completion rates). However, the best estimates of the size of social returns suggest that in the main, they should not be a key driver of policy. By contrast, there is robust evidence that private returns to education are large and significant. Completing year 12 raises gross income by 30 percent (relative to completing year 10) and completing a bachelor's degree raises gross earnings by 49 percent (relative to completing year 12). Taking taxes and transfers into account lowers these estimates by 11-15 percent, but the private gain from human capital acquisition is still substantial.

What is the cross-country relationship between educational participation and taxes and subsidies? To test this, I look across 27 developed nations, to see whether those with higher public subsidies to education, or less progressive taxes, have higher rates of participation in tertiary education. Contrary to theoretical predictions, I find no significant evidence that more generous subsidies or lower tax rates on the rich have the effect of raising educational participation. One possible interpretation of this result is that the cross-country measure of

participation is poorly measured, or confounded by an omitted variable that affects both participation and subsidies/taxes. Another plausible explanation is that, in aggregate, taxes and subsidies have a relatively small impact on educational participation.

1. Introduction

One of the striking facts in modern political economy is the commitment of governments everywhere to fund (and in many cases, deliver) education. In nations that are rich and poor, autocratic and democratic, one of the main uses of taxation revenue is to fund education.[1] Not surprisingly, this stylised fact holds true for Australia, where total government expenditure on education in 2006-07 (the most recent year for which data are available) amounted to $52 billion, or about 5 percent of national income.[2]

As well as subsidising education, Australian governments raise additional tax revenues as a result of the higher productivity that comes from a more educated workforce. Both spending and taxes have an impact on skill acquisition, and the interplay of these factors is the subject of this paper. Economic theory suggests that more generous subsidies to education will increase educational attainment, while more progressive taxes will reduce educational attainment. However, empirical findings are rather more mixed.

This paper will outline some basic theories about the effect of taxes and subsidies on human capital investment, before reviewing three relevant literatures: the impact of taxes on education, the impact of subsidies on education, and the social returns to education. I then present new empirical evidence of two types. Using Australian data, I estimate the impact of

---

[1] For various theories on why governments fund education (and generally deliver education as well), see Acemoglu and Robinson (1998); Kremer and Sarychev (2000); Pritchett (2002).

[2] In 2006-07, the breakdown across jurisdictions was Commonwealth $16.3 billion, State/Local $37.4 billion, Multi-jurisdictional $14.4 billion, less Intra-sector transfers of $16.2 billion. The breakdown by purpose was Primary and secondary $28.7 billion, Tertiary $19.2 billion, Preschool $2.3 billion, Transportation of students $1 billion, Other $0.7 billion.

taxes and transfers on the benefits of education. Then, using OECD data, I test whether public educational transfers and progressive tax rates appear to be systematically associated with rates of tertiary attainment. The final section concludes.

2. A Simple Model of Taxes and Education

Before reviewing the empirical findings, it is useful to ground the analysis in a formal model. An attractively straightforward model is presented in Dupor et al. (1996), which is adapted here.[3] They model individuals as maximising an objective function that represents the net present value of their stream of post-tax earnings, minus the cost of schooling. Where r is the interest rate, s is a level of schooling, $H_s(t)$ is the level of human capital in period t of an individual with s years of schooling, and τ is a (possibly progressive) taxation schedule, the present value of disposable income V(s) is:

$$V(s) = \int_{t=s}^{T} e^{-rt}[H_s(t) - \tau H_s(t)]\, dt \tag{1}$$

The cost of schooling, C(s) is the present value of the cost of schooling. This includes direct monetary costs D(s) (eg. tuition and books) as well as the indirect cost I(s) of schooling (eg. foregone earnings).

$$C(s) = D(s) + I(s) \tag{2}$$

---

[3] While Dupor et al. (1996) model both formal education and on-the-job training, I focus only on the former.

The individual therefore chooses the level of schooling that maximises lifetime disposable income:

$$\max_{s \in S}[V(s) - C(s)] \tag{3}$$

This intuition of this model can be captured diagrammatically. Figure 1 simply shows the case in which there are neither taxes nor subsidies. It presents two earnings profiles: a dotted income profile for a worker with a low level of education, and a solid income profile for a worker with a high level of education. For the purposes of this exercise, it is assumed that both are of equal ability, so the counterfactual earnings profile for the highly educated worker is that of the worker with low education. In the first few years, the income of the highly-educated worker is negative, reflecting the fact that she not only foregoes income (an indirect cost of education), but also pays tuition (a direct cost of education). After completing education, the worker with the higher level of education earns a better wage. If the interest rate is zero, the net present value of education is represented by the area marked 'Benefit of education' minus the two areas marked 'Indirect cost of education' and 'Direct cost of education'.

Figure 1: Stylised Earnings Profiles for High-educated and Low-Educated Workers in a World without Taxes or Subsidies
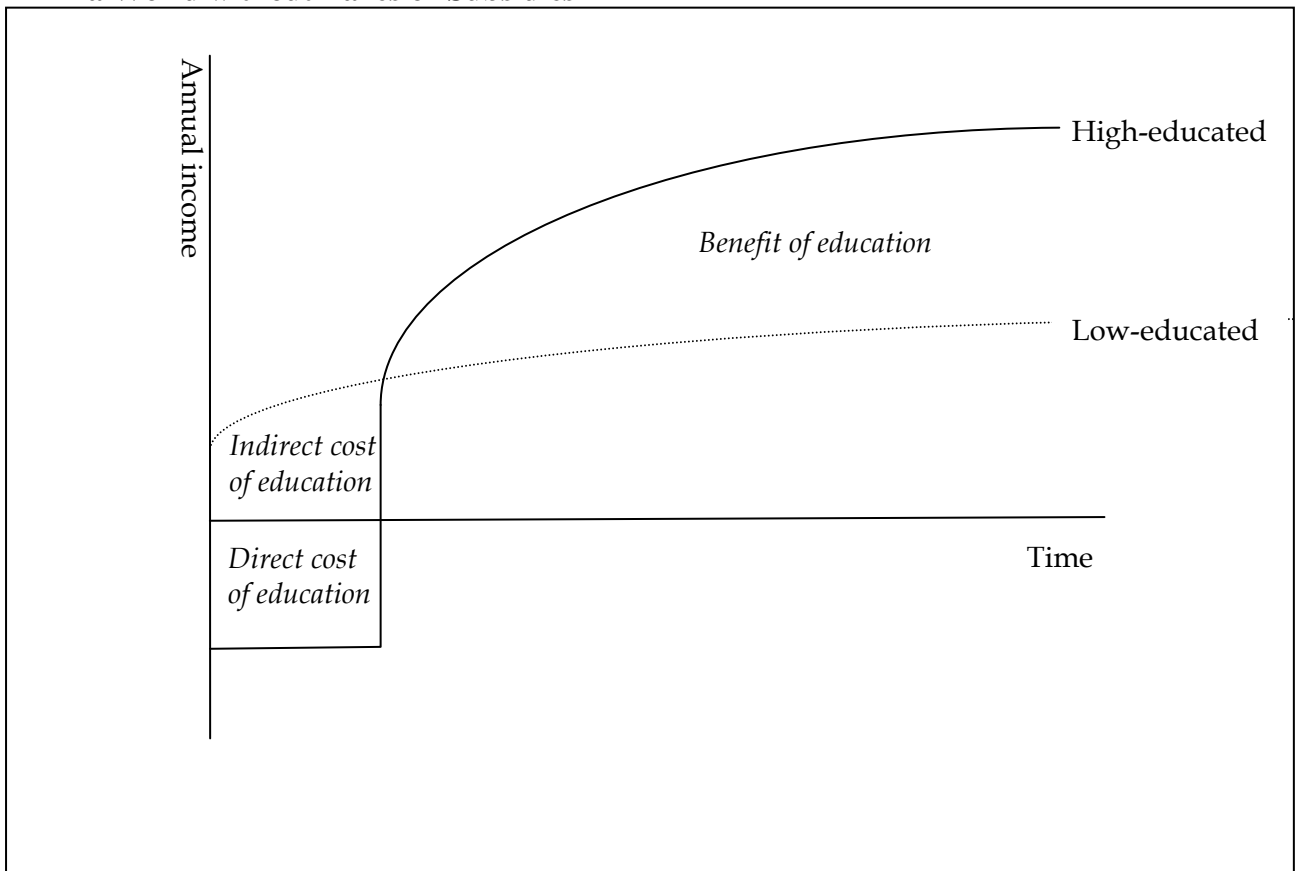
What happens if taxes and subsidies are introduced into the model? Figure 2 shows a third case (depicted with a dashed line) in which education is subsidised, and a progressive labour income tax is imposed on earnings above τ^*. The effect of the subsidy is to increase the disposable income of more highly educated workers while studying, while the effect of the progressive income tax is to reduce the disposable income of more highly educated workers after graduation. The net effect of the two policies on educational enrolment depends on whether the reduction in costs is bigger or smaller than the reduction in benefits. Assuming the interest rate is zero, Figure 2 suggests that the reduction in benefits is likely to be larger than the reduction in costs, and therefore that an individual is less likely to choose to become highly educated in the presence of subsidies and taxes than without them.

Figure 2: Stylised Earnings Profiles for High-educated and Low-Educated Workers in a World with Taxes and Subsidies
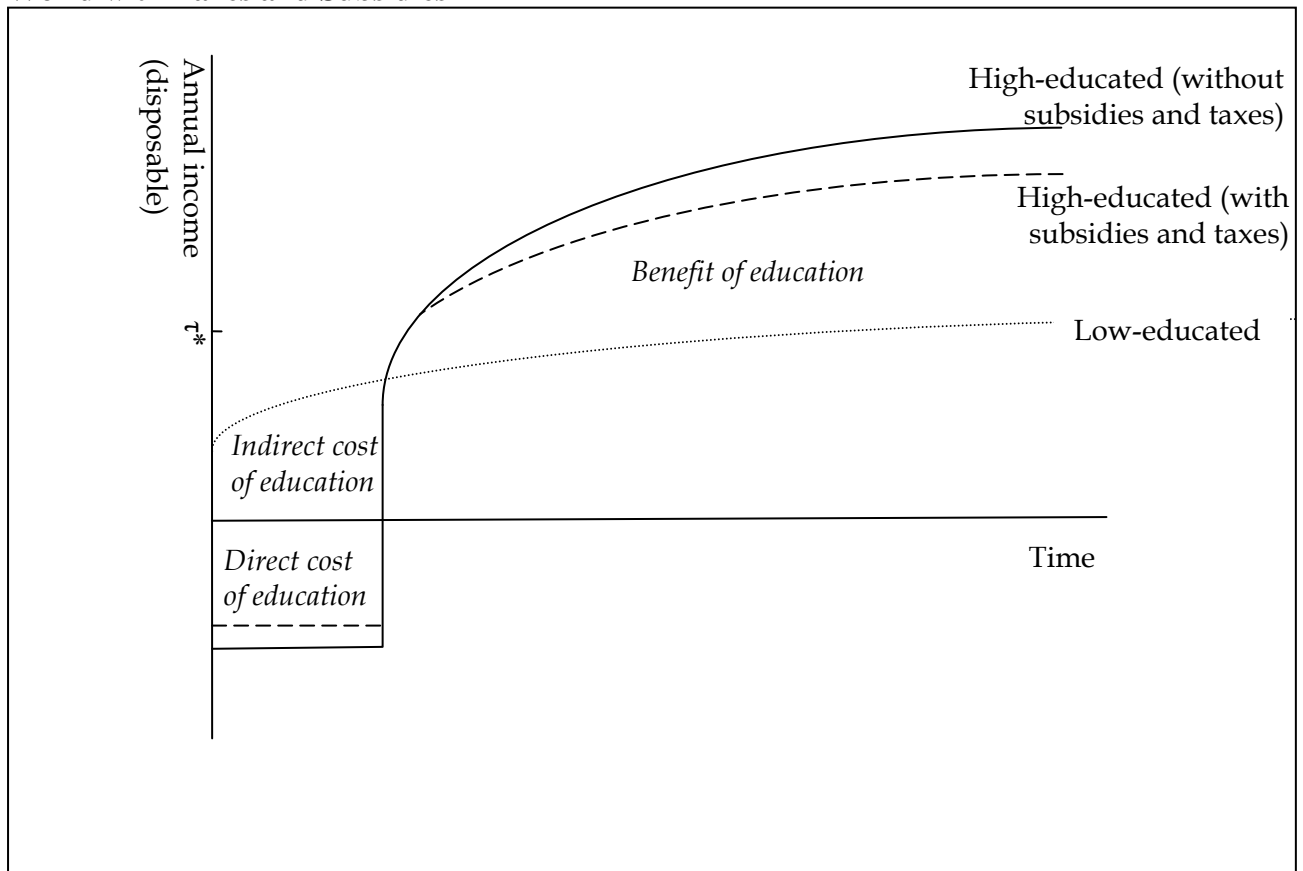
However, while the stylised result in Figure 2 depicts a setting in which taxes and subsidies reduce the incentive to undertake further education, it is not true that *any* regime of taxes and subsidies will make education less attractive. A key result of the theoretical literature (discussed in more detail in the next section) is that if the only cost of education is foregone wages, then a proportional income tax will have no impact on educational attainment, since it has the same effect on the costs and benefits of education. For example, because a 10 percent income tax reduces the opportunity cost of education by 10 percent and reduces the benefits of education by 10 percent, it does not affect an individual's choice over the optimal level of education (ignoring direct costs of education).

Indeed, one could imagine a regime of taxes and subsidies that increased the incentive to invest in education, relative to the no-tax counterfactual. For example, a country with proportional income taxes and generous living allowances for students might end up raising the level of educational attainment above what it would be in the absence of both sets of programs.

What is known about the empirical evidence? In the subsequent sections of the paper, I review three literatures: studies on the effect of income taxes on education, studies on the effect of tuition subsidies on education, and studies on the social returns to education.

3. Existing Empirical Evidence on Education and Taxation

A useful starting point in understanding the impact of the taxation system on human capital is a brief paper by Boskin (1977), who noted that a significant portion of investment in human capital consisted of foregone earnings (labelled 'indirect cost' in figures 1 and 2). In this case, a proportional income tax should not affect decisions to invest in education, since the tax saving while studying is balanced out by the tax increase after graduation.

However, as others have pointed out, there are a number of reasons why taxation might affect skill acquisition. Trostel (1993) notes several additional factors to be taken into account. First, goods investments (labelled 'direct cost' in figures 1 and 2) are part of the cost of education. In general, these are not effectively tax-deductible, so a proportional income tax reduces only part of the cost of investing in human capital.[4] Second, taxes are often

---

[4] Exceptions to this general rule include the Education Tax Refund in Australia (which allows parents to deduct certain school expenses up to a given threshold) and the Hope Credit and

progressive, such that the marginal rate that an individual would have faced if she had chosen not to study is lower than the marginal rate that she faces after graduation. Third, capital income taxes can affect education through general equilibrium effects. In a closed economy model, capital taxes lower the stock of investment, leading to a fall in the wage rate and lowering the returns to human capital.

Trostel's simulation models the decision-making process of an infinitely lived representative agent with perfect foresight. Surveying several literatures, he identifies 'reasonable' values for several key parameters, including the rate of time preference, the labour demand elasticity, the labour supply elasticity, the intertemporal elasticity of consumption, and the cost shares of time and goods invested in education. Trostel's preferred estimate is that a one percentage point increase in the income tax rate reduces the long-run stock of human capital by 1 percent.

Using data from the 1970 Census, Dupor et al. (1996) present simulations from a structural model of human capital accumulation. They find that taxation has a substantial distortionary effect on the accumulation of human capital, but argue that most of the impact occurs through progressivity (meaning that marginal rates are higher when reaping the rewards of human capital than when making the investment). They conclude that switching from the tax system that prevailed in the US in 1970 to a flat tax would increase human capital by 5 percent.

Heckman et al. (1998) and Heckman et al. (1999) present dynamic overlapping-generations models which they use to simulate two revenue-neutral policy changes: a shift to a flat

---

Lifetime Learning Credit in the United States (which allow parents, spouses or the individual themselves to deduct tuition and certain educational expenses).

income tax, and a shift to a flat consumption tax. Relative to the 1995 tax code, they conclude that both policies would raise human capital, with education levels being slightly higher under a flat income tax than under a flat consumption tax. In Heckman et al. (1999), they also model a policy reform that makes tuition tax-deductible, and find that this has very little impact on skill formation.

Several papers also look at the effect of capital taxes on human capital. Perhaps the starting point here is the insight of Heckman (1976) that – holding all else constant – higher capital income taxation encourages people to acquire more human capital. Nerlove et al. (1993) build on this with a model that begins with the following observations: first, in a world with only unskilled labour and physical capital, a comprehensive income tax distorts the leisure-consumption tradeoff and the intertemporal savings consumption tradeoff. Second, in the presence of human capital, there are two additional distortions: the capital income tax component discriminates in favour of human capital investment (relative to physical capital investment), and the wage tax component discriminates against human capital investment (assuming that the sole investment is tuition costs). Third, the two human capital distortions do not offset one another because the depreciation of human capital at death is not tax-deductible. In simulations, Nerlove et al. (1993) find a very large impact of higher comprehensive income taxes on the ratio of human capital to physical capital. In other words, their simulations suggest that a high and equal tax rate on both capital and labour earnings leads to a situation in which there is too much investment in human capital relative to physical capital.[5]

---

[5] Other papers that discuss the relationship between physical capital and human capital investments include Bovenberg and Jacobs (2005) and Richter (2009).

Applying these theories – and a slightly adapted model – to the 'Nordic system' of taxation, Nielsen and Sorensen (1997) argue that some of the distortions may be offset in certain real-world contexts. In simple terms, the Nordic system involves proportional taxes on capital, but progressive taxes on labour. They argue that this may be a second-best solution in which the distortionary bias against investment in non-human capital is offset by a progressive tax on labour income. However, the authors acknowledge that the precise tax rates that would need to prevail to make this a second-best solution are a matter for empirical analysis.

What explains the divergence in the literature? One factor is the assumption that is made about the split between time investments and goods investments in education. At the extremes, Nielsen and Sorensen (1997) assume that time is the only investment, while Nerlove et al. (1993) assume that goods are the only investment. This is partially explained by the fact that the former is focusing on Nordic countries (where the price of university tuition is zero), while the latter is focusing on the United States. Between these two cases is Trostel (1993), who assumes that the cost of educational investment is 25 percent goods and 75 time (foregone labour income), and Dupor et al. (1996), who contend that Trostel overstates the goods component, and that no more than 8 percent of educational investment is in goods that are not tax deductible. In general, labour income taxation will have a more distortionary impact on educational investment the greater is the share of non-deductible goods in human capital investment. The empirical findings cast greatest doubt on the results of Nerlove et al. (1993), whose strong results must be partly due to the assumption that human capital acquisition is purely a goods investment.

It is also worth mentioning that the empirical literature on taxation and human capital largely ignores uncertainty. As Trostel (1993) points out, there are two forms of uncertainty that

might matter. One is that individuals are uncertain about the return to a human capital investment. The larger this is, the less progressive labour income taxation will reduce human capital acquisition (since progressive taxes are akin to an insurance policy on one's future earnings).[6] Another form of uncertainty is over tax policies themselves. The more that tax policies are expected to change in the future, the less that any single tax change will affect behaviour. Given the amount of change in tax policies in most developed countries over past decades, it is quite possible that for many individuals, the degree of uncertainty about future tax policies may be larger than the degree of uncertainty about their own returns to education!

A related issue is the amount of information that individuals have about the taxation system when making human capital investment decisions. An implicit assumption in most simulation studies is that individuals are fully aware of the capital and labour income tax rates. In practice, there is likely to be some degree of misunderstanding of the tax system. Slemrod (2006) reports vast disparities between expert opinion and public opinion on many tax questions: for example, 51 percent of US respondents think that the personal income tax system is regressive[7] (while all experts regard it as progressive), and 49 percent think that

---

[6] Hogan and Walker (2007) adopt an interesting approach to the issue of risk by using a model that allows individuals to drop out of school. They regard education as akin to an option, and in their simulations, higher risk leads to more acquisition of human capital (since individuals can avoid unlucky labour market outcomes by staying in school, but can take advantage of a lucky labour market opportunities by dropping out).

[7] The question regarding progressivity was prefaced by the following question: "25. In the United States… we have what is called a graduated federal income tax system. That is, people with higher incomes are taxed at a higher percentage than people with lower incomes. Some people would like to change the current tax system so that everyone would pay the same income tax rate (for example, 10 percent or 20 percent). Generally, would you be in favor of such a flat-rate system for federal income taxes, would you prefer keeping the system we have now, or don't you know enough to say?".

most people have to pay the estate tax[8] (the true figure at the time of the survey was 2 percent). Similarly, Slemrod and Bakija (2000) report that on average, respondents believed that 45 percent of millionaires paid no income tax at all (IRS statistics put the actual figure below 2 percent).

Assuming the experts are correct, there are two possible reasons why many survey respondents understate the progressivity of the tax code. One possibility is that respondents are mistaken about the statutory rates, while the other is that they incorrectly believe that the rich are engaging in a very high degree of tax evasion. Although the work cited above does not allow us to distinguish between these two explanations, they have similar implications for the impact of tax rates on behaviour. (Other recent studies have also highlighted taxpayers' imperfect understanding of the tax system: see eg. Chetty et al. 2007; Chetty and Saez 2009).

When considering the impact of taxes on human capital accumulation, it is also worth noting that these decisions are typically made at quite a young age. Since individuals' knowledge of the tax system tends to improve over the lifecycle, the assumption of full information is likely to be more problematic when considering investments that are made at a younger age. For example, it seems unlikely that when considering whether to stay on at high school, most 16 year olds are strongly influenced by the tax rate on capital gains (though we have no firm evidence on this point).

The question itself was: "29. And do you think people with high incomes would generally pay more income tax, less income tax, or about the same amount of income tax as they pay now?".

[8] The question about the estate tax was: "51. Do you think that most families have to pay the federal estate tax when someone dies or only a few families have to pay it?".

Overall, one of the notable features about the empirical studies on taxation and human capital is that it consists almost exclusively of simulation studies, which model behaviour according to a set of parameters that are drawn from previous studies. Empirical results are always more reassuring if the results from simulations accord with results from real-world policy changes, as measured by randomised trials or natural experiments. In the case of taxation and human capital, we should probably be less confident about the conclusions that can be drawn without compelling evidence from natural experiments (for example looking across countries, states or cities to see whether changes in capital and labour income taxation have an impact on educational participation). Controlled or natural experiments have the advantage of taking account of issues such as uncertainty or limited information, which are difficult to model correctly using the simulation approach.

4. Existing Empirical Evidence on Educational Subsidies

Although (as noted in section 2), taxation and subsidies should conceptually be considered together, the two literatures have developed in a sufficiently distinct manner as to warrant separate treatment. In this section, I begin by discussing the empirical evidence on the elasticity of university attainment with respect to tuition costs, before turning to consider issues regarding the structure of higher education financing.

Using natural experiment techniques, several studies have analysed the impact of tuition price changes and scholarships on college attainment in the United States. Exploiting within-state variation in public tuition costs, Kane (1994) found that a $1000 drop in tuition costs induced a 3.7 percentage point increase in college attendance. Dynarski (2000) concluded that students who were eligible to receive merit aid through Georgia's HOPE scholarship were more likely to attend college, with a $1000 increase in aid leading to a 4 percentage point

increase in attendance. Exploiting a sudden policy change that reduced financial aid to children of deceased Social Security beneficiaries, Dynarski (2003) found that a $1000 drop in benefits reduced college attendance by 3.6 percentage points. These three natural experiment studies are consistent with cross-sectional studies (reviewed in Leslie and Brinkman 1988) which find quite similar magnitudes. However, they are not consistent with research on Pell Grant aid, which generally finds little or no impact on university attainment (Hansen 1983; Kane 1995; Seftor and Turner 2002). Dynarski (2003) attempts to reconcile these findings by suggesting that youth from disadvantaged backgrounds may be more price-sensitive than recipients of more broadly-based tuition assistance (of the type delivered through the Pell Grant scheme).[9]

Buttressing the evidence on the impact of tuition subsidies on college attendance, other research has shown that scholarship programs can have an impact on other margins too. Noting that the college dropout rate has risen over time (half of US college students drop out without completing a degree), Dynarski (2008) shows that state scholarship programs can be an effective tool to reduce attrition. And Kane (2007) demonstrates that the DC Tuition Assistance Grant program, which allowed District of Columbia residents to pay in-state tuition at public institutions in other states, led to a fourfold increase in the number of DC residents attending four-year colleges in other states.

The issue of credit constraints is dealt with in a pair of structural papers by Michael Keane and co-authors, which use data on men in the 1979 National Longitudinal Survey of Youth.

---

[9] Singell et al. (2006) presents evidence of an interaction effect: more targeted financial aid programs such as Georgia HOPE can have the effect of helping students to leverage Pell grant awards.

Keane and Wolpin (2001) and Keane (2002) compare the impact of grants and loans on collage attainment. The papers conclude that grants and parental transfers have a large impact on university enrolment, with a $1000 increase in tuition (1982-83 dollars) leading to a 12 percentage point drop in college enrollment (an effect around three times as large as the natural experiment studies). However, they find little impact of changes in loans. Although young adults have very little access to capital markets, Keane and Wolpin (2001) and Keane (2002) conclude that relaxing borrowing constraints has virtually no impact on boosting college enrolment.[10] Similarly, Stinebrickner and Stinebrickner (2008) use surveys of students at Berea College (a low-income college in Kentucky) to show that increased access to credit to finance consumption would not reduce university attrition.

Keane's results imply that a shift from free tuition to universally available student loans should reduce university enrolment, particularly among low-income students. However, this is not consistent with the evidence from Australia.[11] Chapman (1997), Chapman and Ryan (2005) and Chapman (2006) analysed the shift from zero tuition to the Higher Education Contribution Scheme (HECS), an income-contingent loans scheme introduced in 1989. They also examine changes implemented in 1997, which increased average HECS repayment amounts while reducing the repayment threshold. They conclude that both reforms were accompanied by a steady increase in the share of Australians undertaking higher education,

---

[10] However, the model of Keane and Wolpin (2001) and Keane (2002) does suggest that more generous access to loans reduces students' labour supply while they are enrolled.

[11] In the US, the evidence on grants versus loans also suggests that the impact is quite modest. Linsenmeier et al. (2006) analyse the impact on enrolment decisions when an anonymous northeastern US university switched its financial aid package for low-income students from loans to grants. They find only a 3 percentage point increase in matriculation, which is not statistically significant.

and no fall in the relative propensity for low-income high school graduates to undertake university studies.

Since the Australian studies only exploited time series variation, it is possible that a negative causal impact of HECS was masked by shifts in demand or some other policy change. But these studies at least provide some evidence that the introduction of a loans scheme (and increases in repayments) did not reduce university attendance. That said, the Australian evidence can probably be reconciled with Stinebrickner and Stinebrickner (2008), since it is possible that more generous loans to finance consumption while at university (such as the hypothetical offer to Berea College students, or the Student Financial Supplement Scheme that operated in Australia from 1993-2003) might not increase participation or reduce dropout.

5. Existing Empirical Evidence on Social Returns to Education

If the returns to education are purely private, optimal tax and subsidy policies can be developed by considering only the private benefits and private costs. However, if there are positive externalities of education, then it will be underprovided in the absence of any government intervention. In such instances, there is a proper role for government intervention in raising educational participation.[12]

---

[12] The principle that education subsidies should be increased (or graduate taxes decreased) if there is a social return to education fails to hold only in very special circumstances. These include ineffective policies (ie. the elasticity of educational attainment with respect to government policy is zero), corner solutions (in the private equilibrium, everyone is already obtaining the maximum level of education), and unusual cases concerning lumpy investments (eg. suppose that people can either get 12 or 15 years of education; if the private equilibrium is 12 years for everyone, and the social optimum is 13 years for everyone, it may be better for the government not to intervene than to subsidise everyone to get 15 years of education).

The social benefits of education are easier to catalogue than they are to measure. A plethora of possible social benefits of education have been proposed, including on health, family structure and child wellbeing, the environment, crime, productivity, and political engagement.

Health

Of these theories, the relationship between health and education has been explored the most extensively. It is true that education is positively correlated with health status, and that the relationship is stronger than the association between health and income, or health and occupational status (Stacey 1998; Cutler et al. 2006).[13] However, this does not necessarily mean that education has a causal relationship on health. It is possible that the reverse is true, for example if healthier individuals are better able to pursue education. Alternatively, it might be the case that a third variable (such as parental background or time preference) affects both health and education.

In order to separate the causal effect of education, researchers have sought to identify exogenous changes in education, which are plausibly unrelated to trends in health. Exploiting the openings of new universities, Currie and Moretti (2003) find that women in nearby counties were more likely to graduate from university, and had healthier babies. Other researchers have analysed changes in compulsory schooling laws, and found that increases in

---

[13] In a panel of developed and developing countries, increases in the quality of education – as measured by scores in international tests – have also been shown to be associated with reductions in infant mortality (Jamison et al. 2007).

the compulsory leaving age boosted health outcomes in England and Ireland (Oreopoulos 2003) and the United States (Lleras-Muney 2005). Although little is known about the causal pathways, theories include better management of complex conditions, and greater ability to comply with doctors' instructions.

Another approach is to observe health behaviours before and after completing education. To evaluate whether university attendance reduces smoking, Farrell and Fuchs (1982) control for behaviour when respondents were in high school. They find that differences in smoking behaviour between those who did and did not attend university are entirely explained by differences in smoking in high school, and reject the hypothesis that education has a causal impact on smoking.[14] Using a similar approach, Sander (1998) concluded that university attendance had no causal impact on marijuana usage.

Taken together, the literature seems consistent with modest health benefits to schooling. To the extent that these accrue to children (as with infant health), or help to reduce lifetime public health expenditures, such health benefits should be regarded as a positive externality flowing from higher levels of education.

Family structure and child wellbeing

Another possible social benefit of education is in the category of 'family structure and child wellbeing'. US researchers have documented a robust association between low levels of

---

[14] An alternative approach is that of de Walque (2007), who instruments university attendance with Vietnam draft exposure. However, if those who went to university to avoid the draft had a lower discount rate (as seems plausible), then this instrument may not satisfy the exclusion restriction.

education and teenage childbearing. There is also evidence documenting higher rates of child abuse where parental education is lower (for a survey, see Stacey 1998). However, as with health, much of this evidence could possibly be confounded by reverse causality or omitted variable bias.

Evidence from changes in compulsory schooling laws in Norway and the United States (Black et al. 2008) suggests that increased high schooling does in fact reduce the number of teenage births. In a follow-up study, Monstad et al. (2008) show that raising the compulsory school leaving age does not reduce total fertility; instead it shifts the timing of births away from teenage motherhood and towards the time when mothers are in their 20s and 30s. (The magnitude of the effect suggests that it is more than an 'incarceration effect', but that more education also affects fertility behaviour after leaving school.) Since there is evidence to suggest that children who are born to a teenage mother are more likely to have poor life outcomes, the reduction in teenage childbearing does represent a social benefit of education. However, the scope for major improvements in this domain is limited in Australia by the relatively low levels of teenage childbearing. For example, in 2006, the fertility rate among women aged 15-19 was 15.4 births per 1000 women (compared with 120.1 births per 1000 women aged 30-34).[15]

The Environment

Although there is the potential for schooling to matter in instances where an environmental problem is complex (eg. global warming), the research supporting this hypothesis is thin. In a

---

[15] The rate of teenage childbearing was higher among Indigenous women (69 per 1000 women in 2006), suggesting that this social benefit might justify greater educational investment among this population group.

review of the literature on education and the environment, Smith (1997) concludes that there is no direct evidence that education plays a significant role in improving environmental quality. A challenge for further studies on this topic is that researchers not only need to demonstrate that better-educated individuals make choices that improve their own environmental wellbeing, but also that these decisions have a positive externality for others as well.

Crime

In broad terms, there are three possible ways that education might reduce an individual's propensity to commit crime. First, education has an incapacitation effect, such that more time spent in school lowers the opportunities to commit crime. Second, education may raise an individual's productivity in the legal labour market, and thereby increase the opportunity cost of committing a crime. And third, education may have a socialising impact on students, making them more willing to obey authority figures and more compliant with society's rules and norms. However, the difficulty in separating causality is present here (as with other categories of potential social benefits). For example, Dodson and Hunter (2006) interpret the negative correlation between arrest age and educational attainment among Indigenous people as evidence that being arrested leads to lower levels of schooling.

Reviewing the literature up to the mid-1990s, Witte (1997) concluded that "neither years of schooling completed nor receipt of a high school degree has a significant effect on an individual's level of criminal activity". However, Lochner and Moretti (2004) presented evidence from changes in compulsory schooling laws across US states that demonstrated a robust impact: raising male high school graduation rates by 1 percent reduces crime rates

across most categories of crime by 1-3 percentage points. Crime is a very large negative social externality, and Lochner and Moretti (2004) show that the $6,000 cost of educating a male student for an additional year delivers expected social benefits in crime reduction in the order $1,170-2,100 (or 14-26 percent of the private returns). Even larger returns can be observed from randomised early childhood intervention programs, such as Perry Preschool (Schweinhart 2005). However, it is likely that the impact on crime of increasing university enrolments is quite small, and plausible that the impacts observed in a relatively high-crime country like the United States are higher than might be found elsewhere.

Productivity spillovers

If individuals learn from their co-workers, then increases in educational attainment should lead to an increase in productivity among those who obtain more schooling, and among those who do not obtain more schooling, but who work alongside better-educated workers. However, since low-educated workers who work alongside high-educated workers may have some unobservable characteristic that increases their productivity, it is necessary to have some exogenous variation in education. Using variation in child labour and compulsory schooling laws across US states, Acemoglu and Angrist (2000) concluded that the social returns to education from productivity spillovers are around 1 percent and not statistically significant.

The productivity returns to university appear to be larger. Using variation across cities, Moretti (2004) instrumented cities' educational composition using their lagged demographic structure and the presence of a land-grant college. He found that a 1 percentage point increase in university graduates raises wages by more than 1 percent for those with less than a

university education, and by 0.4 percent for those with a university degree. Similarly, using factory-level data, Moretti (2002) estimated that an increase in the share of university graduates in the city where that plant is located had the effect of raising productivity.

Social and political engagement

A large literature in political science has suggested that education enables a 'culture of democracy'. For example, Acemoglu et al. (2005) quote Lipset (1959, p79):

> Education presumably broadens men's outlooks, enables them to understand the need for norms of tolerance, restrains them from adhering to extremist and monistic doctrines, and increases their capacity to make rational electoral choices

Yet as Acemoglu et al. (2005) pointed out, the available cross-country evidence does not appear to support this result. Although Barro (1999) and Glaeser et al. (2004) found an association between a country's level of democracy and level of education, this relationship disappeared if country and year fixed effects are added to the model (effectively allowing for the possibility that some unobserved variable might affect a country's level of education and its level of democracy).

While these results suggest that any cross-sectional relationship between education and political engagement should be treated with caution, democratisation is not the critical margin for a well-established democracy such as Australia. Perhaps more relevant are the findings of Dee (2004), who used two instrumental variables strategies to estimate the impact of education on civic engagement in the US. Instrumenting university attendance with the

proximity of universities, and school completion with state child labour laws, he concluded that individuals with more education were more likely to vote, more supportive of free speech, and more likely to read newspapers.

Another novel approach is that of Gibson (2001), who used variation in educational attainment between twins to estimate the impact of education on volunteering. He found a significant effect, but in the 'wrong' direction: twins with more education were less likely to volunteer, and supplied fewer volunteer hours, than their less-educated sibling.

A major challenge in the case of social/political engagement outcomes is quantifying the size of the effect. For example, if we believe that education causally increases support for free speech and reduces volunteering, should we regard this as a net positive or a net negative effect? For this reason, there is some reason to think that social and political engagement should perhaps be left to one side when weighing up the social benefits of education.

Table 1: Possible Social Benefits of Education

Outcome	Evidence
Health	Positive impact of education on life expectancy and infant health; little impact on substance use (NB. These are only social benefits if they affect children or reduce government health spending).
Family structure and child welfare	Positive impact of school completion on reducing teenage childbearing (but the rate in Australia is already quite low)
Environment	Minimal evidence
Crime	Large effects from programs targeted at disadvantaged men
Productivity spillovers	Small effects from schooling, potentially larger effects for university
Social and political engagement	Positive effect on support for free speech, negative effect on volunteering

The evidence on social returns to education is summarised in Table 1. Although there appear to be positive impacts in several domains, it is important to recall that not all types of

schooling impact all domains. For example, while raising high school completion rates seems to have a causal impact on reducing crime, it does not appear to have much impact on the productivity of co-workers. Given this, Haveman and Wolfe's (1994) suggestion that the social benefits of education might be as large as the private benefits seems overstated.

Another factor to be borne in mind when considering the social returns from education is that better-educated individuals are more likely to move overseas (Pirttila 2004).[16] Consequently, any social returns from education should be scaled down by the share of high-educated individuals who remain in the country after graduation.

This consideration is reflected in the design of New Zealand's income-contingent loans scheme for higher education, the New Zealand Student Loan Scheme. Recognising that a high share of New Zealand graduates subsequently move overseas, the scheme does not charge any interest in debts while graduates continue to live in the country, but begins to accrue interest (at a rate of 6.9 percent per annum in 2007) if graduates move overseas for 6 months or more.

6. Empirical Estimates of the Impact of Taxes on the Benefits of Education

To gain some sense of the impact of taxes and subsidies on returns to education in Australia, I now turn to analyse data from the Household Income and Labour Dynamics in Australia (HILDA) survey. Since 2001, HILDA has collected data on the labour market outcomes of

---

[16] Another literature analyses the relationship between tax rates and migration decisions, and tends to find that tax rates have either no impact (Pirttila 2004; Liebig and Sousa-Poza 2006; Leigh 2008a), or only a small effect (Schmidheiny 2003; Liebig and Sousa-Poza 2004; Cebula and Alexander 2006).

nearly 20,000 individuals, including data on pre-tax and post-tax incomes. An important advantage of the HILDA data over Australian Bureau of Statistics files available to researchers is that it is available at a finer level of aggregation (eg. single year of age rather than 5-year age bands), allowing for the inclusion of a richer set of econometric controls.

To estimate the impact of taxes on the returns to education, I estimate Mincer earnings equations, in which the dependent variable is log annual individual gross income, or log annual individual disposable income (the difference between the two measures being taxes and transfers). The approach set out here essentially follows Leigh (2008b), and assumes that there is no selection bias in the decision to undertake education. For example, in estimating the returns to completing year 12 relative to dropping out at the end of year 10, a Mincer earnings equation implicitly assumes that the observed outcomes for year 10 dropouts are a reasonable counterfactual for what an individual who completed year 12 would have earned had she dropped out a year earlier.

In theory, the bias could go in either direction: individuals with more innate ability might undertake more education (because they find it easier), or less (because the opportunity cost is higher).[17] Summing up the US literature on instrumental variables approaches to overcoming the ability bias problem, Card (1999) concludes that IV estimates are typically 20-40 percent higher than the corresponding OLS estimates. Part of the explanation for this may be that these instruments primarily affect disadvantaged subgroups of the population, for whom the marginal returns to education may be higher. Although fewer quasi-experimental studies have been conducted in Australia, most of the available evidence (see eg. Rummery,

---

[17] This paragraph draws on Leigh (2008b).

Vella and Verbeek 1999; Miller, Mulvey and Martin 2006; Leigh and Ryan 2008) finds ability-adjusted returns that are similar in magnitude to OLS returns.

The results in Table 2 focus on two educational margins: staying on to year 12 relative to completing year 10, and completing a bachelor degree relative to finishing year 12. The regressions use HILDA data from 2001-07, and include respondents aged 25-64 who are not studying (full-time or part-time), and who reported positive amounts of gross and disposable income. All regressions are estimated using Ordinary Least Squares, and include survey year fixed effects, and gender×years of experience fixed effects. Formally, the regression is:

$$\ln Y_{it} = \alpha + \beta_1 E_{it} + \beta_2 \mathbf{X_{it}} + \gamma_t + \varepsilon_{it} \tag{4}$$

In this equation, Y is a measure of the earnings of individual i in year t, and E is an indicator variable for having a higher level of education. $\mathbf{X}$ is a vector of individual characteristics, comprising indicator variables for single years of actual work experience, interacted with gender dummies. This allows for a fully flexible experience-earnings profile, which differs between men and women. Finally, γ is a survey year fixed effect, and ε is a disturbance term. Although HILDA has a panel structure, the seven waves are simply treated as pooled cross-sectional surveys. To account for the fact that the same individuals' labour market outcomes may be correlated over time, standard errors are clustered at the person level.

When an effect is close to zero, the log approximation is perfectly fine, but with quite large effects, it can be imprecise. Accordingly, I also show in italics the percentage effect, which is simply exp(β)-1. In the case of year 12 completion, the impact on gross income is 26.5 log points (30 percent), while the impact on log disposable income is 17.5 log points (19 percent). This suggests that taxes and transfers reduce the returns to completing year 12 by 11

percentage points. In the case of bachelor completion, the impact on gross income is 40.1 log points (49 percent), while the impact on disposable income is 29.6 log points (34 percent). Thus taxes and transfers reduce the returns to a bachelor's degree by 15 percentage points.[18]

Table 2: Australian Education Premiums in Gross and Disposable Terms

	[1] Log gross income	[2] Log disposable income	[3] Impact of taxes on return to education [1]-[2]
Completing year 12 (relative to year 10)			
Year 12	0.265***	0.175***	-0.090
	[0.039]	[0.026]	
Observations	9530	9530	
R-squared	0.19	0.18	
Percentage effect	*30%*	*19%*	*-11%*
Bachelor degree (relative to year 12)			
Bachelor degree	0.401***	0.296***	-0.105
	[0.033]	[0.023]	
Observations	9533	9533	
R-squared	0.2	0.24	
Percentage effect	*49%*	*34%*	*-15%*

Note: Standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%. Sample is from the 2001-07 HILDA surveys, aged 25-64, not studying, and reporting positive gross and disposable income. All regressions include survey year fixed effects, and gender×years of experience fixed effects. Percentage effect is calculated as exp(β)-1.

To see how the effect of education and taxes varies over the lifecycle, I plot smoothed age-income profiles for men and women according to their level of education. Figure 3 compares the age-income profiles for respondents who have completed year 10 only and year 12 only. The top two panels focus on men, while the bottom two panels focus on women (note that the vertical axis is different for the two genders, but is kept constant when comparing gross and

---

[18] By contrast, the average tax rate (including taxes and transfers) is -19 percent for HILDA respondents aged 16-17 with only a year 10 education, and -14 percent for HILDA respondents aged 18-21 with only a year 12 education. (Put another way, among these respondents, average disposable income is higher than average gross income.)

disposable income within the same gender). As can be seen, the average income of high school graduates is higher than the average income of high school dropouts for both genders and at all ages. However, the effect of taxes and transfers is to bring the two lines closer together (ie. to reduce the returns to education) and to flatten the age-income profile.

Figure 3: Age-Income Profiles for High School Graduates and Dropouts
Dashed line denotes year 12 only, solid line denotes year 10 only
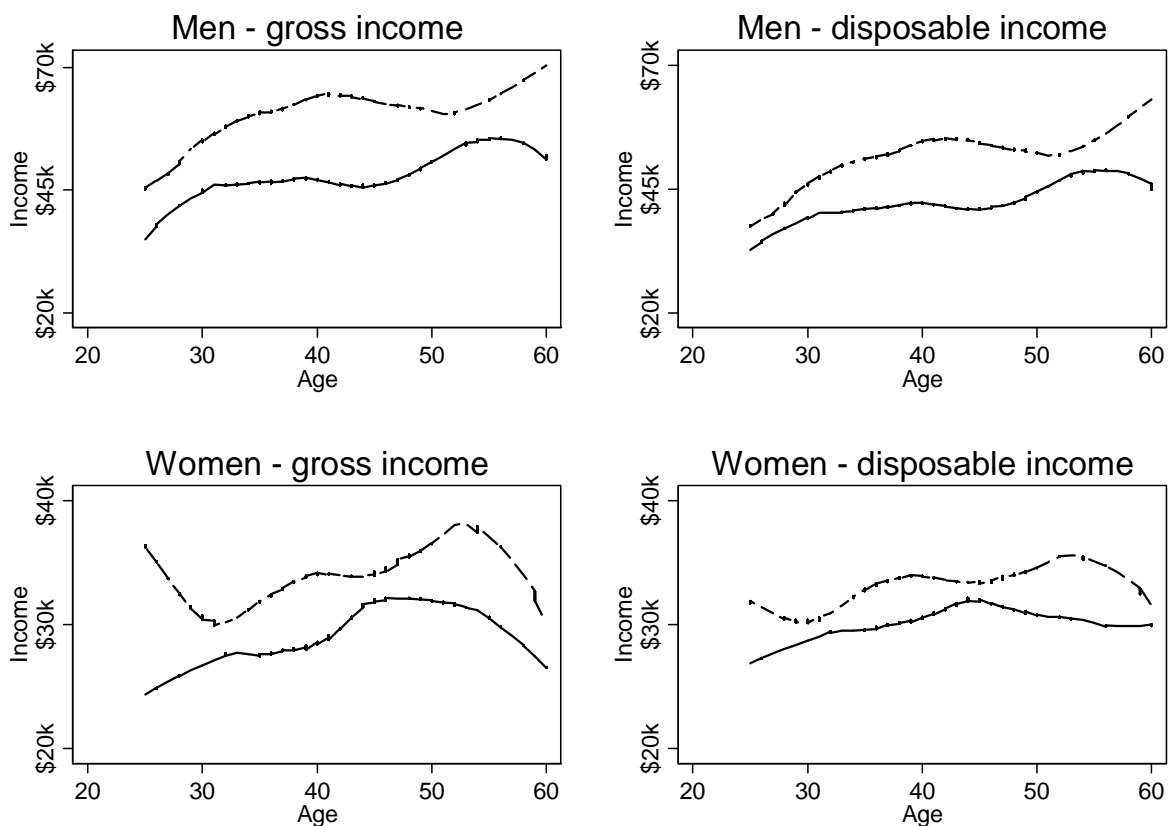
Note: Graphs are lowess smoothed graphs based upon data from the 2001-07 HILDA survey, with incomes set at 2007 levels.

A qualitatively similar result can be seen when comparing university graduates with those whose highest qualification is year 12 completion. Figure 4 charts these results, which show that bachelor degree holders not only enjoy higher incomes, but also a steeper age-income profile over the lifecycle. Although taxes and transfers clearly reduce the educational premium, there is no clear pattern over the lifecycle.

Figure 4: Age-Income Profiles for University and High School Graduates
Dashed line denotes bachelor degree, solid line denotes year 12 only
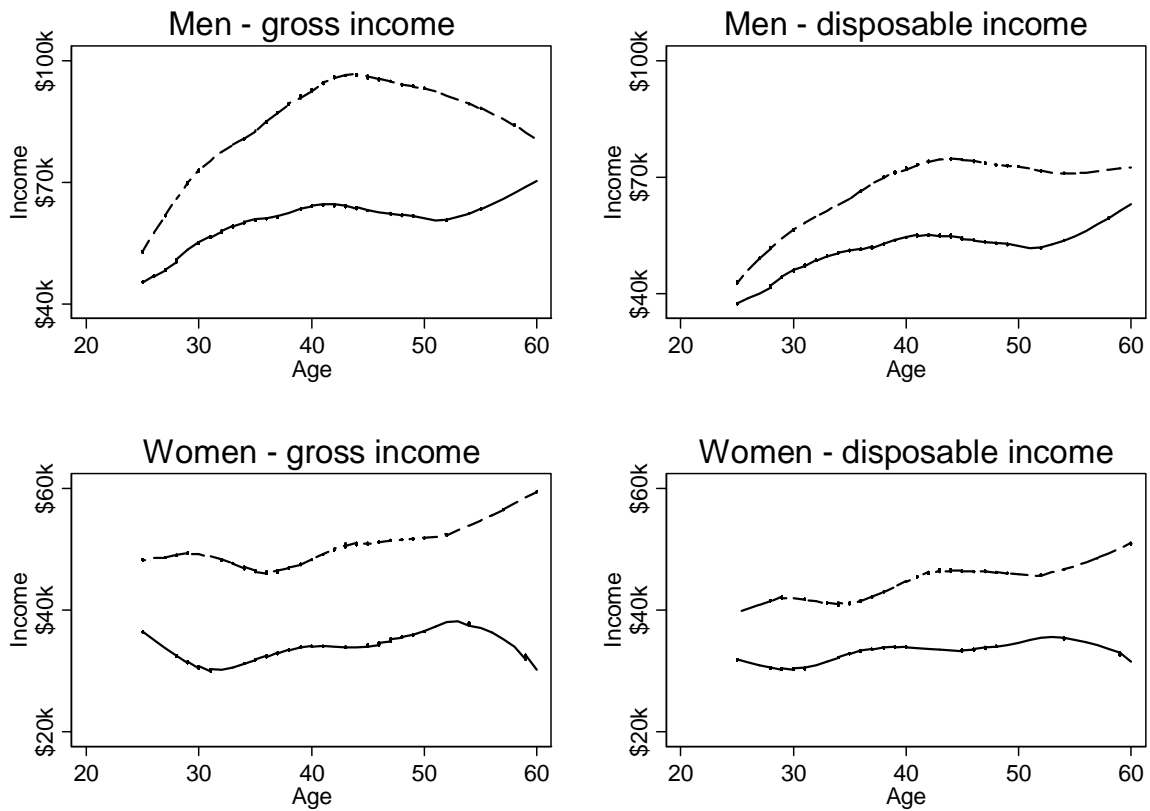
Note: Graphs are lowess smoothed graphs based upon data from the 2001-07 HILDA survey, with incomes set at 2007 levels.

7. Empirical Estimates of the Relationship Between Taxes and Subsidies in the OECD

To what extent do taxes and subsidies affect educational participation? One way to answer this question is to analyse data across developed countries, which report comparable statistics to the OECD on their level of participation in education, subsidies to education, and taxes on

labour income.[19] I use data from 2005, which is the most recent year for which comparable data are available for each of these measures across a wide range of OECD countries.

For the purposes of this exercise, I focus on participation in tertiary education, since this is the form of education for which theory suggests there should be the strongest link between skill acquisition and taxation. The dependent variable is therefore the share of individuals aged 25-34 who have completed some form of tertiary education.[20] For Australia, this figure was 38.1 percent.

As a measure of the increase in the tax burden associated with acquiring tertiary education, I use the difference between the average rate of income tax on a single person with earnings at 167 percent of average earnings and the average rate of income tax on a single person with average earnings.[21] The OECD reports tax burdens at 67 percent, 100 percent and 167 percent of average earnings, and the difference between the tax burden at 100 percent and 167 percent seems to approximate the difference between the average earnings of a high school graduate and a university graduate. For example, the ratio of university graduate earnings to high school graduate earnings in OECD countries averaged 163 percent for men and 157

---

[19] I am grateful to Nicholas Carroll for suggesting this analysis. In revising this paper, I became aware of Anderson (2008), who uses a somewhat different methodology from mine to calculate taxes and subsidies on human capital for 25 OECD countries.

[20] When looking at those aged 25-34, tertiary education includes both tertiary-type 'A programmes', which are largely theoretically-based and designed to provide qualifications for entry to advanced research programmes and professions with high skill requirements, and tertiary-type 'B programmes' which are classified at the same level of competencies as tertiary-type A programmes but are more occupationally-oriented and lead to direct labour market access

[21] This measure of personal income tax burden ignores employee social security contributions and cash benefits, and does not take account of other taxes such as consumption taxes and company taxes.

percent for women. For Australia, the average tax rate at 100 percent of average earnings was 24.0 percent, and the average tax rate at 167 percent of average earnings was 31.7 percent. Thus the increase in the average tax burden was 7.7 percent.

As a measure of the public subsidy provided to higher education, I use the per-student funding to higher education, expressed as a share of GDP. For Australia, this figure was 22.2 percent. All regressions also control for the log of per-capita GDP, converted to US dollars at purchasing power parity. (However, I also show scatterplots without any GDP control.) Table 3 tabulates the data for all countries.

Table 3: OECD Data on Education, Taxes and Subsidies

Country	GDP per capita in USD (PPP)	Share of 25-34 year olds with tertiary education	Average tax rate at 167% of average earnings	Average tax rate at 100% of average earnings	Difference between tax rate at 167% and 100%	Public subsidy per student for tertiary education (as a share of average earnings)
Australia	$33,963	38.1%	31.7%	24.0%	7.7%	20.4%
Austria	$33,496	19.7%	21.9%	14.7%	7.2%	44.4%
Belgium	$32,063	40.6%	34.7%	28.0%	6.7%	28.2%
Czech Republic	$20,366	14.2%	14.8%	11.6%	3.3%	36.7%
Denmark	$33,196	39.8%	39.6%	30.1%	9.4%	51.3%
Finland	$30,644	37.5%	32.1%	25.0%	7.1%	32.4%
France	$29,758	39.3%	20.0%	15.3%	4.7%	31.7%
Germany	$31,380	22.5%	30.0%	21.9%	8.1%	26.9%
Greece	$24,928	25.4%	16.5%	7.8%	8.7%	22.5%
Hungary	$16,958	19.6%	28.1%	20.2%	7.9%	29.5%
Iceland	$35,009	35.8%	31.7%	25.4%	6.3%	34.8%
Ireland	$38,693	40.6%	22.7%	10.2%	12.5%	33.7%
Italy	$28,144	16.1%	24.2%	18.1%	6.1%	24.4%
Japan	$30,312	53.2%	10.8%	6.6%	4.1%	15.5%
Korea	$21,342	51.0%	8.1%	2.8%	5.3%	5.4%
Mexico	$12,432	18.1%	11.7%	3.1%	8.6%	50.4%
Netherlands	$35,111	35.4%	24.6%	10.7%	13.9%	32.7%
New Zealand	$24,469	30.8%	26.2%	20.4%	5.7%	25.7%
Norway	$47,319	40.9%	28.7%	21.2%	7.5%	56.4%
Poland	$13,786	25.5%	7.4%	6.2%	1.2%	19.5%
Portugal	$20,656	19.1%	18.3%	11.4%	7.0%	28.5%
Slovak Republic	$16,175	16.3%	11.9%	8.7%	3.2%	31.4%
Spain	$27,377	39.7%	18.7%	13.9%	4.9%	23.7%
Sweden	$32,298	37.3%	35.3%	24.2%	11.1%	40.6%
Switzerland	$35,429	31.0%	15.7%	10.7%	5.0%	50.0%
United Kingdom	$32,695	35.0%	24.2%	17.7%	6.6%	21.9%
United States	$41,718	39.2%	22.4%	16.6%	5.8%	30.7%
Mean	**$28,170**	**31.9%**	**22.7%**	**15.8%**	**6.9%**	31.5%
Standard Deviation	**$9,021**	**10.6%**	**8.6%**	**7.5%**	**2.7%**	11.5%

Note: All data are from the OECD, for 2005.

I now turn to estimating a simple cross-country regression, looking at the relationship between tertiary attainment, taxes and subsidies. The full regression equation is:

$$A_j = \alpha + \beta_1 S_j + \beta_2 \tau_j + \beta_3 Y_j + \varepsilon_j \qquad (5)$$

In this equation, A is a measure of educational attainment in country j, being the share of 25-34 year olds with tertiary education. S is a measure of the public subsidy as a ratio of average annual earnings, τ is a measure of the tax difference (the average tax rate at 167 percent of average earnings minus the average tax rate at 100 percent of average earnings), Y is log per-capita GDP in US dollars, and ε is a normally-distributed mean-zero error term.[22]

In Table 4, I show the results from regressing the share of the 25-34 year old cohort completing tertiary education on the level of public subsidies, the amount of increased taxes payable by those who undertake tertiary education, and both together. In both columns 1 and 3, the per-student public subsidy is negatively correlated with tertiary attainment (contrary to theory). The coefficient is around -0.3, suggesting that a 1 percentage point increase in the per-student public subsidy is associated with a 0.3 percentage point fall in the tertiary attainment rate. One possible explanation for this counter-intuitive finding is that an exogenous increase in tertiary attendance, holding funding constant, will reduce the per-student subsidy. In principle, one could account for this through an instrumental variables approach, though it is difficult to know what instruments might satisfy the exclusion restriction.

The coefficient on the tax difference is negative in both columns 2 and 3, but not statistically significant. Controlling for the subsidy (column 3), the coefficient is -0.01, suggesting that a 10 percentage point increase in the tax differential between university graduates and high school graduates is associated with a 0.1 percentage point fall in the tertiary attainment rate. Given that the cross-country standard deviation of the tertiary attainment rate is over 10

---

[22] The results are robust to expressing the public subsidy as a ratio of GDP per capita, rather than as a ratio of average annual earnings.

percent, this suggests that taxes – at least in this specification – explain very little of the variation in tertiary attendance across OECD countries.[23]

Table 4: Tertiary Attainment, Taxes and Subsidies Across OECD Countries in 2005

Dependent variable is the share of the 25-34 year old cohort with a tertiary qualification

	[1]	[2]	[3]
Per-student public subsidy as a fraction of average earnings	-0.333**		-0.332**
	[0.147]		[0.154]
Increase in taxes from 100% of average earnings to 167% of average earnings		-0.375	-0.014
		[0.719]	[0.691]
Log GDP per capita in USD (PPP)	0.205***	0.191***	0.205***
	[0.052]	[0.060]	[0.056]
Observations	27	27	27
R-squared	0.43	0.31	0.43

Note: Standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%

Figure 5 shows these results graphically, first by plotting taxes and subsidies against attainment (top two panels), and then by showing added-variable plots (bottom two panels). This illustrates the point made by the regressions – the very large variation in tertiary attainment across OECD countries does not seem to be systematically related either to subsidies or taxes.

---

[23] Controlling for the top marginal tax rate, the coefficient on the tax differential measure (in the specification that controls for education subsidies) rises from -0.014 to -0.227, but remains statistically insignificant.

Figure 5: Tertiary Attainment, Taxes and Subsidies Across OECD Countries in 2005
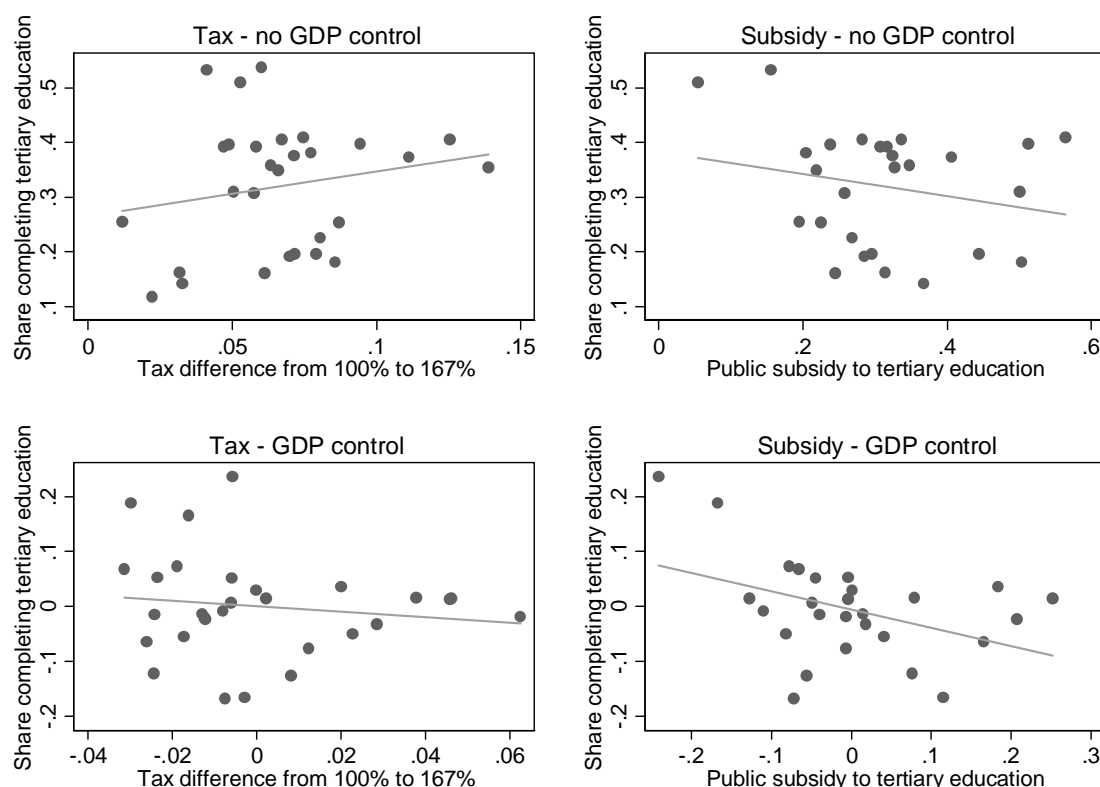
Note: All variables are measured in 2005. Tertiary attainment is the share of the 25-34 year old cohort with tertiary qualifications. Tax difference is the difference between the average tax rate applying at 100 percent of average earnings and the average tax rate applying at 167 percent of average earnings. Subsidy is the per-student public subsidy as a share of average annual earnings. The bottom two panels are added-variable plots, showing residuals of both variables from a regression on log per capita GDP (in USD at PPP).

In the following tables, I carry out a number of robustness checks. First, to account for the possibility that cross-country differences in female educational attainment might have more to do with cultural differences than taxes and subsidies, I re-estimate the model with the dependent variable being the share of 25-34 year old men who have a tertiary qualification, and then with the dependent variable being the share of 25-34 year old women with a tertiary qualification. The results from these specifications are shown in Table 5, and are quite similar to the pooled results in Table 4.

Table 5: Tertiary Attainment Among Men and Women

	[1]	[2]	[3]
Panel A: Dependent variable is the share of the 25-34 year old men with a tertiary qualification			
Per-student public subsidy as a fraction of average earnings	-0.292*		-0.289*
	[0.145]		[0.152]
Increase in taxes from 100% of average earnings to 167% of average earnings		-0.376	-0.062
		[0.696]	[0.682]
Log GDP per capita in USD (PPP)	0.180***	0.170***	0.182***
	[0.051]	[0.058]	[0.055]
Observations	27	27	27
R-squared	0.37	0.27	0.37
Panel B: Dependent variable is the share of the 25-34 year old women with a tertiary qualification			
Per-student public subsidy as a fraction of average earnings	-0.371**		-0.371**
	[0.166]		[0.175]
Increase in taxes from 100% of average earnings to 167% of average earnings		-0.394	0.009
		[0.812]	[0.781]
Log GDP per capita in USD (PPP)	0.226***	0.210***	0.226***
	[0.058]	[0.068]	[0.064]
Observations	27	27	27
R-squared	0.42	0.3	0.42

Note: Standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%

Second, to account for the fact that some of those in the 25-34 year old cohort will have made the decision about whether or not to attend university based on policy parameters that were in place much earlier, I switch the dependent variable to be the 'graduation rate'.[24] The graduation rate is defined by the OECD to be the number of first-time graduates in 2005, as a share of the population at the typical age of graduation.[25] The typical age of graduation

---

[24] In theory, another approach would be to look at lagged values of education funding and taxation. However, data limitations make this impractical.

[25] Due to data limitations, the graduation rate only includes first-time graduates from tertiary-type 'A programmes' (which are largely theoretically-based and designed to provide

differs across countries, but in Australia it is defined to be 20-25 year old. Thus the graduation rate is the number of tertiary graduates in 2005, divided by one-sixth of the 20-25 year old age cohort. I also estimate models in which the dependent variable is the male graduation rate or the female graduation rate. These results are shown in Table 6. Although the graduation rate measure is only available for 22 of the 27 countries, the main results appear quite robust to using this different measure of tertiary attainment. In none of these specifications is the tertiary attainment rate strongly positively related to the public subsidy amount, nor is the tertiary attainment rate strongly negatively related to the increase in taxes associated with a move from average earnings to 167 percent of average earnings.

qualifications for entry to advanced research programmes and professions with high skill requirements). Data are drawn from OECD (2007, Tables A3.2 and A3.8).

Table 6: Tertiary Attainment Among Younger Cohorts

	[1]	[2]	[3]
Panel A: Dependent variable is the graduation rate among the graduate-age cohort			
Per-student public subsidy as a fraction of average earnings	-0.222		-0.225
	[0.235]		[0.242]
Increase in taxes from 100% of average earnings to 167% of average earnings		0.161	0.211
		[0.930]	[0.935]
Log GDP per capita in USD (PPP)	0.075	0.034	0.065
	[0.081]	[0.088]	[0.094]
Observations	22	22	22
R-squared	0.06	0.02	0.06
Panel B: Dependent variable is the male graduation rate among the graduate-age cohort			
Per-student public subsidy as a fraction of average earnings	-0.325*		-0.321*
	[0.156]		[0.160]
Increase in taxes from 100% of average earnings to 167% of average earnings		-0.339	-0.268
		[0.663]	[0.617]
Log GDP per capita in USD (PPP)	0.098*	0.068	0.111*
	[0.054]	[0.063]	[0.062]
Observations	22	22	22
R-squared	0.22	0.06	0.23
Panel C: Dependent variable is the female graduation rate among the graduate-age cohort			
Per-student public subsidy as a fraction of average earnings	-0.119		-0.129
	[0.347]		[0.355]
Increase in taxes from 100% of average earnings to 167% of average earnings		0.661	0.69
		[1.338]	[1.372]
Log GDP per capita in USD (PPP)	0.051	0.001	0.019
	[0.119]	[0.126]	[0.138]
Observations	22	22	22
R-squared	0.01	0.02	0.02

Note: Standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%

8. Conclusion

Theories of the impact of taxation on human capital acquisition can have a powerful impact on policymaking. According to Steuerle (1996), economic evidence that the US tax system discriminated against goods investments in human capital influenced President Clinton's

decision to propose tax-deductibility of certain tuition costs. This eventually led to the 1997 enactment of the Hope Credit and Lifetime Learning Credit, which make certain tuition and educational expenses tax-deductible. Assessing the net impact of taxes and subsidies on educational attainment is clearly an issue of considerable policy-relevance, not only in Australia, but also elsewhere.

A striking feature about the literature on taxation and human capital is the extent to which it is comprised almost entirely of simulation exercises, based upon plausible elasticities. A clear risk of such an approach is that elasticities measured in one context may not necessarily be applicable in another setting. For example, middle-aged individuals who are making repeated decisions (such as whether or not a spouse should work), may be more responsive to taxes than a young person who is making a once-in-a-lifetime choice (such as whether or not to attend university). If an elasticity estimated in the first setting is applied to the second, it may inadvertently overstate the impact of taxes on behaviour.

In many tax policy contexts, the assumption of full information and no uncertainty are quite reasonable. Taxpayers who are educated, older, and interact repeatedly with the system are likely to be highly responsive to changes in policy. But most educational attainment decisions are made by individuals who are young and (by definition) have less education. In this context, the assumptions of certainty and full information are shakier. In particular, it is difficult to reconcile the simulation results in section 3 – which tend to show that more progressive taxes reduce educational participation – with the fact that 51 percent of US taxpayers believe that the current tax system is regressive.

An advantage of much of the literature on tuition subsidies is that it does not rely on these kinds of assumptions, and instead uses natural experiment approaches to estimate the causal impact of university tuition subsidies on educational participation. The general finding of this literature is that more generous cash subsidies raise participation rates (and lower dropout rates) among low-income youth. However, the elasticity of attendance with respect to subsidies is lower among the general population. It would be useful to have more studies of this type in the case of tax changes, since looking at real-world policy variation might provide different results. Although the simulation approach has its benefits, policy conclusions are always more believable if they are robust to using different modelling approaches.

In trying to set optimal education taxes and subsidies, it is useful to have regard to the literature on social returns to education. This suggests that social returns are present, particularly in the areas of crime (from higher school completion rates) and productivity (from higher university completion rates). However, the best estimates of the size of social returns suggest that in the main, they should not be a key driver of policy. By contrast, there is robust evidence that private returns to education are large and significant. Completing year 12 raises gross income by 30 percent (relative to completing year 10) and completing a bachelor's degree raises gross earnings by 49 percent (relative to completing year 12). Taking taxes and transfers into account lowers these estimates by 11-15 percent, but the private gain from human capital acquisition is still substantial.

What is the cross-country relationship between educational participation and taxes and subsidies? To test this, I look across 27 developed nations, to see whether those with higher public subsidies to education, or less progressive taxes, have higher rates of participation in tertiary education. Contrary to theoretical predictions, I find no significant evidence that more

generous subsidies or lower tax rates on the rich have the effect of raising educational participation. One possible interpretation of this result is that the cross-country measure of participation is poorly measured, or confounded by an omitted variable that affects both participation and subsidies/taxes. Another plausible explanation is that, in aggregate, taxes and subsidies have a relatively small impact on educational participation.

References

Acemoglu, Daron and Joshua Angrist. 2000. "How Large Are Human-Capital Externalities? Evidence from Compulsory Schooling Laws", *NBER Macroeconomics Annual*, 15: 9-59

Acemoglu, Daron and James A. Robinson. 1998. *Why Did the West Extend the Franchise? Democracy, Inequality and Growth in Historical Perspective*. Centre for Economic Policy Research Discussion Paper 1797. London: CEPR.

Acemoglu, Daron, Simon Johnson, James A. Robinson, and Pierre Yared. 2005. "From Education to Democracy?" *AEA Papers and Proceedings*, 95(2):44-49.

Alstadsaeter, Annette. 2003. "Does the Tax System Encourage Too Much Education?" *FinanzArchiv*, 59(1):27-48.

Anderson, Glenn M. 2008. "Effective Tax Rates on Skill Formation: A Comparison of 25 OECD-Member Countries", *mimeo*, Sydney Campus of Curtin University of Technology: Sydney.

Barro, Robert J. 1999. "Determinants of Democracy." *Journal of Political Economy,* 107(6):S158-S183.

Black, Sandra E., Paul J. Devereux, and Kjell G. Salvanes. 2008. "Staying in the Classroom and Out of the Maternity Ward? The Effect of Compulsory Schooling Laws on Teenage Births." *Economic Journal*, 118(July):1025-1054.

Bovenberg, A. Lans and Bas Jacobs. 2005. "Redistribution and education subsidies are Siamese twins." *Journal of Public Economics*, 89(11-12):2005-2035.

Card, David. 1999. "The Causal Effect of Education on Earnings", *Handbook of Labor Economics*, 3(1): 1801-1863.

Cebula, Richard J. and Gigi M. Alexander. 2006. "Determinants of Net Interstate Migration, 2000-2004." *Journal of Regional Analysis and Policy*, 36(2):116-123.

Chapman, Bruce. 1997. "Conceptual Issues and the Australian Experience with Income Contingent Charges for Higher Education." *Economic Journal*, 107(442):738-751.

Chapman, Bruce. 2006. "Income Contingent Loans for Higher Education: International Reform." In Hanushek, Eric and Finis Welch (eds.), Handbook on the Economics of Education. New York: North-Holland, 1435-1503.

Chapman, Bruce and Chris Ryan. 2005. "The Access Implications of Income Related Charges for Higher Education: Lessons from Australia." *Economics of Education Review*, 24(5):491-512.

Chetty, Raj, Adam Looney, Kory Kroft. 2007. "Salience and Taxation: Theory and Evidence", NBER Working Paper No. 13330, Cambridge, MA: NBER

Chetty, Raj and Emmanuel Saez. 2009. "Teaching the Tax Code: Earnings Responses to an Experiment with EITC Recipients", NBER Working Paper No. 14836. Cambridge, MA: NBER

Cigno, Alessandro and Annalisa Luporini. 2009. "Scholarships or Student Loans? Subsidizing Higher Education in the Presence of Moral Hazard." *Journal of Public Economic Theory*, 11(1):55-87.

Currie, Janet and Enrico Moretti. 2003. "Mother's Education and the Intergenerational Transmission of Human Capital: Evidence from College Openings." *Quarterly Journal of Economics*, 118(4):1495–1532.

Cutler, David, Angus Deaton, and Adriana Lleras-Muney. 2006. "The Determinants of Mortality." *Journal of Economic Perspectives*, 20(3):97-120.

Dee, Thomas. 2004. "Are there Civic Returns to Education?" *Journal of Public Economics*, 88(9-10):1697-1720.

de Walque, Damien. 2007. "Does education affect smoking behaviors? Evidence using the Vietnam draft as an instrument for college education." *Journal of Health Economics*, 26(5):877-895.

Dodson, M. and Hunter, B. 2006. "Selected crime and justice issues for Indigenous families", *Family Matters*, 75 34–41.

Dupor, Bill, Lance Lochner, Christopher Taber, and Mary Beth Wittekind. 1996. "Some Effects of Taxes on Schooling and Training." *AEA Papers and Proceedings*, 86(2):340-346.

Dynarski, Susan. 2000. "Hope for Whom? Financial Aid for the Middle Class and Its Impact on College Attendance." *National Tax Journal*, 53(3):629-661.

Dynarski, Susan. 2003. "Does Aid Matter? Measuring the Effect of Student Aid on College Attendance and Completion." *American Economic Review*, 93(1):279-288.

Dynarski, Susan. 2008. "Building the Stock of College-Educated Labor." *Journal of Human Resources*, 43(3):576-610.

Farrell, Phillip and Victor R. Fuchs. 1982. "Schooling and Health: The Cigarette Connection." *Journal of Health Economics*, 1(3):217-230.

Fuest, Clemens and Bernd Huber. 2001. "Tax Progression and Human Capital in Imperfect Labour Markets." *German Economic Review*, 2(1):1-18.

Garcia-Penalosa, Cecilia and Klaus Walde. 2000. "Efficiency and equity effects of subsidies to higher education." *Oxford Economic Papers*, 52(4):702-722.

Gibson, John. 2001. "Unobservable family effects and the apparent external benefits of education." *Economics of Education Review*, 20(3):225-233.

Glaeser, Edward L.; La Porta, Rafael; Lopez-de-Silanes, Florencio and Shleifer, Andrei. 2004. "Do

Institutions Cause Growth?" *Journal of Economic Growth*, 9(3): 271–303.

Lipset, Seymour Martin. 1959. "Some Social Requisites of Democracy: Economic Development and Political Legitimacy." *American Political Science Review*, 53(1): 69–105.

Hansen, W. Lee. 1983. "The Impact of Student Financial Aid on Access." In Froomkin, Joseph (ed.), The crisis in higher education. New York: Academy of Political Science, 84-96.

Haveman, Robert and Wolfe, Barbara. 1994. *Succeeding Generations: On the Effects of Investments in Children*. New York: Russell Sage Foundation.

Heckman, James J., Lance Lochner, and Christopher Taber. 1998. "Tax Policy and Human-Capital Formation." *AEA Papers and Proceedings*, 88(2):293-297.

Heckman, James J., Lance Lochner, and Christopher Taber. 1999. "Human Capital Formation and General Equilibrium Treatment Effects: A Study of Tax and Tuition Policy." *Fiscal Studies*, 20(1):25-40.

Hogan, Vincent and Ian Walker. 2007. "Education choice under uncertainty: Implications for public policy." *Labour Economics*, 14(6):894-912.

Imai, Susumu and Michael P. Keane. 2004. "Intertemporal Labor Supply and Human Capital Accumulation." *International Economic Review*, 45(2):601-641.

Ionescu, Felicia. 2009. "The Federal Student Loan Program: Quantitative implications for college enrollment and default rates." *Review of Economic Dynamics*, 12(1):205-231.

Jamison, Eliot A., Dean T. Jamison, and Eric A. Hanushek. 2007. "The effects of education quality of income growth and mortality decline." *Economics of Education Review*, 26(6):771-788.

Kane, Thomas J. 1994. "College Entry by Blacks since 1970: The Role of College Costs, Family Background, and the Returns to Education." *Journal of Political Economy*, 102(5):878-911.

Kane, Thomas J. 1995. *Rising Public College Tuition and College Entry: How Well Do Public Subsidies Promote Access to College?* NBER Working Paper 5164. Cambridge, MA: NBER.

Kane, Thomas J. 2006. "Evaluating the Impact of the D.C. Tuition Assistance Grant Program." *Journal of Human Resources*, 42(3):555-582.

Keane, Michael P. 2002. "Financial Aid, Borrowing Constraints, and College Attendance: Evidence from Structural Estimates." *AEA Papers and Proceedings*, 92(2):293-297.

Keane, Michael P. and Kenneth I. Wolpin. 2001. "The Effect of Parental Transfers and Borrowing Constraints on Educational Attainment." *International Economic Review*, 42(4):1051-1103.

Kremer, Michael and Andrei Sarychev. 1998. *Why Do Governments Operate Schools?* mimeo.

Leigh, Andrew. 2008a. "Do Redistributive State Taxes Reduce Inequality?" *National Tax Journal*, 61(1): 81-104.

Leigh, Andrew. 2008b. 'Returns to Education in Australia' *Economic Papers*, 27(3): 233-249.

Leigh, Andrew and Chris Ryan. 2008. "Estimating Returns to Education Using Different Natural Experiment Techniques" *Economics of Education Review*, 27(2): 149-160

Leigh, J. Paul. 1998. "The Social Benefits of Education: a Review Article." *Economics of Education Review*, 17(3):363-368.

Leslie, Larry and Paul Brinkman. 1988. *The economic value of higher education*. New York: Macmillan.

Liebig, Thomas and Alfonso Sousa-Poza. 2004. *Taxation, ethnicities, and the location of highly-skilled immigrants.* mimeo.

Liebig, Thomas and Alfonso Sousa-Poza. 2006. "The influence of taxes on migration: evidence from Switzerland." *Cambridge Journal of Economics*, 30(2):235-252.

Lin, Shuanglin. 1998. "Labor income taxation and human capital accumulation." *Journal of Public Economics*, 68(2):291-302.

Linsenmeier, David M., Harvey S. Rosen, and Cecilia Elena Rouse. 2006. "Financial Aid Packages and College Enrollment Decision: An Econometric Case Study." *Review of Economics and Statistics*, 88(1):126-145.

Lleras-Muney, Adriana. 2005. "The Relationship between Education and Adult Mortality in the United States." *Review of Economic Studies*, 72(1):189-221.

Lleras-Muney, Adriana and Frank R. Lichtenberg. 2002. *The Effect of Education on Medical Technology Adoption: Are the More Educated More Likely to Use New Drugs?* NBER Working Paper 9185. Cambridge, MA: NBER.

Lochner, Lance and Enrico Moretti. 2004. "The Effect of Education on Crime: Evidence from Prison Inmates, Arrests, and Self-Report." *American Economic Review*, 94(1):155-189.

Miller, P.W., Mulvey, C. and Martin, N. 2006. "The Return to Schooling: Estimates from a Sample of Young Australian Twins". *Labour Economics*, 13(5): 571-587.

Monstad, Karin, Carol Propper, and Kjell G. Salvanes. 2008. "Education and Fertility: Evidence from a Natural Experiment." *Scandinavian Journal of Economics*, 110(4):827-852.

Moretti, Enrico. 2002. *Human Capital Spillovers in Manufacturing: Evidence from Plant-Level Production Functions*. NBER Working Paper 9316. Cambridge, MA: NBER.

Moretti, Enrico. 2004. "Estimating the social return to higher education: evidence from longitudinal and repeated cross-sectional data" *Journal of Econometrics*. 121(1-2): 175-212

Nerlove, Marc, Assaf Razin, Efraim Sadka, and Robert K. von Weizsacker. 1993. "Comprehensive income taxation, investments in human and physical capital, and productivity." *Journal of Public Economics*, 50(3):397-406.

Nielsen, Soren Bo and Peter Birch Sorensen. 1997. "On the optimality of the Nordic system of dual income taxation." *Journal of Public Economics*, 63(3):311-329.

OECD. 2007. *Education at a Glance 2007*. Paris: OECD.

Oreopoulos, Philip. 2003. *Do Dropouts Drop Out Too Soon? Wealth, Health, and Happiness from Compulsory Schooling.* NBER Working Paper 10155. Cambridge, MA: NBER.

Pirttila, Jukka. 2004. "Is International Labour Mobility a Threat to the Welfare State? Evidence from Finland in the 1990s." *Finnish Economic Papers*, 17(1):18-34.

Pritchett, Lant. 2002. *'When Will They Ever Learn?' Why All Governments Produce Schooling.* mimeo. Cambridge, MA: Harvard Kennedy School.

Richter, Wolfram F. 2009. "Taxing Education in Ramsey's Tradition", CESifo Working Paper 2586. Munich: CESifo.

Rummery, S., Vella F., and Verbeek, M. 1999 "Estimating the Returns to Education for Australian Youth via Rank-Order Instrumental Variables", *Labour Economics*, 6: 491–507.

Sander, William. 1998. "The Effects of Schooling and Cognitive Ability on Smoking and Marijuana Use by Young Adults." *Economics of Education Review*, 17(3):317-324.

Schmidheiny, Kurt. 2003. *Income Segregation and Local Progressive Taxation: Empirical Evidence from Switzerland* HWWA Discussion paper 248. Hamburg: HWWA.

Schweinhart, Lawrence J., Montie, J., Xiang, Z., Barnett, W. S., Belfield, C. R., & Nores, M. 2005. *Lifetime effects: The High/Scope Perry Preschool study through age 40.* (Monographs of the High/Scope Educational Research Foundation, 14). Ypsilanti, MI: High/Scope Press.

Singell, Larry D., Glen R. Waddell, and Bradley R. Curs. 2006. "HOPE for the Pell? Institutional Effects in the Intersection of Merit-Based and Need-Based Aid." *Southern Economic Journal*, 73(1):79-99.

Slemrod, Joel. 2006. "The Role of Misconceptions in Support for Regressive Tax Reform." *National Tax Journal*, 59(1):57-75.

Slemrod, Joel and Jon Bakija. 2000. *Taxing Ourselves: A Citizens' Guide to the Great Debate over Tax Reform.* Second edition. Cambridge, MA: MIT Press.

Smith, V. Kerry: 1997. "Feedback Effects and Environmental Resources". In *Social Benefits of Education*, ed. Jere R. Behrman and Nevzer Stacey. Ann Arbor: University of Michigan Press

Stacey, Nevzer. 1998. "Social Benefits of Education." *Annals of the American Academy of Political and Social Science*, 559(1):54-63.

Steuerle, C. Eugene. 1996. "How Should Government Allocate Subsidies for Human Capital?" *AEA Papers and Proceedings*, 86(2):353-357.

Stinebrickner, Ralph and Todd Stinebrickner. 2008. "The Effect of Credit Constraints on the College Drop-Out Decision: A Direct Approach Using a New Panel Study." *American Economic Review*, 98(5):2163-2184.

Taber, Christopher. 2002. "Tax Reform and Human Capital Accumulation: Evidence from an Empirical General Equilibrium Model of Skill Formation." *BE Journals Advances in Economic Analysis and Policy*, 2(1): article 3.

Trostel, Philip A. 1993. "The Effect of Taxation on Human Capital." *Journal of Political Economy*, 101(2):327-350.

van Ewijk, Casper and Paul J.G. Tang. 2007. "Unions, progressive taxes, and education subsidies." *European Journal of Political Economy*, 23(4):1119-1139.

Witte, A. Dryden. 1997. "Crime". In *Social Benefits of Education*, ed. Jere R. Behrman and Nevzer Stacey. Ann Arbor: University of Michigan Press.