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The welfare effects of income-contingent financing for higher education

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Abstract

In this paper, it is shown that educational financing schemes with income-contingent repayments provide a mixture of consumption-smoothing benefits and insurance against the uncertain outcomes of risky educational investments. Educational financing schemes with income-contingent repayment will enhance welfare relative to the alternative of upfront fees yielding the same revenue in present value terms

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1 Introduction

Problems related to the of financing post-secondary education have become more salient in recent years. Demand has increased, at a time when governments are facing limits on their capacity to raise additional revenue. At the same time, in most jurisdictions, participation in post-secondary education is far from universal. Hence, free provision of post-secondary education represents a subsidy within any given cohort, from those who do not participate in post-secondary education to those who do. Since the latter group, on average, have higher parental incomes and higher earnings after the completion of education than the former, this subsidy may be seen as regressive.

On the other hand, for most students engaged in post-secondary education, current incomes are below the average for the community. In the absence of government transfer payments, the incomes of students consistent primarily of transfers from other family members and of earnings from employment. These sources of income exceed standard poverty lines in some but not all cases. Hence, many students would find significant difficulty in meeting the full costs of education if these were required to be paid in the form of 'upfront' fees, prior to or during post-secondary education.

A variety of solutions have been adopted in response to this policy problem. One of the most interesting involves income-contingent payment systems. In 1988 the Australian government introduced a system in which students undertaking a higher education incur a debt which represents a contribution to the costs of tuition and other services. This debt is repaid through an income-contingent charge, referred to as the Higher Education Contributions Scheme (HECS).

Some of the economic implications of income-contingent repayment schemes have been analyzed, but many issues remain unresolved. Grout (1983) presented a version of the Arrow (1973a, 1973b) discrimination model with imperfect information and showed that 'an element of income contingency will offset to some extent the misallocation of educational

resources resulting from imperfect expectations'. Chapman (1997) discussed, but did not formally analyse, a range of conceptual issues.

The object of the present paper is to synthesize and extend these contributions. Although the complexities of post-secondary education financing are such that no simple model captures all the relevant concerns, models of production under uncertainty and over time provide insights into many of the central issues. Hence, many results from existing literature are applicable to these questions.

Educational financing schemes with income-contingent repayments provide a mixture of consumption-smoothing benefits and insurance against the uncertain outcomes of risky educational investments. As Barr (2001) notes, this combination is typical of the operations of the welfare state. Barr usefully distinguishes between 'the welfare state as piggy bank' and 'the welfare state as Robin Hood'

The analysis presented here provides a strong case to show that educational financing schemes with income-contingent repayment will enhance welfare relative to the alternative of upfront fees yielding the same revenue in present value terms. It is also important, however, to consider whether alternative approaches to financing, perhaps separating the consumption-smoothing and insurance aspects of HECS and similar schemes, could yield greater benefits at lower cost.

2 Background

Before developing formal models, it is useful to consider some of the issues that arise in analyzing the problems of financing individual investments in post-secondary education. First, as the term 'investment' implies, it is natural to focus on a narrow version of the human capital model, in which the private benefits of education take the form of increases in earning capacity. This focus excludes externalities associated with education, and also joint products of the higher education system such as research. Since such externalities and joint products are appropriately funded by the community as a whole, they should not be considered as part of the individual financing problems. In addition, the implied focus excludes consumption benefits of higher education, whether these are received while

individuals are students, or take such forms as a greater capacity to appreciate art and literature. Such consumption benefits are hard to measure, and have probably decreased in importance as participation rates have grown. The use of the term 'post-secondary education' rather than 'higher education' is relevant in this context.

We first consider problems of uncertainty, noting that investment in human capital has uncertain returns at the time that students make the investment decision. These uncertainties take several distinct forms. First, a significant proportion of students (around 25 per cent) do not graduate and as a result will not experience high lifetime earnings, at least to the extent that these are depend on the attainment of specific qualifications[1]. Second, some part of a potential graduate's expected future earnings will not be known by a student because of incomplete information with respect to their inherent talents and motivation. Third, students may not be able to signal their talents and motivation to potential lenders. Finally, some part of a potential graduate's expected future earnings will not be know by either students or potential lenders because of incomplete information with respect to future labour market conditions.

In view of these uncertainties, it seems reasonable to consider the hypothesis that a financing scheme which provides some element of insurance will improve welfare. Ideally, the insurance mechanism should induce a positive correlation between the (present value of) payments made by students and benefits actually received from post-secondary education. In the first part of this paper, we consider the potential value of insurance that can be provided by income-contingent loans.

A logically separate issue relates to the transactions costs of borrowing. Standard debt contracts are necessarily associated with some prospect of default, which is costly for both borrowers and lenders. As well as costs incurred through actual defaults, the need for lenders to protect themselves against default creates a range of transactions costs. These costs, and expected losses from default, are reflected in the margin between the rates of interest paid by private borrowers and the rate on government bonds or high-grade private bonds.[2] Although lenders lose from default, borrowers usually do not gain, relative

[1]The literature on 'sheepskin effects' suggests that partial completion of a degree enhances earnings, though not proportionately.

[2]To the extent that default risks are correlated with systematic risk for the economy as a whole, there

to the alternative of not entering into the loan contract in the first place. The costs of bankruptcy and reputational loss typically outweigh the benefits of higher consumption in the pre-default period. Hence, the entire interest rate margin represents a social loss associated with the risk of default.

An income-contingent loan offers a form of default protection which is not available with a normal loan. On the other hand, income-contingent loans create problems of moral hazard and creditor priority which imply that they will be appropriate only in limited circumstances.

In the remainder of this paper, we will present models that will assist in the analysis of the costs and benefits of income-contingent loans. Rather than attempt to develop a single all-embracing model, the issues of uncertainty and transactions costs will be considered separately. A more complex model, encompassing both these issues would be analytically intractable, although such a model would form an appropriate basis for simulation modelling.

3 Uncertainty

3.1 A simple model

We consider a model in which individuals undertake risky investments in education, which enhances their human capital. We model educational outcomes by a stochastic production function

$$h = h(e, \theta)$$

where e is education expenditure. The random variable θ may reflect differences in ability, or random events during education that affect the outcome of the educational process. We suppose

$$h_e \geq 0$$

$$h_\theta \geq 0$$

will be a further 'pure' risk premium analogous to the risk premium for equity arising in CAPM and related models of financial markets

In general, we would expect $h_{e\theta} \geq 0$, which implies that, the greater the educational expenditure, the riskier the outcome. However, there may be cases when training is a substitute rather than a complement for native ability, so that $h_{e\theta} \leq 0$.

In the context of Australian higher education, expenditure is largely determined by the initial decision to undertake a particular degree course, and in particular to attend university rather than seeking employment after finishing school. For discrete choices of this kind, the extensive margin, represented by the rate of participation in higher education, is more significant than the intensive margin represented by the decisions of individual students to undertake more or less intensive degree programs.

We begin by considering the case where income follows a non-stochastic time-path $y_t\left(h(e,\theta)\right),\ t = 0, 1..T$ where h is the level of human capital, 0 is the period in which education is undertaken and T represent the beginning and end of the individual's working life. For simplicity, we will generally focus on the case where there are two time periods, denoted 0 and 1, in which there is a single earning period. This allows the time subscript for period 1 variables to be dropped, so we can simply write income as $y\left(h(e,\theta)\right)$.

Out of this income, it is necessary to make repayments $k_t\left(y,e\right)$ over periods $t = 0, 1, ...T$. Under HECS, k_0 is a choice variable, but the repayments $k_t,\ t > 0$ are determined by income, the outstanding debt and the parameters of the scheme.

Given a rate of cost recovery λ, the repayment must satisfy:

$$(1+r)\,k_0 + E_\theta\left[k\left(y, \lambda e - k_0\right)\right] = (1+r)\,\lambda e$$

That is, the payment consists of an upfront (period 0) payment k_0 and a (period 1) income-contingent payment $k\left(y, \lambda e - k_0\right),$. which will also depend on the outstanding debt at the end of period 0, given by $\lambda e - k_0$.

A system of pure upfront fees may be represented by a payment $k_0 = \lambda e$, assuming $k\left(y, 0\right) = 0,\ \forall y$.

Individual preferences are represented by an additive function of the form

$$V\left(\mathbf{c}\right) = (1+\delta)\,u\left(c_0\right) + u\left(c_1\right)$$

where u is a utility function and δ is the pure rate of time preference. We will simplify by

assuming that the utility function takes the homothetic form

$$u(c) = \begin{cases} \frac{c^{1-\gamma}}{1-\gamma} & 0 \leq \gamma \neq 1 \\ \log(c) & \gamma = 1 \end{cases}$$

which has the constant intertemporal elasticity of substitution

$$-\frac{cu''(c)}{u'(c)} = \gamma$$

Under the assumption that all individuals can freely borrow and lend at rate r, the consumption path must satisfy the intertemporal budget constraint:

$$y = c_0 + (1+r)c + k_0 + (1+r)k$$

which may be restated as:

$$C = Y - K(Y)$$

where

$$\begin{aligned} V &= (1+\delta)u(c_0) + u(c_1) \\ C &= (1+r)c_0 + c_1 \\ Y &= y \\ K(Y) &= (1+r)k_0 + k(y, \lambda e - k_0) \end{aligned}$$

We may refer to the welfare associated with the optimal consumption path as

$$V^*(Y - K(Y)) = \max\{V(c) : C = Y - K(Y)\}$$

and observe that V^* is concave in its argument.

The framework developed above enables us to consider the welfare effects of income-contingent charges under a range of informational assumptions.

3.2 Income-contingent fees with no prior information

We begin by considering the case when individuals are unaware of their ability θ until after deciding their education level e. In this case, all individuals will choose the same e,

satisfying

$$E_\theta \left[\frac{\partial V^*}{\partial Y} \left(\left(1 - \frac{\partial K}{\partial Y} \right) \frac{\partial Y}{\partial e} - \frac{\partial K}{\partial e} \right) \right]$$

Note that $\frac{\partial K}{\partial e} = \lambda$.

If all individuals are risk-neutral, $\frac{\partial V^*}{\partial Y}$ is constant, and it is immediate that the social optimum is obtained by setting $\lambda = 1$, $\frac{\partial K}{\partial Y} = 0$, that is, a charge yielding full cost recovery that is independent of income. In this case, the optimality condition is simply $\frac{\partial Y}{\partial e} = 1$.

In the general case of risk-averse preferences, the problem falls into the class examined by Feder (1978) and subsequently analyzed by Meyer and Ormiston (1989) and Quiggin (1991). Feder (1978), following Sandmo (1971) shows that for problems of this class with $f_{e\theta} \geq 0$, the optimal level of the decision variable e chosen by a risk-averse decisionmaker will be less than the risk-neutral optimum. Meyer and Ormiston (1989) and Quiggin (1991) show that the reduction in risk arising when $\frac{\partial K}{\partial Y} \geq 0$ will call forth an increase in the privately optimal level of e.

Hence,

(a) Assuming risk-aversion, an income-contingent scheme with $\frac{\partial K}{\partial Y} \geq 0$ and $\lambda \leq 1$ always increases individual welfare

(b)Assuming DARA, an income-contingent scheme with $\frac{\partial K}{\partial Y} \geq 0$ and $\lambda \leq 1$ always increases education and expected net income

The result in Proposition ... is what would be expected for any policy that offers insurance at fair or subsidised rates. The special characteristics of the HECS class of repayment schemes permit the derivation of some sharper results. For many purposes, the HECS scheme may be seen as providing underwriting or, in the language of real options theory, a put option (ref needed here).

An idealised underwriting scheme may be described as follows. Assuming an individual has lifetime present value income Y that exceeds some threshold level $\overline{\overline{Y}}$, the present value of repayments K is equal to e. On the other hand, if lifetime present value income Y is less than some $\overline{Y} < \overline{\overline{Y}}$, no payment is required. For $\overline{Y} \leq Y \leq \overline{\overline{Y}}$, a partial payment $K = \gamma \left(Y - \overline{Y} \right)$ is made.

Closely related payment structures have been analyzed by Eeckhoudt and Hansen (1980), Quiggin and Anderson (1981) and Quiggin (1983). Using the approach of Quiggin

(1983), we may derive the result that for any given value of λ (the average subsidy) the welfare-maximising payment structure is an underwriting scheme, or, more precisely

Proposition 1 *For given λ, the optimal payment structure is an underwriting scheme with $\gamma = 1$, $\overline{\overline{Y}} = \overline{Y} + e$*

Proposition 2 *Proof: See Appendix.*

The actual structure of the HECS scheme differs in important respects from the idealised underwriting scheme described above. First, on most measures, the maximum payment made by students is less than the total expenditure e, implying that all students receive some subsidy e. However, Quiggin (2001) argues that for students undertaking the major categories of purely vocational education, namely law, economics and business, the effective subsidy is close to zero when account is taken of the funding formulas used within universities and the existence of unfunded, but mandated, university functions such as research funding (expected of all academics, not merely those who receive grant funding) and community services. If students in purely vocational courses pay full cost, the subsidy to other areas of study such as the sciences and humanities may be interpreted as a recognition of the positive externalities generated by learning in these areas.

A second important point is that repayments are assessed on the basis of annual, rather than lifetime, income. An individual whose lifetime income is below $\overline{Y}$ but whose annual income is sufficiently variable, will make repayments in years of high income, and will therefore lose some of the insurance benefits of an idealised scheme. (As discussed below, if the individual cannot borrow or lend freely at the rate r, consumption-smoothing benefits will still arise).

Finally, the changes to HECS in the 1996 Budget lowered the minimum threshold $\overline{Y}$ to a point where nearly all students are required to repay the maximum amount in present value terms. Hence, analysis of HECS as an underwriting scheme is primarily applicable to the pre-1996 version of the scheme.

Thus far, we have been concerned only with the welfare of the individuals undertaking education. Clearly, the private welfare of individuals undertaking education is maximized

when $\lambda = 0$, that is, when education is provided free of charge. However, this invovles a transfer from the rest of society

3.3 Income-contingent fees with full information

Now suppose that individuals choose their education expenditure e after becoming aware of their endowment θ. For the two period case, the first order condition for the (private) optimal choice of e is

$$\frac{\partial y}{\partial h}\frac{\partial h}{\partial e} = (1+r)\frac{\partial Y}{\partial e} = (1+r)\frac{\partial K}{\partial e} = (1+r)\lambda$$

The optimal expenditure level e is increasing in (decreasing in, independent of) θ, depending on whether $\frac{\partial^2 h}{\partial e^2} > (<, =)0$.

In this case, the structure of the model is similar to that of an optimal taxation model, such as that of Mirrlees (1974). The optimal structure arising from models of this kind normally involves a payment increasing in income. There are few general results on the concavity or convexity of the payment structure. The most promising approach to problems of this kind is that of Holmstrom and Milgrom (1987), who show that, in situations where the agent has considerable freedom of action, the principal will never benefit from the use of a nonlinear payment structure. Thus, the optimal repayment will be of the form $K = a + bY$. Imposing the natural constraint that $K \geq 0$, we obtain the standard income-contingent repayment structure with a lower threshold $\overline{Y}$.

3.4 Uncertainty about educational outcomes

For the model when individuals are uncertain about educational outcomes, we can perform two comparisons.

(1) For a given level of cost recovery $k_0 e$, we can compare the non-contingent charge

$$k(e, \theta) = k_0$$

with members of the class of contingent charges $k(e, \theta)$ such that

$$E[k(e, \theta)] = k_0$$

(2) Given a maximum level of cost recovery c_0 and an allowable subsidy with expectation s, we consider the class of charges $k(e,\theta)$ such that

$$\begin{aligned} k(e,\theta) &\leq k_0 \\ E[k(e,\theta)] &= k_0 - s \end{aligned}$$

I think we can show that the optimal policy is a HECS-style policy with a threshold. This policy always increases education. However, since there is a subsidy, if people are risk-neutral, they will choose too much education and welfare will be reduced. In general there will be two effects

(i) an insurance effect, which is welfare-improving

(ii) a subsidy effect which is welfare reducing

3.5 Costly borrowing

Now suppose that governments can borrow and lend at the real bond rate r, but that individuals face a higher borrowing rate $r+\rho$, because of transactions costs and default risks faced by private lenders. The case when individuals are credit-constrained may be represented by setting $\rho = \infty$. For simplicity, we will assume that there is no uncertainty.

Assuming that the growth rate of income is greater than $r-\delta$, young people would be net borrowers at the rate r. If governments can lend them money at the rate r and, at zero cost, ensure full repayment using the tax system, this will clearly generate an improvement in welfare, whether or not the loan is used to finance educational investment. The improvement in welfare may be modelled using the simple life-cycle model of consumption and educational investment presented in Section 1 with the modification that the borrowing rate is $r+\rho$ while the return on savings is r .

4 Concluding comments

Educational financing schemes with income-contingent repayments provide a mixture of consumption-smoothing benefits and insurance against the uncertain outcomes of risky ed-

ucational investments. Educational financing schemes with income-contingent repayment will enhance welfare relative to the alternative of upfront fees yielding the same revenue in present value terms.

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