Voting on income-contingent loans for higher education

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Abstract

We consider risk-averse individuals who differ in two characteristics – ability to benefit from education and inherited wealth – and analyze higher education participation under two alternative financing schemes - tax subsidy and (risk-sharing) income-contingent loans. With decreasing absolute risk aversion a distributional university bias exists, with individuals with more wealth being more likely to undertake higher education despite the fact that, according to the stylized financing schemes we consider, individuals do not pay up front any financial cost of education. We then determine which financing scheme arises when individuals are allowed to vote between schemes. If participation is relatively low the income-contingent scheme obtains a majority. The tax-subsidy scheme results only if participation is relatively large and relatively extreme assumptions are placed on relevant parameters.

Keywords: voting, higher education finance, income-contingent loans

JEL Classification: H52, I22, D72

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1 Introduction

Higher education financing schemes that rely partly on contributions from students are being increasingly adopted, or expanded. One acknowledged problem of relying on cost-sharing by students is that liquidity constraints may negatively affect higher education participation. Even if mortgage-type loans are made available to overcome these liquidity constraints, education is often viewed as a risky investment, and deserving but risk-averse individuals may decide not to take these loans. Funding schemes that rely on income-contingent loans, like the Australian Higher Education Contribution Scheme first instituted in 1989 or the more recent funding arrangements in the UK, provide insurance against uncertain educational outcomes. Income-contingent loans are hence supposed to partly, if not fully, overcome the negative effects of risk-aversion, and as such they have been generally regarded as an improvement on mortgage-type loans to enhance higher education participation. The assessment of income-contingent loans versus tax-subsidy schemes, which have been traditionally employed in many European countries to finance higher education, is less conclusive.

Financing schemes for higher education effectively differ in the way educational costs and risks are shared among the population. García-Peñalosa and Wälde (2000) and Del Rey and Racionero (2010) are among the few theoretical contributions in the literature that consider a relatively comprehensive set of higher education financing alternatives, including both tax-subsidy and income-contingent loans. In García-Peñalosa and Wälde (2000) individuals are assumed to differ only in inheritance, whereas in Del Rey and Racionero (2010) individuals differ only in ability. When individuals differ in inheritance, the social optimum implies that either none or all should study. When individuals differ in ability, it is possible to determine an optimum threshold ability level (i.e. an optimal level of participation in higher education) and assess whether alternative financing schemes yield insufficient or excessive participation. Indeed, Del Rey and Racionero (2010) focuses on participation, paying particular attention to the effects of the insurance and subsidy components of alternative financing schemes. Del Rey and Racionero (2010) shows that
an income-contingent loan with risk-pooling can induce the optimal level of participation provided that it covers both financial costs of education and forgone earnings, lending theoretical support for extending the coverage of income-contingent loans to non-tuition costs of education. However, universal income-contingent loans of the risk-pooling type, where successful students are essentially responsible for the full cost of the education of their cohort, are relatively rare in reality. Tax-subsidy schemes, where the cost of education is financed by general taxes, have been historically common, particularly in Europe. However income-contingent loans of the risk-sharing type, where successful graduates contribute to a large extent to the cost of their education, possibly the full cost if there are no implicit subsidies, and the cost of the education of unsuccessful students is financed by general taxes, are being increasingly adopted or proposed (see Chapman (2006) for an overview of the international experience with income-contingent loans).

In this paper we focus on the tax-subsidy and risk-sharing income contingent loans schemes. Contrary to García-Peñalosa and Wälde (2000) and Del Rey and Racionero (2010) we consider individuals that differ in two characteristics: ability and inheritance. In this sense the model follows De Fraja (2001), which incorporates both differences in parental income and ability, but departs in other respects: most notably, we incorporate income-contingent loans as a financing scheme option. We analyze participation under both schemes, paying particular attention to the welfare individuals of different ability and inheritance achieve under each. We use this information subsequently to study which financing scheme is preferred by a majority when individuals are able to vote between the two schemes.

Recent contributions dealing with the political economy of higher education finance include De Fraja (2001), Anderberg and Balestrino (2008), and Borck and Wimbersky (2009). De Fraja (2001) considers two education policies - an admission test and a subsidy financed out of general taxation - and shows that both enhance equality of opportunity, but have ambiguous equity and efficiency effects. The ambiguous equity effects of the policies are reflected in the voting behavior of individuals: when voting on the extent of
the subsidy a partial ”ends against the middle” phenomenon arises with better-off households unambiguously like a lower subsidy as would some worse-off households with less able children, whereas the poor households with more able children prefer an increase in the subsidy. Anderberg and Ballestrino (2008) also consider tax-subsidy schemes in a model where endogenous credit constraints play a key role. They show that a voting equilibrium, if it exists, is such that voters in the two tails of the income distribution support a reduction, while the “middle-class” supports an expansion, of the education subsidy. Borck and Wimbersky (2009) study voting over higher education financing schemes in an economy with risk averse households who differ in income. They consider four alternative systems: a traditional subsidy scheme, a pure loan scheme, income contingent loans and graduate taxes. Their numerical simulations suggest that poor household tend to prefer traditional tax-subsidy financing to graduate taxes or income-contingent loans, due to the positive effect on the endogenous unskilled wages, and that majorities for income-contingent loans or graduate taxes become more likely if risk-aversion rises and/or the income distribution is less unequal. We incorporate an additional dimension of individual heterogeneity: ability. The financing schemes that we study are however relatively inflexible, when compared to the flexible endogenous subsidy rates that Borck and Wimbersky (2009) consider, but by focussing on the choice between schemes we are able to provide relatively clear and intuitive results, even if we also rely on numerical simulations to illustrate several possibilities.

We focus exclusively on the choice between tax-subsidy and (risk-sharing) income-contingent loans. As mentioned above, the comparison between tax-subsidy and income-contingent loans, particularly of the risk-sharing type, has been rather inconclusive. However they are two of the most commonly employed higher education finance schemes with many countries switching, or planning to do so, from the former to the latter. Many countries have progressively introduced, or raised, their tuition fees to be able to support an increasing number of students. The British government, for instance, first introduced upfront charges for students in 1998. They were replaced in England in 2004 with a
scheme with higher fees but that allowed students to receive income-contingent loans, designed in such a way that students effectively share the risk with the general taxpayer: there is no real interest rate charged on the loan, students start to repay only after they earn more than a threshold level of income, among other concessions. Recent proposed tuition fees increases in England, which in some cases are expected to triple the fees that were previously charged, generated some heated protests from students. At the same time the British government is seeking to slash its direct funding of university teaching, which should put less pressure on the average taxpayer. This paper aims to shed more light on the political economy aspects of the switch from tax-subsidy to (risk-sharing) income-contingent loans schemes.

The paper is organized as follows. We first present the model and describe each financing scheme in section 2. In section 3 we determine the tax that is required under each financing scheme for a given participation level. In section 4 we analyze participation with risk neutral (benchmark) and risk averse individuals. In section 5 we characterize the voting outcome. We conclude in section 6.

2 The model

We consider an economy in which a continuum of individuals of mass $N$ live for 2 periods. Individuals differ in their ability $a$ and their initial wealth $b$, which we take as exogenously given, with $a \in [a, \bar{a}]$ and $b \in [b, \bar{b}]$. That is, each individual is characterised by a pair $(a, b)$. We assume initially that ability and wealth are independently distributed in $[a, \bar{a}] \times [b, \bar{b}]$. The marginal distributions are denoted by $F(a)$ with $F'(a) = f(a)$, and $H(b)$ with $H'(b) = h(b)$.

Individuals derive utility from consumption, $c$, which is a function of wealth and earned income over the lifetime. We assume that this function is a von Neumann-Morgensten utility function $u(c)$ with, for every $c > 0$, $u'(c) > 0$, $u''(c) \leq 0$, $\lim_{c \to \infty} u'(c) = +\infty$, and

$$d \left[ -\frac{u''(c)}{u'(c)} \right] < 0$$
so that the utility function displays decreasing absolute risk aversion (DARA).

In the first period, the individual decides whether or not to undertake higher education. \( k \) is the per capita cost of education. Individuals who study forego earnings in the first period. In the second period all individuals work and earn income. If the individual has invested in education, her labour market income is given by \( w_H \) with probability \( p(a) \), and by \( w_L < w_H \) with probability \( 1 - p(a) \), with \( p(a) \in (0,1) \), with \( p'(a) > 0 \) for all \( a \in [\underline{a}, \bar{a}] \). If an individual has not gone to university, then her income is given by \( w_L \) for sure.

There are three possible states: the individual studies and is successful, the individual studies and is unsuccessful or the individual does not study. We denote them by subscripts \( S, U \) and \( N \) respectively. Labour supply is exogenous and is normalized to 1. Hence, the lifetime earned labour income of the individual is \( \delta w_H, \delta w_L \) and \( (1 + \delta) w_L \), where \( \delta \) is the discount factor, for individuals \( S, U \) and \( N \) respectively. We assume that \( \delta w_H > (1 + \delta) w_L \).

The government provides education free of charge in the first period and raises the necessary revenue in the second period in a manner that differs according to the financing scheme. A potentially different amount of individuals \( H^j \), where \( j \) represents the funding scheme, enroll in higher education in the first period. We focus on two financing schemes for higher education: tax-subsidy, denoted by \( TS \), and (risk-sharing) income-contingent loan, denoted by \( IC \).

- In the tax-subsidy system, the cost of education is financed by general lump-sum taxes in the second period. Therefore each individual pays \( H^{TS}k/N \) in present value terms, irrespective of her situation.

- We model the income-contingent loan as the risk-sharing income-contingent loan in Del Rey and Racionero (2010). All individuals who want to study borrow \( k \). Only those individuals who are successful have to repay the amount in full. However, a lump-sum tax, which amounts to \( (1 - p)H^{RS}k/N \) in present value terms, is levied on all individuals in order to raise the revenue needed to cover the education cost.
of unsuccessful students.

The timing of the model is the following: first individuals choose by majority voting the higher education financing scheme $TS$ or $IC$. Then, for the higher education financing scheme chosen they decide whether or not to participate. Finally, they contribute. We solve the model by backward induction, starting with the determination of the tax rates, given participation and the finance scheme.

3 Tax cost of alternative schemes

Let $a^{TS}(b)$ be the threshold ability level (i.e. the ability level of an individual who is indifferent between studying or not) of an individual with wealth $b$ for the tax-subsidy financing scheme. Under the tax-subsidy system the number of individuals who undertake higher education is

$$H^{TS} = \int_b^\bar{b} \int_{a^{TS}(b)}^\pi f(a) h(b) \, dadb,$$

and the lump-sum tax required to finance their education is

$$T^{TS} = \frac{k}{N} \int_b^\bar{b} \int_{a^{TS}(b)}^\pi f(a) h(b) \, dadb.$$

With a (risk-sharing) income-contingent loan, all individuals who want to study borrow $k$ but only those students who are successful have to repay the amount in full. A lump-sum tax is levied on all individuals in order to raise the revenue needed to cover the education cost of unsuccessful students. As before, $a^{IC}(b)$ denotes the ability level of an individual with wealth $b$ who is indifferent between studying or not. Under the income-contingent loan system the number of individuals who undertake higher education is

$$H^{IC} = \int_b^\bar{b} \int_{a^{IC}(b)}^\pi f(a) h(b) \, dadb,$$

and the lump-sum tax required to finance their education is

$$T^{IC} = \frac{k}{N} \int_b^\bar{b} \int_{a^{IC}(b)}^\pi (1 - p(a)) f(a) h(b) \, dadb.$$
4 Participation

Given the higher education finance scheme and anticipating the tax cost of participating, individuals decide whether or not to enrol. We first identify the optimal participation that we use as a benchmark against which we compare the participation under each scheme.

4.1 Optimal participation

Focusing exclusively on efficiency, it is optimal that an individual studies when her expected earnings as a student net of the cost of her education exceed her earnings as a non-student. It is possible to determine a threshold ability level, \( \hat{a} \), above which an individual should study and below which an individual should not study:

\[
\delta \left( p(\hat{a}) w_H + (1 - p(\hat{a})) w_L \right) - k = (1 + \delta) w_L. \tag{5}
\]

The optimal amount of graduates is \( H^* = \int_{\hat{a}} f(a) da \). Note that the optimal ability level is independent of family wealth \( b \).

4.2 Tax-subsidy

Let \( G^{TS} (a, b) \) denote the expected net utility gain from investing in higher education under the tax-subsidy scheme for an individual with ability \( a \) and wealth \( b \):

\[
G^{TS} (a, b) \equiv (1 - p(a)) u \left( c^{TS}_U \right) + p(a) u \left( c^{TS}_S \right) - u \left( c^{TS}_N \right). \tag{6}
\]

The expected net utility gain from investing in higher education increases with ability:

\[
\frac{dG^{TS} (a, b)}{da} = p'(a) \left[ u \left( c^{TS}_S \right) - u \left( c^{TS}_U \right) \right] = p'(a) \left[ u (b + \delta w_H) - u (b + \delta w_L) \right] > 0. \tag{7}
\]

since \( p'(a) > 0 \) and \( w_H > w_L \). More able individuals have higher expected utility from studying than less able individuals, and are hence more likely to choose higher education.

The threshold ability level of an individual with wealth \( b \) for the tax-subsidy financing scheme, \( a^{TS} (b) \), satisfies

\[
G^{TS} \left( a^{TS} (b) , b \right) = 0.
\]
That is,

\[
(1 - p \left( a^{TS} \right)) \ u \left( b + \delta w_L - T^{TS} \right) + p \left( a^{TS} \right) \ u \left( b + \delta w_H - T^{TS} \right) = u \left( b + (1 + \delta) w_L - T^{TS} \right).
\]

**Proposition 1** If, for a bequest \( b \in [\underline{b}, \overline{b}] \), there exists a level of ability \( a^{TS} \in [\underline{a}, \overline{a}] \) such that \( G^{TS} (a^{TS}, b) = 0 \), then \( a^{TS} \) is unique and the function \( a^{TS} (b) \) is strictly decreasing in \( b \).

**Proof.** From (7) we know that, if for some value of \( b \in [\underline{b}, \overline{b}] \) there exists a level of ability \( a^{TS} \in [\underline{a}, \overline{a}] \) such that \( G^{TS} (a^{TS}, b) = 0 \), then \( a^{TS} \) is unique.

To determine that \( a^{TS} (b) \) is strictly decreasing in \( b \) we use the implicit function theorem:

\[
\frac{\partial a^{TS}}{\partial b} = -\frac{\partial G^{TS} (\cdot)}{\partial a} < 0
\]

since, as shown above, \( \frac{\partial G^{TS} (\cdot)}{\partial a} > 0 \) (for a given level of \( b \) the expected net gain of investing in higher education increases with ability) and, on the other hand,

\[
\frac{\partial G^{TS} (\cdot)}{\partial b} \equiv (1 - p (a)) \ u' (b + \delta w_L - T^{TS}) + p (a) \ u' (b + \delta w_H - T^{TS})
\]

\[
- u (b + (1 + \delta) w_L - T^{IC}) > 0.
\]

due to the DARA assumption (for a given level of \( a \) a higher income individual is more willing to bear risk and invest in higher education). ■

This result was previously proven by De Fraja (2001) in a slightly different setting with two coexisting generations - mother and daughter- where the mother makes the decisions: most notably she chooses her own consumption, a monetary transfer to her daughter and how much to invest in her daughter’s education, as well as voting on the tax rate that is imposed on the mother’s income to subsidize the costs of education and has to be paid irrespective of whether the daughter studies or not.\(^1\)

The fact that \( a^{TS} (b) \) is strictly decreasing in \( b \) implies that individuals with more

\(^1\)Maxine Montaigne’s 2010 ANU Economics Honours Sub-thesis replicated De Fraja (2001)’s result in a model with two generations like De Fraja (2001), but with no mother’s own consumption or intergenerational transfer, and similar schemes to the ones we employ.
wealth are more likely to undertake higher education. It is worth noticing that this happens despite the fact that, under the scheme considered, individuals do not pay up front any financial cost of education. As pointed out, the assumption of decreasing absolute risk aversion plays a key role. Investment in education is risky, and, if the individual has decreasing absolute risk aversion, she is more willing to bear risk if she has more wealth; in other words, she requires a lower expected return in order to opt for an investment of a given riskiness.

It is easy to show that the threshold ability does not depend on $b$ if individuals are risk neutral since $b$, and $T^{TS}$ as well, cancel out from the equation:

$$G^{TS}(a, b) = (1 - p(a)) \delta w_L + p(a) \delta w_H - (1 + \delta) w_L = G^{TS}(a).$$

Let us denote the threshold ability level of risk neutral individuals under the tax-subsidy system $\hat{a}^{TS}$ (to distinguish it from the risk averse $a^{TS}(b)$).

**Proposition 2** Risk neutral individuals overinvest in education under TS: $\hat{a}^{TS} < \hat{a}$.

**Proof.** $\hat{a}$ is given by (5) and $\hat{a}^{TS}$ is implicitly defined by $G^{TS}(\hat{a}^{TS}) = 0$, which implies

$$\delta \left[ (1 - p(\hat{a}^{TS})) w_L + p(\hat{a}^{TS}) w_H \right] = (1 + \delta) w_L. \tag{9}$$

Then,

$$\delta [p(\hat{a}) w_H + (1 - p(\hat{a})) w_L] - k = \delta \left[ (1 - p(\hat{a}^{TS})) w_L + p(\hat{a}^{TS}) w_H \right]$$

and since

$$\delta [p(\hat{a}) w_H + (1 - p(\hat{a})) w_L] > \delta \left[ (1 - p(\hat{a}^{TS})) w_L + p(\hat{a}^{TS}) w_H \right]$$

it follows that $\hat{a}^{TS} < \hat{a}$. ■

**Proposition 3** Risk aversion reduces participation for all income levels: $a^{TS}(b) > \hat{a}^{TS}$ $\forall b$.  

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Proof. We evaluate $G^{TS}(a,b)$ at $\hat{a}^{TS}$, characterised implicitly by (9) and obtain

$$G^{TS}(\hat{a}^{TS}, b) = (1 - p(\hat{a}^{TS})) u (b + \delta w_L - T^{TS}) + p(\hat{a}^{TS}) u (b + \delta w_H - T^{TS})$$

$$- u (b + \delta [(1 - p(\hat{a}^{TS})) w_L + p(\hat{a}^{TS}) w_H] - T^{TS}) < 0$$

since, with risk aversion, the utility of expected income is higher than the expected utility. Since $\frac{\partial G^{TS}(.)}{\partial a} > 0$ and $G^{TS}(a^{TS}(b), b) = 0$, it turns out that $\hat{a}^{TS} < a^{TS}(b)$. The above indeed holds for any $b \in [\underline{b}, \overline{b}]$.

Since $\hat{a}^{TS} < \hat{a}$ and $\hat{a}^{TS} < a^{TS}(b)$ it remains possible that participation is efficient under the tax subsidy scheme for risk averse individuals with given wealth $b$. In contrast, it is not possible that $a^{TS}(b) = \hat{a}$ for all $b$ since $a^{TS}(b)$ is strictly decreasing. If participation was efficient for individuals with a given threshold wealth, denoted by $\hat{b}$, then below $\hat{b}$ individuals would be under-represented, and above $\hat{b}$ individuals would be over-represented in higher education.

Example

In order to illustrate how different degrees of risk aversion affect participation we represent in Figure 1 (a) - (c) the efficient participation together with participation under the tax-subsidy scheme when individuals are risk neutral and risk averse. In the simulation, we use the constant relative risk aversion function

$$u(c) = \frac{c^{1-\sigma}}{1-\sigma}$$

(10)

where $\sigma = -\frac{u''(c)}{u'(c)}$ represents the coefficient of relative risk aversion. We compare the results for three different degrees of risk aversion $\sigma$: 0.75 (low), 1.5 (intermediate) and 3 (high). Borck and Wimbersky (2009) employ $\sigma = 2.25$ as a reasonable degree of risk aversion but Brodaty et al. (2010) suggest $\sigma = 0.75$ as reasonable for the education decision. The other parameters are set the same throughout: the low skilled wage is normalized to 1, the skilled wage is assumed to be 3 and $\delta = 1.5$. We also set $p(a) = pa$, with $p = 1$ and calculate $T^{TS}$ according to (2). Finally, the cost of higher education is
assumed to equal to 0.5. Both wealth and ability are assumed to be uniformly distributed in the population.²

Figure 1: Participation under TS: risk neutrality versus risk aversion

\( \sigma = 0.75 \)

²The uniform distribution of wealth may be considered unrealistic. We have also considered an alternative lognormal distribution, with a higher density of individuals at lower income levels. The qualitative results remain the same but the uniform distribution is more tractable and convenient for the interpretation of the figures below.
4.3 Income-contingent loan

Let now $G^{IC}(a, b)$ denote the expected net utility gain from investing in higher education for an individual with ability $a$ and wealth $b$ under the risk-sharing income-contingent
loan \((IC)\) scheme:

\[
G^{IC}(a, b) \equiv (1 - p(a))u(b + \delta w_L - T^{IC}) + p(a)u(b + \delta w_H - T^{IC} - k)
- u(b + (1 + \delta)w_L - T^{IC})
\]  

(11)

The expected net utility gain from investing in higher education also increases with ability under this financing scheme:

\[
\frac{\partial G^{IC}(.)}{\partial a} = p'(a)[u(b + \delta w_H - T^{IC} - k) - u(b + \delta w_L - T^{IC})] > 0
\]  

(12)

since \(p'(a) > 0\) and \(\delta (w_H - w_L) > k\), or else no individual would study. If for some value of \(b \in [b, \bar{b}]\) there exists a level of ability \(a^{IC} \in [a, \bar{a}]\) such that \(G^{IC}(a^{IC}, b) = 0\), then \(a^{IC}(b)\) is unique. \(\frac{\partial G^{IC}(.)}{\partial b} > 0\) due to the DARA assumption, which yields

\[
\frac{\partial a^{IC}}{\partial b} = - \frac{\frac{\partial G^{IC}(.)}{\partial b}}{\frac{\partial G^{IC}(.)}{\partial a}} < 0.
\]

That is, \(a^{IC}(b)\) is strictly decreasing in \(b\). This proves the following proposition:

**Proposition 4** If, for a bequest \(b \in [b, \bar{b}]\), there exists a level of ability \(a^{IC} \in [a, \bar{a}]\) such that \(G^{IC}(a^{IC}, b) = 0\), then \(a^{IC}\) is unique and the function \(a^{IC}(b)\) is strictly decreasing in \(b\).

The threshold ability level under risk neutrality \(\hat{a}^{IC}\) satisfies:

\[
p(\hat{a}^{IC})\delta (w_H - w_L) = w_L + p(\hat{a}^{IC})k < w_L + k.
\]  

(13)

It follows that \(\hat{a}^{TS} < \hat{a}^{IC} < \hat{a}\). On the one hand, higher education participation is lower than with the tax-subsidy system. This is due to the fact that the cost of education is partly subsidized by non-students but to a lesser extent than in the tax-subsidy system. At the same time, more individuals get educated than at the optimum since, in expected terms, students are only responsible for part of the cost of their education. Note that the expected cost of becoming educated is \(p(a)k\) (the tax part is paid irrespective of whether the individual studies or not) which is smaller than \(k\).
Proposition 5  Risk neutral individuals overinvest in education under IC, but less so than under TS: $\hat{a}^{TS} < \hat{a}^{IC} < \hat{a}$.

Finally,

Proposition 6  Risk aversion reduces participation for all income levels: $a^{IC}(b) > \hat{a}^{IC}$ $\forall b$.

Proof. $\hat{a}^{IC}$ is characterised implicitly by

$$
(1 - p(\hat{a}^{IC})) \delta w_L + p(\hat{a}^{IC}) (\delta w_H - k) = (1 + \delta) w_L.
$$

We now evaluate $G^{IC}(a, b)$ at $\hat{a}^{IC}$ and obtain

$$
G^{IC} (\hat{a}^{IC}, b) \equiv (1 - p(\hat{a}^{IC})) u (b + \delta w_L - T^{IC}) + p(\hat{a}^{IC}) u (b + \delta w_H - T^{IC})
$$

$$
- u (b + \delta [(1 - p(\hat{a}^{IC})) w_L + p(\hat{a}^{IC}) w_H] - T^{IC}) < 0
$$

since, with risk aversion, the utility of expected income is higher than the expected utility. As before, since $\frac{\partial G^{IC}(\cdot)}{\partial \hat{a}} > 0$ and $G^{IC} (a^{IC}(b), b) = 0$, it turns out that $\hat{a}^{IC} < a^{IC} (b)$. The above holds for any $b \in [\underline{b}, \bar{b}]$. ■

Example

It is not possible to provide a general ordering of higher education participation under alternative financing schemes in general. Figure 2 represents the efficient participation together with the participation thresholds for both TS and IC for the benchmark parameter specification described above. IC yields lower participation with the number of enrolled students being inefficiently low for all levels of wealth, but being more so for individuals with lower wealth. Increasing the coefficient for the degree of risk aversion to $\sigma = 3$ makes participation lower for both schemes, but the difference in participation between schemes becomes smaller (see Figure 3)
Figure 2: Participation with risk aversion: TS vs IC ($\sigma = 1.5$)

Figure 3: Participation with risk aversion: TS vs IC ($\sigma = 3$)

5 Voting over the financing scheme

In this section we analyze the preferences of all individuals concerning the higher education financing scheme when they are able to anticipate both participation decisions and the corresponding tax rate.
5.1 Risk neutrality

For risk neutrality we obtained above that $\hat{a}^{TS} < \hat{a}^{IC} < \hat{a}$. Since participation is lower and graduates contribute more under $IC$, $T^{TS} > T^{IC}$. We are interested in identifying the decisive ability thresholds below which one financing scheme is preferred and above which the other one is preferred instead. Then, we can simply compare the number of individuals at each side of the threshold and conclude what the majority prefers. We are able to establish the following:

**Proposition 7** **Decisive individuals under risk neutrality:** If $(t^{TS} - t^{IC})/k < p(\hat{a}^{IC})$, there exists a threshold $a' \in [\hat{a}^{TS}, \hat{a}^{IC}]$ below which individuals prefer $IC$ and above which individuals prefer $TS$. If $(t^{TS} - t^{IC})/k > p(\hat{a}^{IC})$, there exists a threshold $a'' > \hat{a}^{IC}$ below which individuals prefer $IC$ and above which individuals prefer $TS$.

**Proof.** First, below $\hat{a}^{TS}$, individuals do not study under any of the two systems: they prefer the risk-sharing income contingent loan because they pay less.

Second, in the region $[\hat{a}^{TS}, \hat{a}^{IC}]$ individuals study under $TS$ but do not study with the $IC$ loan. They prefer $IC$ if and only if

$$b + (1 + \delta) w_L - T^{IC} > (1 - p(a)) (b + \delta w_L - T^{TS}) + p(a) (b + \delta w_H - T^{TS}).$$

Hence

$$p(a) < \frac{w_L + T^{TS} - T^{IC}}{\delta (w_H - w_L)} = p(a').$$

(15)

Third, in the region above $\hat{a}^{IC}$ individuals study under both schemes and they prefer $IC$ when

$$(1 - p(a)) (b + \delta w_L - T^{IC}) + p(a) (b + \delta w_H - T^{IC} - k) >$$

$$(1 - p(a)) (b + \delta w_L - T^{TS}) + p(a) (b + \delta w_H - T^{TS}),$$

which can be rewritten as

$$T^{TS} - T^{IC} > p(a) k.$$
Hence, 

\[ p(a) < \frac{T_{TS} - T_{IC}}{k} = p(a'). \]  

(16)

Comparing \( p(a') \) and \( p(a'') \)

\[ p(a') > p(a'') \iff \frac{w_L}{\delta (w_H - w_L) - k} > \frac{T_{TS} - T_{IC}}{k} = p(a''). \]

From the condition for \( \hat{a}_{IC} \) in equation (14),

\[ p(\hat{a}_{IC}) = \frac{w_L}{\delta (w_H - w_L) - k}, \]

we can conclude that if \( p(\hat{a}_{IC}) > \frac{T_{TS} - T_{IC}}{k} = p(a'') \) then \( a'' \) is not in the region above \( \hat{a}_{IC} \). Then, all individuals above \( \hat{a}_{IC} \) prefer \( TS \) and there exists a threshold \( a' \in [\hat{a}_{IC}, \hat{a}_{TS}] \) below which individuals prefer \( IC \).

If, on the other hand, \( p(\hat{a}_{IC}) < \frac{T_{TS} - T_{IC}}{k} = p(a'') \), then some individuals above \( \hat{a}_{IC} \) prefer \( IC \) and all individuals below \( \hat{a}_{IC} \) also prefer \( IC \). To see this last point, note that we know that all individuals with \( p(a) > \frac{w_L + T_{TS} - T_{IC}}{\delta (w_H - w_L)} \) prefer \( TS \) in the region \([\hat{a}_{TS}, \hat{a}_{IC}] \). We then need to show that \( \frac{w_L + T_{TS} - T_{IC}}{\delta (w_H - w_L)} \) is out of this region and hence everyone with ability in \([\hat{a}_{TS}, \hat{a}_{IC}] \) prefers \( IC \):

\[ p(a') = \frac{w_L + T_{TS} - T_{IC}}{\delta (w_H - w_L)} > \frac{w_L}{\delta (w_H - w_L) - k} = p(\hat{a}_{IC}) \]

if and only if

\[ w_L \delta (w_H - w_L) - w_L k + (T_{TS} - T_{IC}) \delta (w_H - w_L) - (T_{TS} - T_{IC}) k > \delta (w_H - w_L) w_L, \]

or

\[ p(a'') = \frac{T_{TS} - T_{IC}}{k} > \frac{w_L}{\delta (w_H - w_L) - k} = p(\hat{a}_{IC}) \]

so it is always the case when \( p(\hat{a}_{IC}) < \frac{T_{TS} - T_{IC}}{k} \). The decisive individuals are given then by \( a'' \) such that \( p(a'') = \frac{T_{TS} - T_{IC}}{k} \).
5.2 Risk aversion

We now explore the relevant case where individuals are risk averse. In the region \([0, \tilde{a}_{TS}(b)]\) individuals do not study under any of the two systems, and they prefer the risk-sharing income contingent loan because they pay less:

\[
u(b + (1 + \delta) w_L - T^{IC}) > u(b + (1 + \delta) w_L - T^{TS}).
\]

In the region \([\tilde{a}_{TS}(b), \tilde{a}^{IC}(b)]\) individuals study with the tax-subsidy scheme but do not study with the risk-sharing income-contingent loan. They prefer \(IC\) if

\[
u(b + (1 + \delta) w_L - T^{IC}) > (1 - p(a)) u(b + \delta w_L - T^{TS}) + p(a) u(b + \delta w_H - T^{TS}).
\]

We can thus define a threshold \(\tilde{a}'(b)\) such that individuals prefer not to study and pay the \(IC\) contribution to the cost of the education of unsuccessful students rather than study and pay the tax with \(TS\):

\[
p(\tilde{a}'(b)) \leq \frac{u(b + (1 + \delta) w_L - T^{IC}) - u(b + \delta w_L - T^{TS})}{(u(b + \delta w_H - T^{TS}) - u(b + \delta w_L - T^{TS}))}.
\]

Let \(G'(a, b)\) be the utility differential between studying with \(TS\) and not studying with \(IC\):

\[G'(a, b) = (1 - p(a)) u(b + \delta w_L - T^{TS}) + p(a) u(b + \delta w_H - T^{TS}) - u(b + (1 + \delta) w_L - T^{IC}).\]

\(G'(a, b)\) is increasing in \(a\). If we evaluate it at \(\tilde{a}^{IC}(b)\)

\[G'(\tilde{a}^{IC}(b), b) = (1 - p(\tilde{a}^{IC}(b))) u(b + \delta w_L - T^{TS}) + p(\tilde{a}^{IC}(b)) u(b + \delta w_H - T^{TS}) - (1 - p(\tilde{a}^{IC}(b))) u(b + \delta w_L - T^{IC}) - p(\tilde{a}^{IC}(b)) u(b + \delta w_H - k - T^{IC}),\]

we obtain two possibilities:

1. If

\[G'(\tilde{a}^{IC}(b), b) > 0\]

then, on the one hand, \(\tilde{a}'(b) < \tilde{a}^{IC}(b)\) and, on the other, every individual with

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wealth \( b \) and ability above \( \tilde{a}^{IC} (b) \) prefers TS: expected utility of education is larger under TS for \( \tilde{a}^{IC} (b) \) and hence it is so for all \( a > \tilde{a}^{IC} (b) \). Then the decisive individual is \( \tilde{a}' (b) \).

2. If

\[
G'(\tilde{a}^{IC} (b), b) < 0
\]

then \( \tilde{a}' (b) > \tilde{a}^{IC} (b) \). Everyone in the region \([\tilde{a}^{TS} (b), \tilde{a}^{IC} (b)]\) prefers IC and some individuals above \( \tilde{a}^{IC} (b) \) prefer also IC. There is then a second threshold \( \tilde{a}'' (b) > \tilde{a}^{IC} (b) \) that becomes the relevant one.

The outcome that ultimately emerges, and whether the individuals with ability \( \tilde{a}' (b) \) or \( \tilde{a}'' (b) \) are the decisive ones, depends on the particular combination of parameters. To shed more light on the role played by those parameters we next proceed to report some examples. Del Rey and Racionero (2010) noted that, with risk averse preferences, it is not possible to determine in general whether TS or IC induce higher participation. Nevertheless the simulations seem to suggest that higher participation with TS results for most reasonable combinations of parameters and we concentrate hereafter on situations of this type.

It is worth noting the reason why it is important to characterize whether the relevant decisive ability threshold, which determines the support for IC versus TS, is \( \tilde{a}' (b) \) or \( \tilde{a}'' (b) \). In the first case, support for the tax-subsidy scheme comes from those individuals who always study, irrespective of the financing scheme, and prefer to pay less, plus those individuals who study under the TS system but would not do so if offered IC loans instead. In the second case, support for the tax-subsidy scheme comes uniquely from a subset of the students who would study under both regimes (i.e., the relatively more able and wealthier). The key difference is that, while in the first case some of those who support TS would not access higher education if offered IC loans instead, in the second case all those who support TS study under both schemes and simply prefer to pay less.

In situations where participation in higher education with TS is below 50% the outcome of the choice between the two stylized schemes that we consider is trivial: the IC
would be preferred. We concentrate next on examples where the combination of parameters adopted yields higher education participation in excess of 50%, which may be unrealistic for some countries.³

5.3 Example 1: the majority supports TS with $\tilde{a}'(b)$ decisive

With the benchmark parameter values adopted before and for $\sigma = 0.75$ we obtain that a majority supports $TS$ with $\tilde{a}'(b)$ being the decisive ability threshold for individuals with wealth $b$.

![Figure 4: Majority for TS with $\tilde{a}'(b)$ decisive](image)

In this example, we represent the thresholds $\tilde{a}^{TS}(b)$ and $\tilde{a}^{IC}(b)$, together wit $\tilde{a}'(b)$. $\tilde{a}^{IC}(b) > \tilde{a}^{TS}(b)$, and both are below 0.5, for all $b$. More than half of the population studies under any of the two schemes and, thus, those who never study do not have the majority of the vote. The threshold $\tilde{a}'(b)$, which is below $\tilde{a}^{IC}(b)$ for all $b$, represents the relevant threshold that allows to determine the support for each scheme: all those below $\tilde{a}'(b)$ support IC (the shaded area, which represents more than 50% of the population,

³The OECD Education at a Glance 2010 indicator suggests participation in higher education in OECD countries ranges from below 30% to above 60%.
supports TS). The support for TS comes from those who would study under any system, and some but not all who would study with TS but not with IC.

5.4 Example 2: the majority supports IC with $\tilde{a}'(b)$ decisive

For the same benchmark parameter values as above but for a degree of risk aversion $\sigma = 1.5$ we obtain that a majority supports IC with $\tilde{a}'(b)$ being the decisive ability threshold for individuals with wealth $b$. Increasing the degree of risk aversion to $\sigma = 3$ we obtain the same qualitative result with an even larger support for IC. The intuitive explanation is that as risk version increases the system that provides insurance becomes more attractive. We again represent the thresholds $\tilde{a}^{TS}(b)$ and $\tilde{a}^{IC}(b)$, together with $\tilde{a}'(b)$. All those below $\tilde{a}'(b)$ support IC (the shaded area, which represents in this case less than 50% of the population, supports TS). The support for IC comes from those who never study, and some but not all who would study with TS but not with IC.

![Figure 5: Majority for IC with $\tilde{a}'(b)$ decisive](image)

5.5 Example 3: the majority supports IC with $\tilde{a}''(b)$ decisive

If from the benchmark parameter values we increase $\delta$ to 3, representing a larger weight of the future earnings relative to the present foregone earnings and cost of education,
and take $\sigma = 3$ we obtain that a majority supports $IC$, but the decisive individuals are characterized by $\tilde{a}''(b) > \tilde{a}''IC(b) > \tilde{a}''TS(b)$ for all wealth values $b$. All those below $\tilde{a}''(b)$ support $IC$ (the shaded area, which represents in this case less than 50% of the population, supports $TS$). The composition of the group that supports $IC$ differs from example 2. Those who prefer $IC$ now include those who never study, all those who study with $TS$ but not with $IC$, and some of those who study regardless of the scheme in place.

![Figure 6: Majority for $IC$ with $\tilde{a}''(b)$ decisive](image)

6 Conclusions

We consider individuals who differ in two characteristics – ability to benefit from education and inherited wealth – and analyze higher education participation under two alternative financing schemes - tax subsidy and (risk-sharing) income-contingent loans -, paying particular attention to the welfare achieved by individuals with different ability and wealth under each. We observe that individuals with more wealth are more likely to undertake higher education. It is worth noticing that this happens in spite of the fact that they do not pay in advance for their education: the assumption of decreasing relative risk aversion plays a crucial role in this result.
We then study which financing scheme arises when individuals are allowed to vote between the two schemes. We do so both for the benchmark case of risk neutrality and for risk aversion. We identify ability thresholds that allow to determine the magnitude of the support for the alternative financing schemes. Those with ability below the threshold ability support the income-contingent loan scheme whereas those higher ability support the tax subsidy scheme. In order to shed more light we perform numerical simulations. For a set of benchmark parameter values, a change in the degree of risk aversion switches the majority support from the tax-subsidy scheme to the income-contingent loan. The composition of the group that supports the alternative schemes can also change depending on the parameter values. We obtain situations in which the support for tax-subsidy comes from those who always study, and some but not all those who study with tax-subsidy and not with income-contingent loans. However, we also obtain cases in which the support for the tax-subsidy scheme only comes from some but not all of those who always study, with all those who do not study, all those who study with tax-subsidy but not with income-contingent loans and some of those who study with both systems supporting income-contingent loans.

The way in which we model the alternative financing schemes is arguably rather inflexible: in particular, the taxes individuals are required to pay to contribute to the cost of higher education are lump-sum, and are calculated from the budget constraint. As a result individuals do not vote on the tax (or subsidy) rate, as is the case in other contributions in the literature, but on the overall financing scheme.

References


