Choosing the type of income-contingent loan: risk-sharing versus risk-pooling

Elena Del Rey
Departament d'Economia, FCEE. Universitat de Girona, Spain

Maria Racionero
Research School of Economics, Australian National University

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Elena Del Rey* and María Racionero†

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Abstract

We study the relative preference for risk-sharing or risk-pooling income-contingent loans for higher education of risk-averse individuals who differ in their ability to benefit from education and inherited wealth. We then analyse the outcome of a majority vote between the two income-contingent schemes. We provide examples where the risk-pooling income-contingent loan is preferred by a majority. The implementation of risk-pooling schemes may however face adverse selection problems, which may be particularly relevant in the presence of student mobility. We explore the implications of allowing students to choose whether to have their loan insured in a risk-pooling fashion or not insured. We show that access to risk-pooling income-contingent loans can sometimes be guaranteed without resorting to coercion.

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

JEL Classification: H52, I22, D72

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*Corresponding author: Departament d’Economia, FCEE. Universitat de Girona. Campus de Montilivi, 17071 Girona (Spain). Tel.: + 34 972 41 87 49. Fax: + 34 972 41 80 32. E-mail: elena.delrey@udg.edu

†Research School of Economics, Australian National University, ACT0200 Canberra (Australia). Tel.: + 61 2 61254466. Fax.: + 61 2 61255124. E-mail: maria.racionero@anu.edu.au

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1 Introduction

Higher education is often highly subsidised, particularly in Western European countries. However, when students are mobile, there are frequent imbalances and requests for compensation by net importers of students. Gérard (2012) explores two alternative solutions to this problem: student vouchers and interjurisdictional transfers. In a slightly different framework, where countries can decide to subsidise internationally applicable or country-specific human capital, Poutvaara (2008) discusses the benefits of suitably differentiated tuition fees, graduate taxes and income-contingent loans.

Around the world there is a growing trend towards increasing students’ contributions to the cost of higher education. One of the advantages is that, when students pay for education, they do so in the country and to the institutions where they study. Relying on tuition fees to finance higher education can however be both inefficient and unfair, preventing access to higher education to liquidity constrained but academically deserving individuals. Even if loans are available, risk aversion can negatively affect participation. Income-contingent loans (ICLs) provide insurance against bad outcomes by making repayments dependent on the amount of income earned. In particular, no repayment is typically due when earnings are below a minimum income repayment threshold. ICLs are being increasingly adopted for the financing of higher education. Australia was the first country to implement in 1989 an ICL system to finance the cost of higher education - the Higher Education Contribution Scheme (HECS). New Zealand, UK, Sweden, Netherlands, among other countries, have since adopted similar schemes (see Chapman (2006) for an overview of the international experience with ICLs). These schemes rely to a greater or lesser extent, depending on differences in their particular designs, on general taxation to finance part of the cost of education, and most notably the cost of education of those individuals unable to achieve the minimum income repayment threshold. Because the risk is hence shared by all taxpayers, they are often denominated risk-sharing ICLs.1

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1There is not yet a consensus on student loan terminology. We employ the terminology from Chapman (2006) for consistency with our previous contributions (e.g. Del Rey and Racionero (2010)). Nicholas Barr, in e.g. Barr (2012a) section 4.1.2, frames the question in terms of where the cost of the loss falls: (a)
While risk-sharing ICLs imply contributions from non-students, alternative risk-pooling ICLs, that make successful graduates responsible for the cost of the education of unsuccessful students, are typically self-financing. There are few examples of risk-pooling ICLs. One such scheme was implemented at Yale University in 1971: the Tuition Postponement Option (TPO) program. Students at Yale could borrow from the University to fund their education with repayment being contingent on income earned in the years after graduation. All students graduating in any year with an outstanding debt were grouped in repayment cohorts with collective repayment responsibilities. An individual student’s contractual obligation did not terminate upon repayment of her individual loan balance, instead her obligations concluded only when her cohort repaid the aggregate loan balance, or after 35 years. Nerlove (1975) explored the adverse selection consequences of the Yale plan and concluded that, for such a university, hoping to attract the highest quality students, the scheme had the perverse effect of encouraging those students, who expected to be successful in the labour market, to seek enrollment at universities offering non-ICL financial assistance. In fact, the Yale plan was soon discontinued.

The failure of the Yale Plan spread the belief that self-financing schemes were not viable. However, the adverse selection effect depends on the existence of alternative funding opportunities for students. Prospective Yale students had other alternatives (e.g. attending another top university with different funding arrangements). In 2001 Hungary first implemented a broad-based self-financing ICL (Berlinger, 2009). The scheme is universal, portable and available to all EU students in Hungary. The interest rate is unsubsidised and variable, and the maturity of the loan is not specified in advance: the outstanding loan balance is cancelled only when the individual dies or receives an old-age pension. Individuals belong to a common risk pool. The interest charged by the Student Loan Centre includes a risk premium covering expired and uncollectible debts.\(^2\)

In this paper we explore the choice between two types of ICLs: one partly subsidised

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\(^2\)See http://www.diakhitel.hu for more details on the Hungarian loan scheme.
(risk-sharing, where the cost of the loss falls on the taxpayer) and the other self-financing (risk-pooling, where the cost of the loss falls on the successful graduates of the cohort). Individuals are risk-averse and differ in their ability to benefit from education and inherited wealth. We first compare the higher education participation achieved with each scheme. We then analyze how the individual’s preference over the two schemes depends on her ability and wealth characteristics and determine which financing scheme prevails if decided by majority voting. We identify circumstances under which the risk-pooling ICL is supported by a majority. However, a proportion of those who study regardless of the scheme in place - precisely those with relatively higher wealth and ability - prefer the risk-sharing to the risk-pooling ICL.

Although the risk-pooling ICL may be preferred by a majority of individuals, it may be difficult to implement if students - particularly those who are more likely to succeed - are able to opt out. This possibility is in many cases limited by the absence of alternative funding opportunities. However, with mobile students, alternative funding arrangements may be available outside their country.\(^3\) Also, with a more heterogeneous cohort of students the potentially highest earners have more incentives to opt out: e.g. if earnings prospects are very different within the pool, those who expect higher earnings may anticipate that they are more likely to end up bearing the cost of unsuccessful students, and may opt out by studying elsewhere. We explore the possibility of coexistence of risk-pooling ICLs and pure loans. The latter are more attractive to those students who expect to be higher earners and their availability may therefore prevent mobile students from searching for better options abroad.

We build on the few theoretical contributions in the literature that consider a relatively comprehensive set of higher education financing schemes, including both risk-sharing and risk-pooling ICLs: García-Peñalosa and Wälde (2000)\(^4\) and Del Rey and Racionero (2010).

\(^3\)We refer here to the possibility of opting out from the funding arrangements existing in a particular country by studying, and obtaining finance to do so, in another country. For example, non-UK EU students who wish to study in England, Northern Ireland or Wales can also apply for maintenance and tuition fee loans. The problem of graduates leaving the country and failing to repay is in contrast common to all schemes.

\(^4\)García-Peñalosa and Wälde (2000) do not use the term risk-pooling ICL but the system they describe
Both papers suggest that the risk-pooling ICL, which provides the largest level of insurance among the schemes considered, is likely to yield higher participation when risk aversion is sufficiently large. However, participation remains inefficiently low. Del Rey and Racionero (2010) propose an alternative financing scheme that induces optimal participation by fully insuring the lowest ability individual who should enroll in higher education. This scheme is shown to be equivalent to a risk-pooling ICL that covers both financial costs of education and forgone earnings.

Our work is also related to political economy models of higher education. Previous contributions in this literature include De Fraja (2001), Anderberg and Balestrino (2008), and Borck and Wimbersky (2009). More recently, Del Rey and Racionero (2012) explored the choice between tax-subsidy and (risk-sharing) ICLs. The purpose was to illustrate the tensions countries face when intending to rely less on taxes and more on students’ contributions, through partly subsidised ICLs, to finance the cost of higher education. In this contribution we focus on the situation faced by countries considering switching from partly subsidised to mostly self-financed funding schemes that still provide insurance through income-contingent repayments. Our results suggest the possibility of a majority preferring self-financing schemes and lends hence support to policy recommendations put forward by Barr (2010, 2012a). Barr (2010) proposes precise mechanisms to enable full recovery of the loan by imposing the cost of low earner’s default on the successful graduates of the cohort: e.g. a cohort risk premium, or a system in which graduates continue to pay for a few years once they have fully repaid their own loan. The importance of good design of student loans to achieve the objectives of (better) quality, (wider) access and (larger) size is further stressed in Barr (2012a).\footnote{Barr (2012b) examines the 2012 reforms in England against these objectives. He identifies the cost of loans to the taxpayer as the root of the problem. He argues for full recovery of the loan and claims that taxpayer money currently spent in financing the unpaid loan could be better spent in policies designed to widen participation (e.g. improving educational outcomes of those in the 0-18 age range).}

Self-financing mechanisms can however be prone to adverse selection effects as some students - precisely those who expect to be relatively successful - are bound to repay more as graduate taxes resembles the idea of risk-pooling ICL in this paper.

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and would accordingly prefer alternative funding arrangements. This problem is likely to be more severe if students are mobile. For this reason, we explore the possibility of letting students self-select into two schemes: a self-financing ICL and a pure loan, which is likely to be more attractive to wealthy high-ability individuals.

The paper is organized as follows. We first present the model and describe each financing scheme in section 2. We also determine the contributions required under each financing scheme to support a given participation level. In section 3 we analyze participation and in section 4 we characterize the voting outcome. We explore the combination of risk-pooling ICLs with pure loans in section 5. We conclude in section 6.

2 The model

We consider the same basic economy as Del Rey and Racionero (2012) but analyze choices among a different set of higher education financing options. The society consists of a continuum of individuals of mass \( N \) who differ in their ability \( a \) and their initial wealth \( b \), with \( a \in [\bar{a}, \overline{a}] \) and \( b \in [\bar{b}, \overline{b}] \). Ability and wealth are independently distributed in \( [\bar{a}, \overline{a}] \times [\bar{b}, \overline{b}] \). 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 depends on wealth and earned income over the lifetime. We assume 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

\[
\frac{d}{dc} \left[ \frac{-u''(c)}{u'(c)} \right] < 0
\]

(i.e. the utility function displays decreasing absolute risk aversion (DARA)).

Individuals live for two periods. In the first period, they decide whether or not to undertake higher education. Those who study forego earnings \( w_L \) in the first period. In the second period all individuals work and earn income. If the individual undertook higher 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 \( p(a) \in (0,1) \), and \( p'(a) > 0 \) for all \( a \in [\underline{a}, \overline{a}] \). If the individual did not go to university, then her income is given by \( w_L \) for sure.\(^6\) There are hence 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 \( \delta w_H > (1 + \delta) w_L \).\(^7\)

We denote by \( k \) the per capita cost of education. 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, enrol in higher education in the first period. We focus on two financing schemes for higher education: risk-sharing and risk-pooling ICLs, denoted by \( RS \) and \( RP \) respectively. We model them as in Del Rey and Racionero (2010). In both schemes all individuals who want to study borrow \( k \) and those individuals who are successful repay the amount in full. However, in the risk-sharing ICL a lump-sum tax is levied on all individuals in order to raise the revenue needed to cover the education cost of unsuccessful students whereas in the risk-pooling ICL this cost is charged exclusively to the successful graduates.\(^8\)

The timing of decisions is the following: first, individuals choose by majority voting the higher education financing scheme; then, for the higher education financing scheme chosen, they decide whether or not to participate; and, finally, they contribute. We start by determining the contributions required under each financing scheme to support a given level of participation.

\(^6\)This assumption is standard in the literature; see e.g. Borck and Wimbersky (2009) and Demange et al. (2012).

\(^7\)It may be worth stressing that our analysis assumes (a) no non-financial returns, (b) choices based on full information, and (c) non-altruistic utility functions. We thank Nicholas Barr for pointing this out.

\(^8\)Our repayment structure is not necessarily regressive, since successful graduates pay the full cost of their education on top of the lump-sum tax. It is however possible to increase the progressivity of the repayment schedule by increasing the tax paid by the successful graduates and reducing the tax paid by low-wage earners (i.e. non-students and unsuccessful graduates). Doing so would clearly attenuate the difference between the two ICL schemes considered.
Let $a^{RS}(b)$ denote the ability level of an individual with wealth $b$ who is indifferent between studying or not for the risk sharing income-contingent financing scheme. The number of individuals who undertake higher education is

$$H^{RS} = \int_{b}^{\bar{b}} \int_{a^{RS}(b)}^{\pi} f(a) h(b) \, da \, db.$$  \hspace{1cm} (1)

Successful graduates pay for the cost of their education, and the cost of unsuccessful graduates is financed by lump-sum taxes $T^{RS}$ imposed on all individuals:

$$T^{RS} = \frac{k}{N} \int_{b}^{\bar{b}} \int_{a^{RS}(b)}^{\pi} (1 - p(a)) f(a) h(b) \, da \, db.$$  \hspace{1cm} (2)

The risk-pooling ICL implies no cost for the taxpayer. Successful graduates pay for the cost of their education and contribute to finance the cost of unsuccessful graduates by paying a surcharge $T^{RP}$. Letting $a^{RP}(b)$ now denote the ability level of an individual with wealth $b$ who is indifferent between studying or not for the risk-pooling ICL, the number of individuals undertaking higher education is now

$$H^{RP} = \int_{b}^{\bar{b}} \int_{a^{RP}(b)}^{\pi} f(a) h(b) \, da \, db,$$  \hspace{1cm} (3)

and the surcharge successful graduates pay is

$$T^{RP} = \frac{k}{N} \int_{b}^{\bar{b}} \int_{a^{RP}(b)}^{\pi} (1 - p(a)) f(a) h(b) \, da \, db \int_{b}^{\bar{b}} \int_{a^{RP}(b)}^{\pi} p(a) f(a) h(b) \, da \, db.$$  \hspace{1cm} (4)

### 3 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. As in Del Rey and Racionero (2012) we denote by $\hat{a}$ the threshold ability level above which an individual should study and below which an individual should not study. It satisfies:

$$\delta \left[ p(\hat{a}) w_H + (1 - p(\hat{a})) w_L \right] - k = (1 + \delta) w_L.$$  \hspace{1cm} (5)
The optimal amount of graduates is $H^* = \int_{a}^{\bar{a}} f(a) da$. The optimal ability level is independent of family wealth $b$.

### 3.1 Participation under each type of ICL

Let $G^j(a, b)$ denote the expected net utility gain from investing in higher education under the financing scheme $j$, with $j = RS, RP$, for an individual with ability $a$ and wealth $b$:

$$G^j(a, b) \equiv (1 - p(a)) u\left(c^j_U\right) + p(a) u\left(c^j_S\right) - u\left(c^j_N\right),$$

where $c^j_U = b + \delta w_L - t^j_U$, $c^j_S = b + \delta w_H - t^j_S$ and $c^j_N = b + (1 + \delta) w_L - t^j_N$ represent the disposable income of the unsuccessful graduates, successful graduates and non-students respectively. In the risk-sharing ICL the cost of the education of unsuccessful students is financed by general lump-sum taxes while successful graduates, in addition, pay the full cost of their education ($t^{RS}_U = t^{RS}_N = T^{RS}$ and $t^{RS}_S = k + T^{RS}$). In the risk-pooling ICL, the general lump-sum tax is zero and successful graduates pay, in addition to the full cost of their education, the surcharge $T^{RP}$ to cover the cost of unsuccessful students. Thus, $t^{RP}_U = t^{RP}_N = 0$ and $t^{RP}_S = k + T^{RP}$.

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

$$\frac{dG^j(a, b)}{da} = p'(a) \left[u\left(c^j_S\right) - u\left(c^j_U\right)\right] = p'(a) \left[u\left(b + \delta w_H\right) - u\left(b + \delta w_L\right)\right] > 0$$

since $p'(a) > 0$ and $w_H > w_L$. Higher ability individuals have larger expected utility from studying than lower ability individuals, and are hence more likely to undertake higher education.

The threshold ability level of an individual with wealth $b$ for the financing scheme $j$, $a^j(b)$, satisfies $G^j(a^j(b), b) = 0$. That is,

$$(1 - p(a^j)) u\left(b + \delta w_L - t^j_U\right) + p(a^j) u\left(b + \delta w_H - t^j_S\right) = u\left(b + (1 + \delta) w_L - t^j_N\right).$$

Del Rey and Racionero (2012) showed that $a^{RS}(b)$ is strictly decreasing in $b$. Following a similar procedure it is possible to show that the same holds for $a^{RP}(b)$. Wealthier
individuals are more likely to undertake higher education. This is so despite the fact that individuals are not required to pay upfront any financial cost of education. The presence of foregone earnings and the assumption of decreasing absolute risk aversion play crucial roles. Investment in education is risky and when individuals display decreasing absolute risk aversion the wealthier ones are more willing to bear risk; in other words, they require a lower expected return in order to opt for an investment of a given riskiness. Both \( RS \) and \( RP \) provide only “partial” insurance. Although the level of cover is higher with \( RP \), both schemes fail to make participation independent of family wealth.

Only in the particular case of risk neutrality the threshold ability does not depend on \( b \), which cancels out from the expression for \( G^j (a, b) \): i.e. \( G^j (a, b) = G^j (a) \ \forall b \). We denote by \( \hat{a}^j \) the threshold ability level that determines participation under each scheme with risk neutrality. For the risk sharing ICL scheme, \( \hat{a}^{RS} \) is implicitly defined by

\[
(1 - p(\hat{a}^{RS})) \delta w_L + p(\hat{a}^{RS}) (\delta w_H - k) = (1 + \delta) w_L. \tag{9}
\]

For the risk-pooling ICL,

\[
(1 - p(\hat{a}^{RP})) \delta w_L + p(\hat{a}^{RP}) (\delta w_H - k - T^{RP}) = (1 + \delta) w_L. \tag{10}
\]

Using (4):

\[
(1 - p(\hat{a}^{RP})) \delta w_L + p(\hat{a}^{RP}) \left( \delta w_H - \frac{k}{\int_{b}^{\hat{a}^{RP}} \int_{a}^{\hat{a}^{RP}} p(a) f(a) h(b) da db} \right) = (1 + \delta) w_L. \tag{11}
\]

Since the probability of success of the marginal individual who studies is smaller than the average probability of success among those who study, and the average probability of success is smaller than one, it follows that \( \hat{a}^{RS} < \hat{a}^{RP} < \hat{a} \). Risk-neutral individuals overinvest in education with ICLs and more so with the risk-sharing type.

Risk aversion reduces participation for all income levels: \( a^j (b) > \hat{a}^j \ \forall b \). To show this
it suffices to evaluate $G^j(a,b)$ at $\hat{a}^j$, characterised implicitly by (9) and (10):

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

$$-u\left(b + \left(1 - p(\hat{a}^{RS})\right) \delta w_L + p(\hat{a}^{RS}) \left(\delta w_H - k\right) - T^{RS}\right) < 0$$

and

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

$$-u\left(b + \left(1 - p(\hat{a}^{RP})\right) \delta w_L + p(\hat{a}^{RP}) \left(\delta w_H - k - T^{RP}\right)\right) < 0$$

since, with risk aversion, the utility of expected income is higher than the expected utility. Using (7) and $G^{TS}(a^{TS}(b), b) = 0$ it follows that $\hat{a}^j < a^j(b)$. The above holds for any $b \in [\underline{b}, \overline{b}]$.

As in Del Rey and Racionero (2010, 2012) it is not possible to provide a general ordering of higher education participation under alternative financing schemes when individuals are risk averse. This is so because, for both schemes, participation decreases with risk aversion but it does so at different rates. Thus, the theoretical possibility of participation becoming larger with the risk-pooling ICL, relative to the risk-sharing ICL, cannot be ruled out. We perform below some numerical simulations to shed more light on the relative magnitude of degree of risk aversion required to reverse the relative participation results obtained with risk neutrality.

### 3.2 An example

In the simulation we use the constant relative risk aversion function

$$u(c) = \frac{c^{1-\sigma}}{1-\sigma}, \quad (12)$$

where $\sigma = -c \frac{u''(c)}{u'(c)}$ represents the coefficient of relative risk aversion. In order to illustrate how different degrees of risk aversion affect participation we let the coefficient of risk aversion vary. Borck and Wimbersky (2009) employ $\sigma = 2.25$ but Brodaty et al. (2010) suggest $\sigma = 0.75$ as reasonable for the education decision. We compare the results for
three different positive degrees of risk aversion $\sigma$ alongside the risk neutrality benchmark: 0.75 (low), 1.5 (intermediate) and 3 (high). In some cases we also let the skill premium vary: the low skill wage is normalized to 1, and the high skill wage is assumed to be either 2.5 (low skill premium) or 3.5 (high skill premium).\footnote{According to Chart A7.2 in OECD (2010) the ratio of earnings from employment with tertiary type A and advanced programs relative to below upper secondary education ranges from approximately 1.5 (New Zealand, Australia) to 5 (Brazil). Note that this ratio is based on average earnings of individuals with tertiary type A and advanced programs and includes both successful and unsuccessful graduates.} The other parameters are set the same throughout: the cost of higher education is assumed to be 0.5 and $\delta = 1.5$.\footnote{Direct costs of higher education are typically smaller than forgone costs (Chart A8.3 in OECD, 2010). A discount factor of 1.5 is chosen to account for the fact that, although the individuals discount the future, the second period is longer than the first period.} We also set $p(a) = a$ and calculate $T^{RS}$ and $T^{RP}$ according to (2) and (4) respectively. Both wealth and ability are assumed to be uniformly distributed in the population between 0 and 1.

Figure 1 represents participation under the risk-pooling ICL for different degrees of risk aversion $\sigma$, including risk neutrality, for the benchmark parameter values with a high skill premium ($w_H = 3.5$). Figure 2 represents the efficient participation together with the participation thresholds for $RP$ (solid lines) and $RS$ (dashed lines) for different degrees of
the risk aversion coefficient, including risk neutrality. The shaded area represents optimal participation. Increasing the degree of risk aversion coefficient decreases participation for both scheme. The risk-pooling ICL yields lower participation for the values of $\sigma$ considered reasonable, although participation under both schemes is similar for $\sigma = 3$.

4 Voting over the financing scheme

In this section we analyze which type of ICL is preferred by individuals of different characteristics when they anticipate participation decisions and expected contributions under each. We do so first for the benchmark case of risk neutrality, to provide intuition, and proceed next to the more relevant case of risk aversion.

4.1 Risk neutrality

We know that $\hat{a}^{RS} < \hat{a}^{RP} < \hat{a}$. More people participate, and fail, with the risk-sharing ICL, but the cost of the education of unsuccessful students falls on the full population. Hence, we can not determine in general under which scheme the contribution of successful graduates is larger.
We explore first whether it is possible to identify an ability threshold for which the preference switches from one financing scheme to another. If such a threshold exists we can compare the proportion of individuals at each side of the threshold and conclude what the majority prefers. We classify students by their participation decision and explore their preferences concerning the financing scheme.

Individuals with ability \( a < \hat{a}^{RS} \) never study and they prefer \( RP \) because they do not contribute under this scheme. Individuals with ability \( a \in [\hat{a}^{RS}, \hat{a}^{RP}] \) study with the risk-sharing ICL but do not study with the risk-pooling ICL. They prefer \( RS \) if and only if

\[
(1 - p(a)) \delta w_L + p(a) (\delta w_H - k) - T^{RS} > (1 + \delta) w_L,
\]

(13)

which can be rewritten as

\[
p(a) > \frac{w_L + T^{RS}}{\delta w_H - k - \delta w_L} = p(a^I).
\]

(14)

If \( p(\hat{a}^{RP}) > p(a^I) \) then there are some individuals with \( a < \hat{a}^{RP} \) who prefer to study and contribute with \( RS \) rather than not study but contribute nothing with \( RP \). If \( p(\hat{a}^{RP}) < p(a^I) \) all individuals in the interval \([\hat{a}^{RS}, \hat{a}^{RP}]\) prefer \( RP \). Finally, individuals with ability \( a > \hat{a}^{RP} \) prefer \( RS \) if \( T^{RS} < p(a) T^{RP} \). If this condition is satisfied at \( a = \hat{a}^{RP} \) (i.e. \( p(\hat{a}^{RP}) T^{RP} > T^{RS} \)) it will also be satisfied for all \( a > \hat{a}^{RP} \). In that case all those who study with \( RP \) prefer \( RS \) as well as some, those with \( a > a^I \), who study only with \( RS \). In the opposite case, i.e. \( p(\hat{a}^{RP}) T^{RP} < T^{RS} \), there is a threshold \( a^{II} > \hat{a}^{RP} \), such that \( p(a^{II}) = T^{RS} / T^{RP} \), above which \( RS \) is preferred. In this case only a fraction of those who always study prefer \( RS \): those students with relatively higher ability and wealth.

4.2 Risk aversion

Under risk aversion, the pattern of preferences is similar to that shown above for risk neutrality. Those individuals with sufficiently low ability never study and prefer the risk-pooling ICL. As ability increases, some individuals may choose to study under one of the schemes but not study under the other. There is the theoretical possibility of larger
participation with the risk-pooling ICL, relative to the risk-sharing ICL, for sufficiently large degrees of risk aversion and we have to account for it. We denote by \( a^I(b) \) the ability threshold of individuals indifferent between studying with one scheme and not studying with the other in the interval where individuals study only under one. For those relatively more able individuals who study regardless of the scheme in place, the more able contribute more with \( RP \) and they prefer \( RS \). A threshold \( a^{II}(b) \) represents the ability of those indifferent between the two schemes among those who study regardless of the scheme if such a threshold exists in this region.

Since it is not possible to obtain general analytical results we perform some numerical simulations below to illustrate the relative support for the alternative schemes. In cases where participation is below 50% (e.g. high degree of risk aversion in Figure 2) a majority supports \( RP \): all those who do not study prefer \( RP \) because they contribute less (nothing) to the cost of higher education than with the alternative \( RS \). It is possible to show that \( RP \) may still be preferred by a majority even in cases where more individuals study (e.g. lower degrees of risk aversion). In fact, in the benchmark case with high skill premium and low coefficient of risk aversion (\( \sigma = 0.75 \)), represented in Figure 3, \( RP \) obtains a majority with the decisive ability threshold being \( a^{II}(b) \): only a fraction of those who study under any scheme prefers \( RS \) - those with relatively higher ability and wealth, represented by the shaded area in Figure 3.

With low skill premium, participation is smaller than 50% for all levels of risk aversion considered and hence \( RP \) trivially wins the election. However, the decisive threshold is now \( a^I(b) \) provided that the degree of risk aversion is not too large. When \( a^I(b) \) is the decisive threshold all those who study regardless of the scheme in place prefer \( RS \), as well as some that study with \( RS \) but would not do so with \( RP \). In Figure 4 we show that this is the case with low skill premium and coefficient of risk aversion \( \sigma = 0.75 \). Support for risk-sharing is represented by the shaded area.

In our examples, the risk-pooling ICL is preferred to the risk-sharing ICL by a majority of individuals, and support for \( RP \) comes largely from individuals who do not study. It
Figure 3: Voting with high skill premium and $\sigma = .75$: $RP$ wins with $a^{II}(b)$ decisive

Figure 4: Voting with low skill premium and $\sigma = .75$: $RP$ wins with $a^{I}(b)$ decisive
could be argued that the non-students could instead prefer RS if wages were endogenously determined.\textsuperscript{11} Indeed, if the number of high-skill workers has a positive effect on low-skill wages, non-students might prefer the scheme that yields higher participation, often the RS, provided that the positive effect on the wage outweighs the contribution they have to pay under this scheme. In our examples participation with RS is larger than participation with RP but the difference is smaller as the level of risk aversion increases. Then RP surely prevails as the preferred option for non-students if risk aversion is sufficiently high. Suppose that risk aversion is low, and the production technology is such that the difference in participation (net of those who fail) is enough for the increase in the low-skill wage under RS to outweigh the size of the tax paid by non-students with this scheme. The increased support for RS among non-students would need to be balanced against the increased support for RP among students, whose wage as graduates would be inversely related to the number of graduates. Thus, although further research is required in this case, our conjecture is that RP will remain the preferred option for reasonable values of the parameters.

5 Combining pure loans with risk-pooling ICLs

We have identified above several cases in which the risk-pooling ICL is preferred to the risk-sharing ICL when individuals choose between these two schemes by majority voting. However, risk pooling may not arise as a market equilibrium due to adverse selection if individuals have alternative financing options available: wealthy high-ability individuals may opt out if another financing option is more advantageous. In many instances a risk-pooling ICL may need to be implemented compulsorily by the government. In this section we explore the possibility of offering loans to students and letting them choose whether

\textsuperscript{11}Consider the production function for the composite consumption good \( y, y = F(h, l) \), where \( h \) represents the number of high-skill workers and \( l \) represents the number of low-skill workers. In a competitive framework, equilibrium wages for the high- and low-skill workers are given, respectively, by \( w_H = F_h(h, l) \) and \( w_L = F_l(h, l) \). Given the usual assumptions \( F_h > 0, F_{hh} < 0, F_l > 0, F_{ll} < 0 \) and \( F_{hl} > 0 \), an increase in the number of high-skill workers and the corresponding decrease of low-skill workers has a positive effect on the low-skill wage \( w_L \) and a negative effect on the high-skill wage \( w_H \).
to have them insured in a risk-pooling fashion or not insured at all. This alternative may be easier to implement than compulsory participation in a unique risk-pooling scheme, particularly given the difficulty of achieving the latter if students are mobile. Eckbert and Zilcha (2011) have suggested that combining pure loans with (risk-pooling) ICLs can increase welfare, but Del Rey (2012) shows that separation of students in this fashion does not always constitute an equilibrium.

With a pure loan scheme \((L)\) individuals are required to pay the costs of education \(k\) irrespective of whether they are successful or not: i.e. \(c^L_U = b + \delta w_L - k\) and \(c^L_S = b + \delta w_H - k\), with an uninsured gap \(\delta (w_H - w_L)\) between success and failure. The higher ability students may prefer to forego the insurance provided by the risk-pooling ICL and opt for pure loans instead: they expect to be successful with a relatively high probability, and with risk pooling they would then be responsible for the debt repayment of the unsuccessful students in their cohort. In contrast, lower ability students, who expect to fail with a higher probability, prefer the risk-pooling ICL to the pure loan because of the insurance the scheme provides. We denote by \(a^{RP}(b)\) the maximum ability of those students who remain in the risk-pooling scheme when there is the option of opting out for the pure loan. It is defined by:

\[
\begin{align*}
(1 - p(a)) \ u(b + \delta w_L - k) + p(a) \ u(b + \delta w_H - k) = \\
(1 - p(a)) \ u(b + \delta w_L) + p(a) \ u(b + \delta w_H - k - T^{RP})
\end{align*}
\]

with \(T^{RP}\) given now by

\[
T^{RP} = k \frac{\int_{\bar{b}}^{\bar{b}} \int_{a^{RP}(b)}^{a^{RP}(b)} (1 - p(a)) f(a) h(b) \, dab}{\int_{\bar{b}}^{\bar{b}} \int_{a^{RP}(b)}^{a^{RP}(b)} p(a) f(a) h(b) \, dab},
\]

and \(a^{RP}(b)\) given by (8) with \(t^U = t^N = 0\) and \(t^S = k + T^{RP}\). Expression (15) accounts for the fact that the cost of the unsuccessful students in the \(RP\) scheme is paid by the successful students in the \(RP\) scheme, with the successful students who opted for pure loans just contributing to the cost of their own education. It is worth highlighting
that $a^{RP}(b)$ - the ability threshold that determines higher education participation when pure loans and risk-pooling ICLs are jointly offered - is larger than $a^{RP}(b)$ - the ability threshold that determines participation when only the risk-pooling ICL is offered. Some of the individuals who would have otherwise cross-subsidized the lower ability individuals, more likely to default, opt out of the risk-pooling ICL, with a resulting contraction of the range of individual abilities within the risk-pooling ICL and less higher education participation overall.

The threshold ability level of an individual with bequest $b$ when only the pure loan is offered, $a^{L}(b)$, is implicitly defined by:

$$(1 - p(a^{L}(b))) u(b + \delta w_L - k) + p(a^{L}(b)) u(b + \delta w_H - k) = u(b + (1 + \delta) w_L).$$

This threshold is below $\bar{a}^{RP}(b)$, which indicates that among those individuals who would study if the pure loan was the only alternative, the lower ability ones are better off with the risk-pooling ICL when both are offered. And this is so despite the fact that they are likely to be the ones who will bear the cost of the unsuccessful colleagues within the risk-pooling IC scheme.

We provide a numerical example for the benchmark parameter values with high skill premium and low risk aversion in Figure 5. The shaded area represents the individuals who self-select into the uninsured loan. The black lines represent the maximum and minimum ability levels of those individuals within the risk-pooling ICL when the pure loan is a feasible alternative (i.e. $\bar{a}^{RP}(b)$ and $\underline{a}^{RP}(b)$). The blue line and the purple line represent the ability thresholds, and hence participation, when only the pure loan or the risk-pooling ICL is available (i.e. $a^{L}(b)$ and $a^{RP}(b)$, respectively). This example illustrates that a risk-pooling scheme can survive even when individuals have the option to opt out and finance their education with pure loans instead. There is however a negative effect on overall participation: the minimum ability level of those who participate in the risk-pooling ICL, $\underline{a}^{RP}(b)$, is above $a^{RP}(b)$. Optimal participation for this set of parameters would be 60% (i.e. a straight line through 0.4 in Figure 5).
It is possible to show that, as risk aversion increases, participation decreases further away from its optimal level. The proportion of individuals who opt for the pure loan becomes also smaller. If risk aversion is sufficiently large the possibility of opting out becomes less attractive and the participation pattern is then similar to that obtained when only risk-pooling ICLs are offered.

6 Concluding remarks

We have analysed the majority voting outcome in an economy in which risk-averse individuals who differ in ability to benefit from education and wealth chose between risk-sharing and risk-pooling income-contingent loans for higher education. The risk-pooling scheme provides more insurance and is self-financed, by imposing the cost of the loss of the unsuccessful students on the successful graduates. We have provided numerical examples in which larger degrees of risk aversion imply increased support for the risk-pooling ICL, which is preferred by a majority for all the combinations of parameter values considered. These results cast a positive light on policy recommendations for full recovery of loans in an income-contingent fashion, made by Nicholas Barr. Barr (2010), for instance, pro-
poses precise mechanisms to impose the cost of the loss from unsuccessful students of a given cohort on the successful graduates of that cohort (e.g. a cohort risk premium or a repayment extension for successful graduates beyond the repayment of their own loan).

A recognized problem of risk-pooling schemes is that they may lead to adverse selection if alternative funding arrangements are available: high-ability individuals would like to opt out because, with higher probabilities of success, they are likely to be the ones to bear the cost of higher education of unsuccessful students. One solution is to make risk-pooling schemes compulsory but it might not be enforceable if students are mobile and can seek alternative, more favourable, funding arrangements abroad. We have explored the possibility of letting students self-select into two schemes - a self-financing ICL and a pure loan, likely to be more attractive to wealthy high-ability individuals - and we have shown that risk-pooling ICLs can sometimes be guaranteed without resorting to coercion.

In this contribution we have referred to student mobility as a constraint on the extent to which a country can enforce self-financing ICLs that make successful graduates responsible for the cost of the loss. We have argued that the problem of graduates leaving the country and failing to repay is in contrast common to all schemes. A number of contributions have analyzed the strategic choice of higher education financing structure of countries in the presence of graduates and/or students mobility, e.g. Poutvaara (2000, 2001, 2004, 2008), Lange (2009) and Kemnitz (2010). A recent contribution in the area, Demange et al. (2012), analyses the tax-fee mix decision by two countries that belong to an integrated labour market under different migration scenarios - one where only skilled workers are mobile and one where, in addition, also students can freely migrate. They show that when only skilled workers are mobile, there is a sub-optimal shift from taxes to fees and the number of students is too low. However when students can also migrate, there is a countervailing force such that maintaining the optimal financial mix becomes possible. It would be worth exploring whether the strategic interaction of countries affects the sustainability of self-financing ICLs that allow students to opt out when education is a risky investment. We leave this issue for further research.
References


