

Document de treball de l'IEB 2014/7

CHOOSING THE TYPE OF INCOME-CONTINGENT LOAN: RISK-SHARING
VERSUS RISK-POOLING

Elena Del Rey, María Racionero

**CHOOSING THE TYPE OF INCOME-CONTINGENT
LOAN: RISK-SHARING VERSUS RISK-POOLING**

Elena Del Rey, María Racionero

The **Barcelona Institute of Economics (IEB)** is a research centre at the University of Barcelona (UB) which specializes in the field of applied economics. The **IEB** is a foundation funded by the following institutions: Applus, Abertis, Ajuntament de Barcelona, Diputació de Barcelona, Gas Natural and La Caixa.

Postal Address:

Institut d'Economia de Barcelona
Facultat d'Economia i Empresa
Universitat de Barcelona
C/ Tinent Coronel Valenzuela, 1-11
(08034) Barcelona, Spain
Tel.: + 34 93 403 46 46
ieb@ub.edu
<http://www.ieb.ub.edu>

The IEB working papers represent ongoing research that is circulated to encourage discussion and has not undergone a peer review process. Any opinions expressed here are those of the author(s) and not those of IEB.

**CHOOSING THE TYPE OF INCOME-CONTINGENT
LOAN: RISK-SHARING VERSUS RISK-POOLING***

Elena Del Rey, María Racionero

ABSTRACT: This paper analyses the choice between risk-sharing and risk-pooling income-contingent loans for higher education of risk-averse individuals who differ in their ability to benefit from education and inherited wealth. The paper identifies the possible outcomes of a majority vote between the two income-contingent schemes and provides several examples where the risk-pooling income-contingent loan is preferred. The paper then discusses the implications on participation and voting outcomes if successful graduates are mobile and provides examples where the riskpooling income-contingent loan remains being preferred. Risk-pooling schemes can however be prone to adverse selection problems, particularly if students are mobile. The paper explores the implications of allowing students to opt out of the riskpooling income-contingent loan for a pure loan. It shows that risk-pooling income-contingent loans can be sustained even when some students opt out.

JEL Codes: H52, I22, D72

Keywords: Voting, higher education, income-contingent loans, risk, mobility

Elena Del Rey
Departament d'Economia, FCEE
Universitat de Girona
Campus de Montilivi
17071 Girona (Spain)
E-mail: elena.delrey@udg.edu

María Racionero
Research School of Economics
Australian National University
ACT0200 Canberra (Australia)
E-mail: maria.racionero@anu.edu.au

* We would like to thank Nicholas Barr, Julien Jacqmin, David Wildasin, the reviewers, and the organizers of the CESifo Venice Summer Institute conference on "Cross Border Mobility of Students and Researchers: Financing and Implications for Economic Efficiency and Growth" and the IV Workshop on Economics of Education (IEB, Barcelona) for their useful comments and suggestions. We gratefully acknowledge financial support from the Spanish Ministry of Science and Innovation through Research Grant ECO2010-16353 and the Autonomous Government of Catalonia through Research Grant 2009SGR-189 and XREPP. Errors remain ours.

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

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. According to Berlinger (2009) its main characteristics are universal access and universal conditions, income-contingent repayment, private funding, and self-sustaining (zero-profit) operation without direct state

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) on the taxpayer, (b) on the cohort of graduates, (c) on universities via a university-specific risk premium, or (d) on a mix. Our risk-sharing and risk-pooling ICLs correspond to (a) and (b), respectively.

subsidy. She identifies the latter as a particularly unique feature, shows that a 1–2 per cent risk premium can ensure zero-profit operation and concludes that adverse selection is less menacing for a self-financing ICL system than the literature suggests.

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

Emigration has been identified as a potential problem for ICLs. We discuss the implications on participation and voting outcomes of allowing successful graduates to emigrate. We assume that successful graduates repay the loan regardless of whether they stay or emigrate, which is consistent with the rules that apply for instance in the UK ICL scheme. In contrast, successful graduates are not liable for the tax component in the risk-sharing ICL if they emigrate. We show that the support for risk sharing may increase or decrease when successful graduates are able to migrate but in our examples the risk-pooling ICL remains the majority voting outcome.

Although the risk-pooling ICL may be preferred by a majority it may be difficult to implement if students - particularly those who are more likely to succeed - are able to opt out. As mentioned before, this possibility is in many cases limited by the absence of alternative financing options. However, with mobile students, alternative funding ar-

rangements may be available abroad.² 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. We explore the possibility that some students may choose to study abroad with a pure loan rather than at home with a risk-pooling ICL. We show that a risk-pooling ICL can be sustained even when some students opt out.

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)³ and Del Rey and Racionero (2010). 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.

²We 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.

³García-Peñalosa and Wälde (2000) do not use the term risk-pooling ICL but the system they describe as graduate taxes resembles the idea of risk-pooling ICL in this paper.

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).⁴

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 $a \in [\underline{a}, \bar{a}]$ and $b \in [\underline{b}, \bar{b}]$. Ability and wealth are independently distributed in $[\underline{a}, \bar{a}] \times [\underline{b}, \bar{b}]$. 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 depends on wealth and earned

⁴Barr (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).

income over the lifetime. We assume a von Neumann-Morgensten utility function $u(c)$ with, for every $c > 0$, $u'(c) > 0$, $u''(c) \leq 0$, $\lim_{c \rightarrow \infty} u'(c) = +\infty$, and

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

(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 $a \in [\underline{a}, \bar{a}]$. If the individual did not go to university, then her income is given by w_L for sure.⁵ 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 δw_H , δw_L and $(1 + \delta) w_L$, where δ is the discount factor, for individuals S , U and N respectively. We assume that $\delta w_H > (1 + \delta) w_L$.⁶

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

⁵This assumption is standard in the literature; see e.g. Borck and Wimbersky (2009) and Demange et al. (2012).

⁶It 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.

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.⁷

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.

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

$$H^{RS} = \int_{\underline{b}}^{\bar{b}} \int_{a^{RS}(b)}^{\bar{a}} f(a) h(b) da db. \quad (1)$$

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:

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

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

⁷Our 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.

number of individuals undertaking higher education is now

$$H^{RP} = \int_{\underline{b}}^{\bar{b}} \int_{a^{RP}(b)}^{\bar{a}} f(a) h(b) da db, \quad (3)$$

and the surcharge successful graduates pay is

$$T^{RP} = k \frac{\int_{\underline{b}}^{\bar{b}} \int_{a^{RP}(b)}^{\bar{a}} (1 - p(a)) f(a) h(b) da db}{\int_{\underline{b}}^{\bar{b}} \int_{a^{RP}(b)}^{\bar{a}} p(a) f(a) h(b) da db}. \quad (4)$$

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:

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

The optimal amount of graduates is $H^* = \int_{\hat{a}}^{\bar{a}} f(a) da$. 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 :

$$G^j(a, b) \equiv (1 - p(a)) u(c_U^j) + p(a) u(c_S^j) - u(c_N^j), \quad (6)$$

where $c_U^j = b + \delta w_L - t_U^j$, $c_S^j = b + \delta w_H - t_S^j$ and $c_N^j = b + (1 + \delta)w_L - t_N^j$ 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 ($t_U^{RS} = t_N^{RS} = T^{RS}$ and $t_S^{RS} = k + T^{RS}$). 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, $t_U^{RP} = t_N^{RP} = 0$ and $t_S^{RP} = k + T^{RP}$.

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

$$\frac{dG^j(a, b)}{da} = p'(a) [u(c_S^j) - u(c_U^j)] = p'(a) [u(b + \delta w_H) - u(b + \delta w_L)] > 0 \quad (7)$$

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,

$$(1 - p(a^j)) u(b + \delta w_L - t_U^j) + p(a^j) u(b + \delta w_H - t_S^j) = u(b + (1 + \delta) w_L - t_N^j). \quad (8)$$

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 up-front 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

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

For the risk-pooling ICL,

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

Using (4):

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

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):

$$\begin{aligned} G^{RS}(\hat{a}^{RS}, b) &= (1 - p(\hat{a}^{RS})) u(b + \delta w_L - T^{RS}) + p(\hat{a}^{RS}) u(b + \delta w_H - k - T^{RS}) \\ &\quad - u(b + (1 - p(\hat{a}^{RS})) \delta w_L + p(\hat{a}^{RS}) (\delta w_H - k) - T^{RS}) < 0 \end{aligned}$$

and

$$\begin{aligned} G^{RP}(\hat{a}^{RP}, b) &= (1 - p(\hat{a}^{RP})) u(b + \delta w_L) + p(\hat{a}^{RP}) u(b + \delta w_H - k - T^{RP}) \\ &\quad - u(b + (1 - p(\hat{a}^{RP})) \delta w_L + p(\hat{a}^{RP}) (\delta w_H - k - T^{RP})) < 0 \end{aligned}$$

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 $b \in [\underline{b}, \bar{b}]$.

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 σ 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).⁸ The other parameters are set the

⁸According 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.

same throughout: the cost of higher education is assumed to be 0.5 and $\delta = 1.5$.⁹ 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.

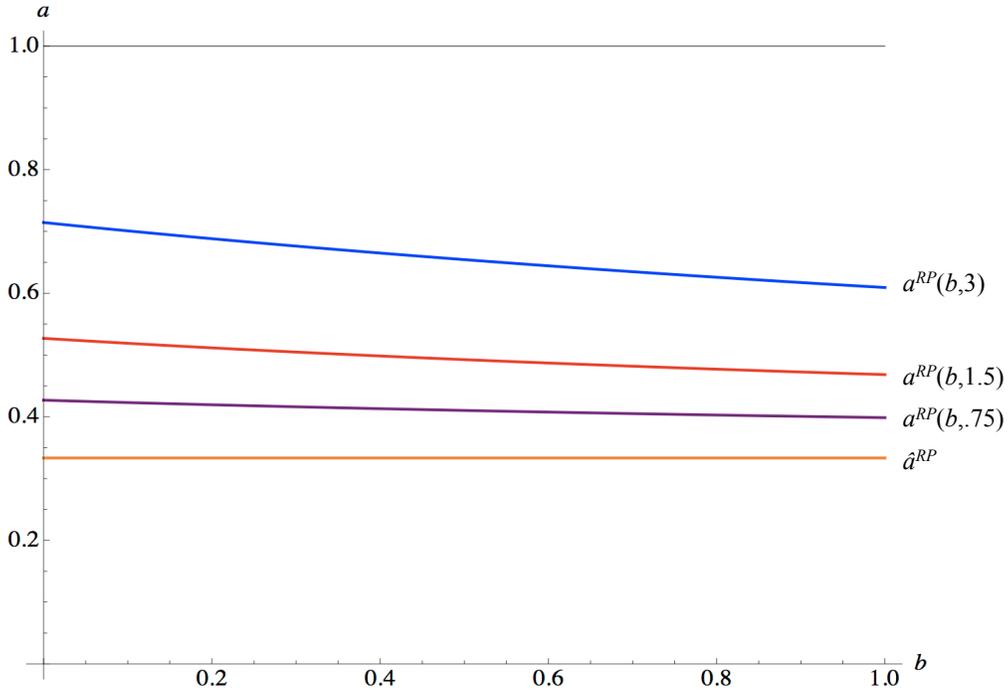


Figure 1: Participation under RP , $\sigma = \{0.75, 1.5, 3\}$

Figure 1 represents participation under the risk-pooling ICL for different degrees of risk aversion σ , 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

⁹Direct 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.

participation. Increasing the degree of risk aversion coefficient decreases participation for both schemes. The risk-pooling ICL yields lower participation for the values of σ considered reasonable, although participation under both schemes is similar for $\sigma = 3$.

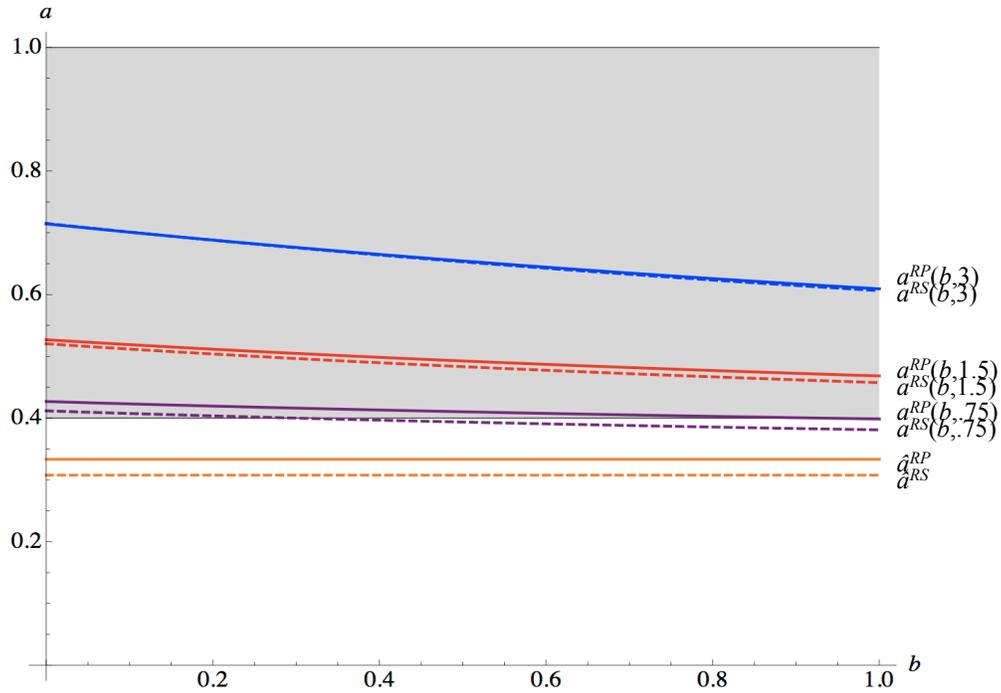


Figure 2: Participation RP versus RS , $\sigma = \{0.75, 1.5, 3\}$

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

$$(1 - p(a)) \delta w_L + p(a) (\delta w_H - k) - T^{RS} > (1 + \delta) w_L, \quad (13)$$

which can be rewritten as

$$p(a) > \frac{w_L + T^{RS}}{\delta w_H - k - \delta w_L} = p(a^I). \quad (14)$$

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 always study prefers RS - those with relatively higher ability and wealth, represented by

the shaded area in Figure 3.

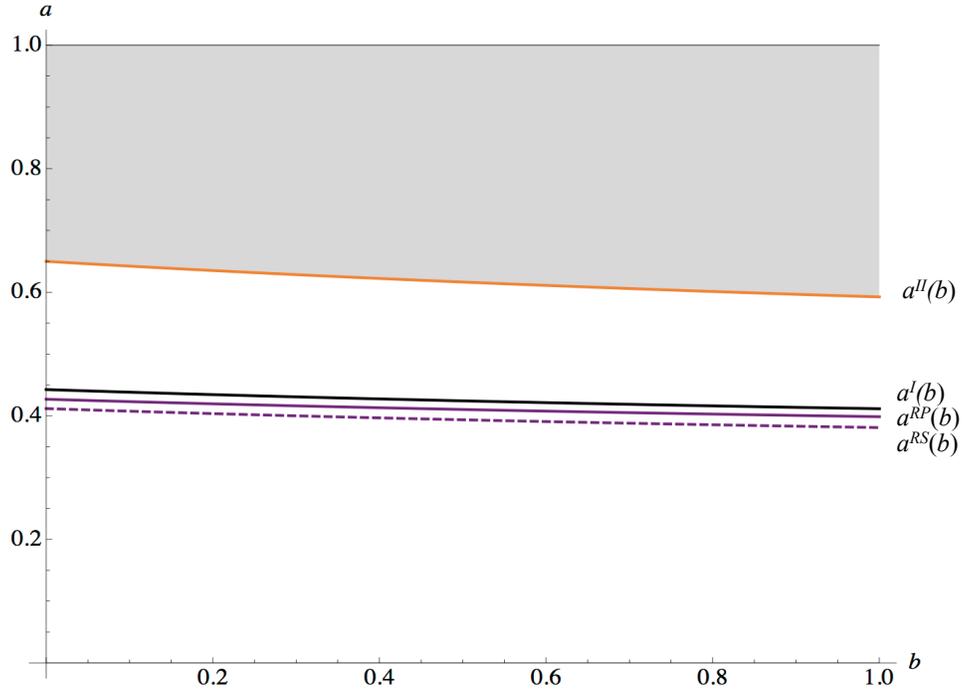


Figure 3: Voting with high skill premium and $\sigma = 0.75$: RP wins with $a^{II}(b)$ decisive

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 always study prefer RS , as well as some who 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.

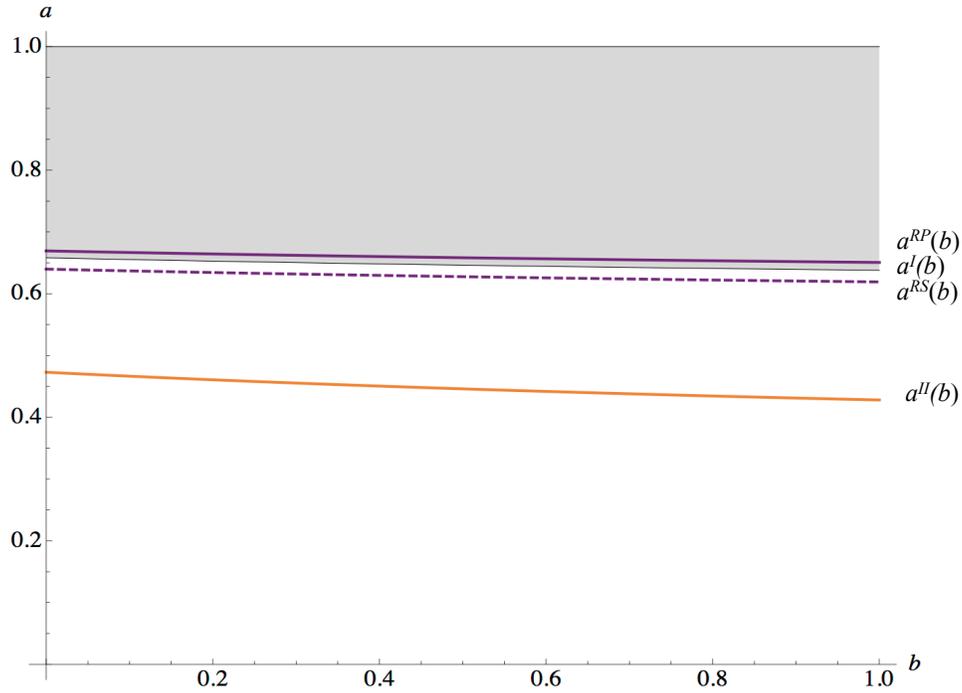


Figure 4: Voting with low skill premium and $\sigma = 0.75$: RP wins with $a^I(b)$ decisive

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 could be argued that the non-students could instead prefer RS if wages were endogenously determined.¹⁰ 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

¹⁰Consider 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 .

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 High skilled mobility

Emigration has been identified as a potential problem for ICLs. In this section we discuss the implications of allowing successful graduates to emigrate. We assume that successful graduates repay the loan regardless of whether they stay or emigrate. This assumption is consistent with the rules that apply in the UK and Hungary.¹¹ These clauses were established in order to avoid the problems that other countries, especially New Zealand, experienced with non-repayment of the loan by successful graduates who opted to work overseas.

We denote the skilled wage overseas by w_H^F and the mobility costs by C , which includes the taxes to be paid overseas. A successful graduate in the risk-pooling scheme emigrates if $\delta w_H^F - C > \delta w_H$. A successful graduate in the risk-sharing scheme emigrates if $\delta w_H^F - C > \delta w_H - T^{RS}$. The difference between these conditions stems from the fact that the cost of the education of the unsuccessful students can be incorporated in the risk-pooling ICL contract, as a repayment extension or interest surcharge, while it is financed out of

¹¹In the UK and Hungary students are liable for the repayment of the loan even if they live abroad. In the UK case there are overseas income thresholds that have been calculated to accommodate differences in living expenses in different countries (see <http://www.studentloanrepayment.co.uk/> for further details).

general taxes in the risk-sharing ICL and successful graduates are not liable for this tax component if they emigrate.

If $\delta w_H^F - C \leq \delta w_H - T^{RS}$ there is no migration. If $\delta w_H^F - C = \delta w_H$ successful graduates stay with the risk-pooling ICL but emigrate with the risk-sharing ICL. If $\delta w_H^F - C > \delta w_H$ successful graduates emigrate with both schemes. When the possibility to emigrate is effectively attractive the participation decision and the relative support for each scheme may be affected.

When deciding whether to undertake higher education, the individual takes into consideration the possibility of earning more abroad if successful and how the possibility of migration impacts on the repayment. When participation increases lower ability individuals, with higher probabilities of being unsuccessful, study, and this increases the cost of education of unsuccessful students: in the case of risk-sharing ICLs successful graduates migrate and this cost falls entirely on those who remain; in the case of risk-pooling ICLs this cost is still borne by the successful graduates.

The ability threshold for the risk-sharing ICL when successful graduates are allowed to migrate and migrating is effectively attractive, which we denote by $a^{RSM}(b)$, satisfies

$$p(a^{RSM}(b)) = \frac{u(b + (1 + \delta)w_L - T^{RSM}) - u(b + \delta w_L - T^{RSM})}{u(b + \delta w_H^F - C - k) - u(b + \delta w_L - T^{RSM})} \quad (15)$$

whereas $a^{RS}(b)$ in the absence of migration satisfies

$$p(a^{RS}(b)) = \frac{u(b + (1 + \delta)w_L - T^{RS}) - u(b + \delta w_L - T^{RS})}{u(b + \delta w_H - k - T^{RS}) - u(b + \delta w_L - T^{RS})}. \quad (16)$$

If individuals are risk neutral participation increases with the possibility of migration. In the general risk-aversion case both the numerator and the denominator increase in the migration case with respect to the no migration case.

The ability threshold for the risk-pooling ICL when successful graduates are allowed

to migrate and migrating is effectively attractive, which we denote by $a^{RPM}(b)$, satisfies

$$p(a^{RPM}(b)) = \frac{u(b + (1 + \delta)w_L) - u(b + \delta w_L)}{u(b + \delta w_H^F - C - k - T^{RPM}) - u(b + \delta w_L)} \quad (17)$$

whereas $a^{RP}(b)$ in the absence of migration satisfies

$$p(a^{RP}(b)) = \frac{u(b + (1 + \delta)w_L) - u(b + \delta w_L)}{u(b + \delta w_H - k - T^{RP}) - u(b + \delta w_L)}. \quad (18)$$

Whether participation increases depends on whether the net wage gain from migrating (i.e. $\delta w_H^F - C - \delta w_H$) is larger than the increased cost of the education of unsuccessful students when less able individuals undertake higher education.

Regarding the choice between risk-pooling and risk-sharing ICL we know the following: while those who do not study prefer the risk-pooling ICL, potential students face a trade-off between the insurance aspect (the difference in net earnings between successful and unsuccessful students), favouring the risk-pooling ICL, and the education subsidy aspect (the contribution from non-students), favouring the risk-sharing ICL. In the presence of skilled labour mobility, the risk-sharing scheme provides less insurance as successful graduates, who emigrate, do not contribute to the cost of the education of unsuccessful students, thus raising the tax burden on the unsuccessful students and non-students, who stay. On the other hand, those who do not study contribute more and, hence, the education subsidy is larger. The larger the degree of risk aversion is, the more important the insurance component of the ICL becomes and the lower the support for the risk-sharing ICL is relative to the risk-pooling ICL. However, for a given level of risk aversion, it is impossible to predict in general whether the relative support for the risk-sharing ICL will increase or decrease in the presence of skilled labour migration. We have found examples of both. Still, in those examples, even when relative support for the risk-sharing ICL increases, it does not increase enough overcome the support for the risk-pooling ICL.

Figure 5 represents the mobility case associated with the benchmark non-mobility

case in Figure 3: we keep all the parameters the same and make migration attractive for successful graduates under both financing schemes by assuming $\delta w_H^F - C > 3.5\delta$.¹² We posit $\delta w_H^F - C = 4\delta$, which is consistent with several combinations of w_H^F and C (for instance $(w_H^F, C) = (4.5, 0.75)$ for assumed $\delta = 1.5$). When compared with the benchmark non-mobility case in Figure 3, participation increases for both schemes, attracting lower ability types, with higher probability of failure, into higher education. With the risk-pooling ICL the cost of the loan increases for successful graduates even if they emigrate. With the risk-sharing ICL the cost of the education of the unsuccessful students is financed by unsuccessful students and non-students, since the successful graduates emigrate and are not longer liable for the tax component. In this case the support for *RS* decreases and *RP* remains preferable. For higher degrees of risk aversion the support for *RS* decreases even more: the risk-sharing ICL is now relatively riskier since the successful graduates, who all emigrate, are better off and the unsuccessful students and the non-students, who are unable to emigrate, are worse-off.

¹²For $\delta w_H^F - C = 3.5\delta$ participation remains unchanged with *RP* and increases with *RS*, with the gap in participation between the two schemes becoming larger, for all degrees of risk-aversion but particularly so for low ones.

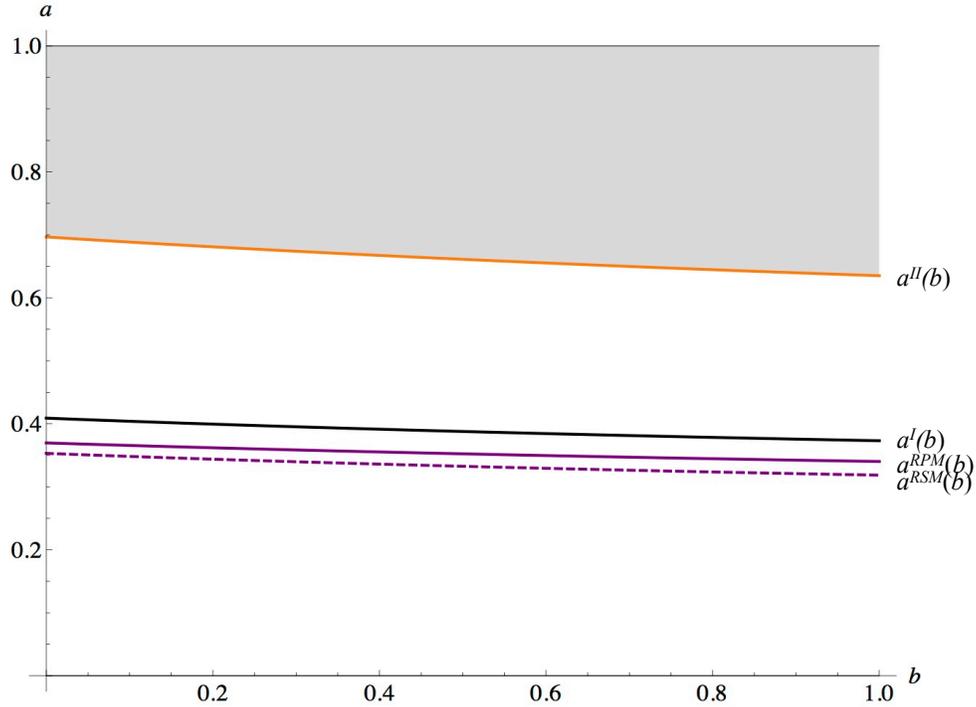


Figure 5: Participation and voting outcomes for $\delta w_H^E - C = 4\delta$ and $\sigma = 0.75$

A similar numerical exercise with low skill premium (i.e. that takes as benchmark non-mobility case the parameter values used in Figure 4 and makes migration attractive for successful graduates by assuming $\delta w_H^E - C = 3\delta > 2.5\delta$) shows an increase in support for *RS* when successful graduates are mobile. *RP* remains however preferable.

6 Student mobility: combining risk-pooling ICLs with pure loans

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. The risk-pooling ICL may however be difficult to implement if students - particularly those who are more likely to succeed - are able to opt out. In many instances a risk-pooling ICL

may need to be made compulsory. However, with mobile students, alternative funding arrangements may be available overseas. In this section we explore the possibility that some students may choose to study abroad with a pure loan rather than at home with a risk-pooling ICL.¹³

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. $c_U^L = b + \delta w_L - k$ and $c_S^L = b + \delta w_H - k$, 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 $\bar{a}^{RP}(b)$ 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:

$$\begin{aligned} (1 - p(\bar{a}^{RP}(b))) u(b + \delta w_L - k) + p(\bar{a}^{RP}(b)) u(b + \delta w_H - k) = \\ (1 - p(\bar{a}^{RP}(b))) u(b + \delta w_L) + p(\bar{a}^{RP}(b)) u(b + \delta w_H - k - T^{RP}) \end{aligned}$$

with T^{RP} given now by

$$T^{RP} = k \frac{\int_{\underline{b}}^{\bar{b}} \int_{\underline{a}^{RP}(b)}^{\bar{a}^{RP}(b)} (1 - p(a)) f(a) h(b) da db}{\int_{\underline{b}}^{\bar{b}} \int_{\underline{a}^{RP}(b)}^{\bar{a}^{RP}(b)} p(a) f(a) h(b) da db}, \quad (19)$$

and $\underline{a}^{RP}(b)$ given by (8) with $t_U^j = t_N^j = 0$ and $t_S^j = k + T^{RP}$. Expression (19) accounts for the fact that the cost of the unsuccessful students in the RP scheme is paid by the

¹³The analysis is equivalent to that of a government offering loans to students and letting them decide whether to have them uninsured or insured in a risk-pooling fashion. 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.

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 $\underline{a}^{RP}(b)$ - the ability threshold that determines higher education participation when pure loans and risk-pooling ICLs coexist - is larger than $a^{RP}(b)$ - the ability threshold that determines participation when the risk-pooling ICL is the only option. 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 options coexist. 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 6. The shaded area represents the individuals who self-select into the uninsured loan (i.e. study abroad if the only possibility to opt out is to study abroad with a pure loan). $\bar{a}^{RP}(b)$ and $\underline{a}^{RP}(b)$ represent the maximum and minimum ability levels of those individuals within the risk-pooling ICL when the pure loan is a feasible alternative. $a^L(b)$ and $a^{RP}(b)$ represent the ability thresholds, and hence participation, when only the pure loan or the risk-pooling ICL is available. This example illustrates that a risk-pooling scheme can be sustained 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 6).

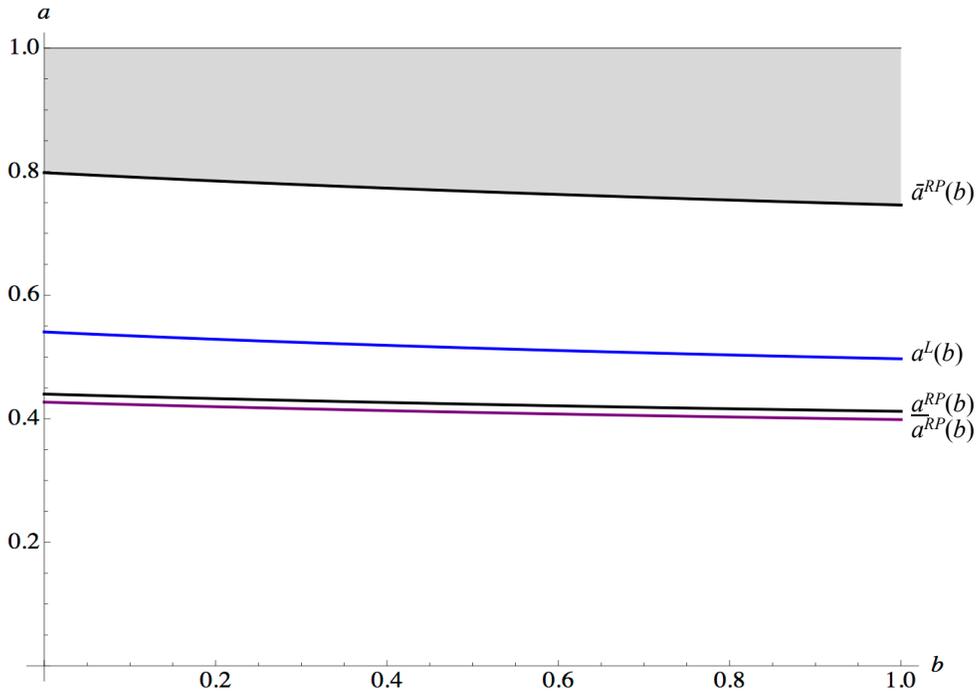


Figure 6: Coexistence of insured and uninsured loans ($\sigma = 0.75$)

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 the risk-pooling ICL is the only option.

7 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, proposes 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).

We have discussed the implications on participation and voting outcomes of skilled workers migration. We assumed that successful graduates are liable for the loan repayment, which is consistent with clauses employed in the UK and Hungary ICL schemes. In the numerical simulations provided participation and support for the alternative schemes are affected but the risk-pooling ICL is still preferred.

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 be sustained even if students are allowed to opt out.

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 unsuccessful students. We have also discussed the implications of skilled graduates mobility in an stylised non-strategic framework. 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

- [1] Anderberg, Dan and Alessandro Balestrino (2008). The political economy of post-compulsory education policy with endogenous credit constraints, CESifo Working Paper Series No. 2304.
- [2] Barr, Nicholas (2010). Designing student loans to protect low earners, Research Note, Policy Exchange, http://www.policyexchange.org.uk/images/publications/pdfs/Student_loans.pdf

- [3] Barr, Nicholas (2012a). Financing Higher Education: Mobility, Quality and Access, presented at Cross Border Mobility of Students and Researchers: Financing and Implications for Economic Efficiency and Growth, CESifo Venice Summer Institute 2012.
- [4] Barr, Nicholas (2012b). The Higher Education White Paper: The good, the bad, the unspeakable – and the next White Paper, *Social Policy and Administration*, 46(5), 483-508.
- [5] Berlinger, Edina (2009). An Efficient Student Loan System: Case Study of Hungary, *Higher Education in Europe*, 34(2), 257-267.
- [6] Borck, Rainald and Martin Wimbersky (2009). Political economics of higher education finance, CESifo Working Paper Series No. 2829.
- [7] Brodaty, Thomas, R. Robert Gary-Bobo and Ana Prieto (2010). Heterogeneity in risk-aversion, education and wages, mimeo.
- [8] Chapman, Bruce, (2006). Income contingent loans for higher education: international reforms, in: E.A. Hanushek, F. Welch (Eds). *Handbook on the Economics of Education*, Vol. 2. North-Holland, Amsterdam, pp. 1435–1503.
- [9] De Fraja, Gianni, (2001). Education policies: Equity, efficiency and voting equilibrium, *The Economic Journal*, 111, C104-C119.
- [10] Demange, Gabrielle, Fenge, Robert and Silke Uebelmesser (2012). Financing Higher Education in a Mobile World, forthcoming *Journal of Public Economic Theory*.
- [11] Del Rey, Elena and Maria Racionero (2010). Financing schemes for higher education, *European Journal of Political Economy*, 26, 104-113.

- [12] Del Rey, Elena and Maria Racionero (2012). Voting on income-contingent loans for higher education, *The Economic Record* 88, Special Issue, 38-50.
- [13] Del Rey, Elena (2012). Deferring higher education fees without relying on contributions from non-students, *Education Economics*, 20(5), 510-521.
- [14] Eckbert, Bernhard and Itzhak Zilcha (2011). Competition in Funding Higher Education, CESifo Working Paper Series No. 3588.
- [15] García-Peñalosa, Cecilia and Klaus Wälde (2000). Efficiency and equity effects of subsidies to higher education, *Oxford Economic Papers*, 52, 702–722.
- [16] Gérard, Marcel (2012). Who Is to Pay for Mobile Students?, chapter 39 in: A. Curaj, P. Scott, L. Vlasceanu, L. Wilson (Eds). *European Higher Education at the Crossroads*, Springer, Netherlands, pp. 727-748.
- [17] Kemnitz, Alexander (2010). Educational Federalism and the Quality Effects of Tuition Fees, CESifo Working Paper Series No. 3193.
- [18] Lange, Thomas (2009). Public Funding of Higher Education when Students and Skilled Workers are Mobile, *FinanzArchiv: Public Finance Analysis*, 65, 178-199
- [19] Nerlove, Marc (1975). Some problems in the use of income-contingent loans for the finance of higher education, *Journal of Political Economy*, 83, 157-183.
- [20] Poutvaara, Panu (2000). Education, Mobility of Labour, and Tax Competition, *International Tax and Public Finance*, 7, 699–719.
- [21] Poutvaara, Panu (2001). Alternative Tax Constitutions and Risky Education in a Federation, *Regional Science and Urban Economics*, 31, 355–377.

- [22] Poutvaara, Panu (2004). Educating Europe: Should Public Education be Financed with Graduate Taxes or Income-Contingent Loans?, *CESifo Economic Studies*, 50, 663-684
- [23] Poutvaara, Panu (2008). Public and Private Education in an Integrated Europe: Studying to Migrate and Teaching to Stay?, *Scandinavian Journal of Economics*, 110, 591-608.
- [24] OECD (2010). Education at a Glance 2010: OECD Indicators, Organisation for Economic Cooperation and Development, OECD Publishing, France.

Notes

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) on the taxpayer, (b) on the cohort of graduates, (c) on universities via a university-specific risk premium, or (d) on a mix. Our risk-sharing and risk-pooling ICLs correspond to (a) and (b), respectively.

²We 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.

³García-Peñalosa and Wälde (2000) do not use the term risk-pooling ICL but the system they describe as graduate taxes resembles the idea of risk-pooling ICL in this paper.

⁴Barr (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).

⁵This assumption is standard in the literature; see e.g. Borck and Wimbersky (2009) and Demange et al. (2012).

⁶It 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.

⁷Our 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.

⁸According 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.

⁹Direct 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.

¹⁰Consider 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 .

¹¹In the UK and Hungary students are liable for the repayment of the loan even if they live abroad. In the UK case there are overseas income thresholds that have been calculated to accommodate differences in living expenses in different countries (see <http://www.studentloanrepayment.co.uk/> for further details).

¹²For $\delta w_H^F - C = 3.5\delta$ participation remains unchanged with RP and increases with RS , with the gap in participation between the two schemes becoming larger, for all degrees of risk-aversion but particularly so for low ones.

¹³The analysis is equivalent to that of a government offering loans to students and letting them decide whether to have them uninsured or insured in a risk-pooling fashion. 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.

2011

- 2011/1, **Oppedisano, V; Turati, G.**: "What are the causes of educational inequalities and of their evolution over time in Europe? Evidence from PISA"
- 2011/2, **Dahlberg, M; Edmark, K; Lundqvist, H.**: "Ethnic diversity and preferences for redistribution "
- 2011/3, **Canova, L.; Vaglio, A.**: "Why do educated mothers matter? A model of parental help"
- 2011/4, **Delgado, F.J.; Lago-Peñas, S.; Mayor, M.**: "On the determinants of local tax rates: new evidence from Spain"
- 2011/5, **Piolatto, A.; Schuett, F.**: "A model of music piracy with popularity-dependent copying costs"
- 2011/6, **Duch, N.; García-Estévez, J.; Parellada, M.**: "Universities and regional economic growth in Spanish regions"
- 2011/7, **Duch, N.; García-Estévez, J.**: "Do universities affect firms' location decisions? Evidence from Spain"
- 2011/8, **Dahlberg, M.; Mörk, E.**: "Is there an election cycle in public employment? Separating time effects from election year effects"
- 2011/9, **Costas-Pérez, E.; Solé-Ollé, A.; Sorribas-Navarro, P.**: "Corruption scandals, press reporting, and accountability. Evidence from Spanish mayors"
- 2011/10, **Duch, A.; Calero, J.; Escardíbul, J.O.**: "Hell to touch the sky? private tutoring and academic achievement in Korea"
- 2011/11, **Mira Godinho, M.; Cartaxo, R.**: "University patenting, licensing and technology transfer: how organizational context and available resources determine performance"
- 2011/12, **Duch-Brown, N.; García-Quevedo, J.; Montolio, D.**: "The link between public support and private R&D effort: What is the optimal subsidy?"
- 2011/13, **Breuil, M.L.; Duran-Vigneron, P.; Samson, A.L.**: "To assemble to resemble? A study of tax disparities among French municipalities"
- 2011/14, **McCann, P.; Ortega-Argilés, R.**: "Smart specialisation, regional growth and applications to EU cohesion policy"
- 2011/15, **Montolio, D.; Trillas, F.**: "Regulatory federalism and industrial policy in broadband telecommunications"
- 2011/16, **Pelegrín, A.; Bolancé, C.**: "Offshoring and company characteristics: some evidence from the analysis of Spanish firm data"
- 2011/17, **Lin, C.**: "Give me your wired and your highly skilled: measuring the impact of immigration policy on employers and shareholders"
- 2011/18, **Bianchini, L.; Revelli, F.**: "Green politics: urban environmental performance and government popularity"
- 2011/19, **López Real, J.**: "Family reunification or point-based immigration system? The case of the U.S. and Mexico"
- 2011/20, **Bogliacino, F.; Piva, M.; Vivarelli, M.**: "The impact of R&D on employment in Europe: a firm-level analysis"
- 2011/21, **Tonello, M.**: "Mechanisms of peer interactions between native and non-native students: rejection or integration?"
- 2011/22, **García-Quevedo, J.; Mas-Verdú, F.; Montolio, D.**: "What type of innovative firms acquire knowledge intensive services and from which suppliers?"
- 2011/23, **Banal-Estañol, A.; Macho-Stadler, I.; Pérez-Castrillo, D.**: "Research output from university-industry collaborative projects"
- 2011/24, **Lighthart, J.E.; Van Oudheusden, P.**: "In government we trust: the role of fiscal decentralization"
- 2011/25, **Mongrain, S.; Wilson, J.D.**: "Tax competition with heterogeneous capital mobility"
- 2011/26, **Caruso, R.; Costa, J.; Ricciuti, R.**: "The probability of military rule in Africa, 1970-2007"
- 2011/27, **Solé-Ollé, A.; Viladecans-Marsal, E.**: "Local spending and the housing boom"
- 2011/28, **Simón, H.; Ramos, R.; Sanromá, E.**: "Occupational mobility of immigrants in a low skilled economy. The Spanish case"
- 2011/29, **Piolatto, A.; Trotin, G.**: "Optimal tax enforcement under prospect theory"
- 2011/30, **Montolio, D.; Piolatto, A.**: "Financing public education when altruistic agents have retirement concerns"
- 2011/31, **García-Quevedo, J.; Pellegrino, G.; Vivarelli, M.**: "The determinants of YICs' R&D activity"
- 2011/32, **Goodspeed, T.J.**: "Corruption, accountability, and decentralization: theory and evidence from Mexico"
- 2011/33, **Pedraja, F.; Cordero, J.M.**: "Analysis of alternative proposals to reform the Spanish intergovernmental transfer system for municipalities"
- 2011/34, **Jofre-Monseny, J.; Sorribas-Navarro, P.; Vázquez-Grenno, J.**: "Welfare spending and ethnic heterogeneity: evidence from a massive immigration wave"
- 2011/35, **Lyytikäinen, T.**: "Tax competition among local governments: evidence from a property tax reform in Finland"
- 2011/36, **Brühlhart, M.; Schmidheiny, K.**: "Estimating the Rivalness of State-Level Inward FDI"
- 2011/37, **García-Pérez, J.I.; Hidalgo-Hidalgo, M.; Robles-Zurita, J.A.**: "Does grade retention affect achievement? Some evidence from Pisa"
- 2011/38, **Boffa, f.; Panzar, J.**: "Bottleneck co-ownership as a regulatory alternative"

- 2011/39, **González-Val, R.; Olmo, J.:** "Growth in a cross-section of cities: location, increasing returns or random growth?"
- 2011/40, **Anesi, V.; De Donder, P.:** "Voting under the threat of secession: accommodation vs. repression"
- 2011/41, **Di Pietro, G.; Mora, T.:** "The effect of the l'Aquila earthquake on labour market outcomes"
- 2011/42, **Brueckner, J.K.; Neumark, D.:** "Beaches, sunshine, and public-sector pay: theory and evidence on amenities and rent extraction by government workers"
- 2011/43, **Cortés, D.:** "Decentralization of government and contracting with the private sector"
- 2011/44, **Turati, G.; Montolio, D.; Piacenza, M.:** "Fiscal decentralisation, private school funding, and students' achievements. A tale from two Roman catholic countries"

2012

- 2012/1, **Montolio, D.; Trujillo, E.:** "What drives investment in telecommunications? The role of regulation, firms' internationalization and market knowledge"
- 2012/2, **Giesen, K.; Suedekum, J.:** "The size distribution across all "cities": a unifying approach"
- 2012/3, **Foremny, D.; Riedel, N.:** "Business taxes and the electoral cycle"
- 2012/4, **García-Estévez, J.; Duch-Brown, N.:** "Student graduation: to what extent does university expenditure matter?"
- 2012/5, **Durán-Cabré, J.M.; Esteller-Moré, A.; Salvadori, L.:** "Empirical evidence on horizontal competition in tax enforcement"
- 2012/6, **Pickering, A.C.; Rockey, J.:** "Ideology and the growth of US state government"
- 2012/7, **Vergolini, L.; Zanini, N.:** "How does aid matter? The effect of financial aid on university enrolment decisions"
- 2012/8, **Backus, P.:** "Gibrat's law and legacy for non-profit organisations: a non-parametric analysis"
- 2012/9, **Jofre-Monseny, J.; Marín-López, R.; Viladecans-Marsal, E.:** "What underlies localization and urbanization economies? Evidence from the location of new firms"
- 2012/10, **Mantovani, A.; Vandekerckhove, J.:** "The strategic interplay between bundling and merging in complementary markets"
- 2012/11, **García-López, M.A.:** "Urban spatial structure, suburbanization and transportation in Barcelona"
- 2012/12, **Revelli, F.:** "Business taxation and economic performance in hierarchical government structures"
- 2012/13, **Arqué-Castells, P.; Mohnen, P.:** "Sunk costs, extensive R&D subsidies and permanent inducement effects"
- 2012/14, **Boffa, F.; Piolatto, A.; Ponzetto, G.:** "Centralization and accountability: theory and evidence from the Clean Air Act"
- 2012/15, **Cheshire, P.C.; Hilber, C.A.L.; Kaplanis, I.:** "Land use regulation and productivity – land matters: evidence from a UK supermarket chain"
- 2012/16, **Choi, A.; Calero, J.:** "The contribution of the disabled to the attainment of the Europe 2020 strategy headline targets"
- 2012/17, **Silva, J.I.; Vázquez-Grenno, J.:** "The ins and outs of unemployment in a two-tier labor market"
- 2012/18, **González-Val, R.; Lanaspa, L.; Sanz, F.:** "New evidence on Gibrat's law for cities"
- 2012/19, **Vázquez-Grenno, J.:** "Job search methods in times of crisis: native and immigrant strategies in Spain"
- 2012/20, **Lessmann, C.:** "Regional inequality and decentralization – an empirical analysis"
- 2012/21, **Nuevo-Chiquero, A.:** "Trends in shotgun marriages: the pill, the will or the cost?"
- 2012/22, **Piil Damm, A.:** "Neighborhood quality and labor market outcomes: evidence from quasi-random neighborhood assignment of immigrants"
- 2012/23, **Ploeckl, F.:** "Space, settlements, towns: the influence of geography and market access on settlement distribution and urbanization"
- 2012/24, **Algan, Y.; Hémet, C.; Laitin, D.:** "Diversity and local public goods: a natural experiment with exogenous residential allocation"
- 2012/25, **Martinez, D.; Sjögren, T.:** "Vertical externalities with lump-sum taxes: how much difference does unemployment make?"
- 2012/26, **Cubel, M.; Sanchez-Pages, S.:** "The effect of within-group inequality in a conflict against a unitary threat"
- 2012/27, **Andini, M.; De Blasio, G.; Duranton, G.; Strange, W.C.:** "Marshallian labor market pooling: evidence from Italy"
- 2012/28, **Solé-Ollé, A.; Viladecans-Marsal, E.:** "Do political parties matter for local land use policies?"
- 2012/29, **Buonanno, P.; Durante, R.; Prarolo, G.; Vanin, P.:** "Poor institutions, rich mines: resource curse and the origins of the Sicilian mafia"
- 2012/30, **Anghel, B.; Cabrales, A.; Carro, J.M.:** "Evaluating a bilingual education program in Spain: the impact beyond foreign language learning"
- 2012/31, **Curto-Grau, M.; Solé-Ollé, A.; Sorribas-Navarro, P.:** "Partisan targeting of inter-governmental transfers & state interference in local elections: evidence from Spain"

- 2012/32, **Kappeler, A.; Solé-Ollé, A.; Stephan, A.; Väilä, T.:** "Does fiscal decentralization foster regional investment in productive infrastructure?"
- 2012/33, **Rizzo, L.; Zanardi, A.:** "Single vs double ballot and party coalitions: the impact on fiscal policy. Evidence from Italy"
- 2012/34, **Ramachandran, R.:** "Language use in education and primary schooling attainment: evidence from a natural experiment in Ethiopia"
- 2012/35, **Rothstein, J.:** "Teacher quality policy when supply matters"
- 2012/36, **Ahlfeldt, G.M.:** "The hidden dimensions of urbanity"
- 2012/37, **Mora, T.; Gil, J.; Sicras-Mainar, A.:** "The influence of BMI, obesity and overweight on medical costs: a panel data approach"
- 2012/38, **Pelegrín, A.; García-Quevedo, J.:** "Which firms are involved in foreign vertical integration?"
- 2012/39, **Agasisti, T.; Longobardi, S.:** "Inequality in education: can Italian disadvantaged students close the gap? A focus on resilience in the Italian school system"

2013

- 2013/1, **Sánchez-Vidal, M.; González-Val, R.; Viladecans-Marsal, E.:** "Sequential city growth in the US: does age matter?"
- 2013/2, **Hortas Rico, M.:** "Sprawl, blight and the role of urban containment policies. Evidence from US cities"
- 2013/3, **Lampón, J.F.; Cabanelas-Lorenzo, P.; Lago-Peñas, S.:** "Why firms relocate their production overseas? The answer lies inside: corporate, logistic and technological determinants"
- 2013/4, **Montolio, D.; Planells, S.:** "Does tourism boost criminal activity? Evidence from a top touristic country"
- 2013/5, **García-López, M.A.; Holl, A.; Viladecans-Marsal, E.:** "Suburbanization and highways: when the Romans, the Bourbons and the first cars still shape Spanish cities"
- 2013/6, **Bosch, N.; Espasa, M.; Montolio, D.:** "Should large Spanish municipalities be financially compensated? Costs and benefits of being a capital/central municipality"
- 2013/7, **Escardíbul, J.O.; Mora, T.:** "Teacher gender and student performance in mathematics. Evidence from Catalonia"
- 2013/8, **Arqué-Castells, P.; Viladecans-Marsal, E.:** "Banking towards development: evidence from the Spanish banking expansion plan"
- 2013/9, **Asensio, J.; Gómez-Lobo, A.; Matas, A.:** "How effective are policies to reduce gasoline consumption? Evaluating a quasi-natural experiment in Spain"
- 2013/10, **Jofre-Monseny, J.:** "The effects of unemployment benefits on migration in lagging regions"
- 2013/11, **Segarra, A.; García-Quevedo, J.; Teruel, M.:** "Financial constraints and the failure of innovation projects"
- 2013/12, **Jerrim, J.; Choi, A.:** "The mathematics skills of school children: How does England compare to the high performing East Asian jurisdictions?"
- 2013/13, **González-Val, R.; Tirado-Fabregat, D.A.; Viladecans-Marsal, E.:** "Market potential and city growth: Spain 1860-1960"
- 2013/14, **Lundqvist, H.:** "Is it worth it? On the returns to holding political office"
- 2013/15, **Ahlfeldt, G.M.; Maennig, W.:** "Homevoters vs. leasevoters: a spatial analysis of airport effects"
- 2013/16, **Lampón, J.F.; Lago-Peñas, S.:** "Factors behind international relocation and changes in production geography in the European automobile components industry"
- 2013/17, **Guío, J.M.; Choi, A.:** "Evolution of the school failure risk during the 2000 decade in Spain: analysis of Pisa results with a two-level logistic model"
- 2013/18, **Dahlby, B.; Rodden, J.:** "A political economy model of the vertical fiscal gap and vertical fiscal imbalances in a federation"
- 2013/19, **Acacia, F.; Cubel, M.:** "Strategic voting and happiness"
- 2013/20, **Hellerstein, J.K.; Kutzbach, M.J.; Neumark, D.:** "Do labor market networks have an important spatial dimension?"
- 2013/21, **Pellegrino, G.; Savona, M.:** "Is money all? Financing versus knowledge and demand constraints to innovation"
- 2013/22, **Lin, J.:** "Regional resilience"
- 2013/23, **Costa-Campi, M.T.; Duch-Brown, N.; García-Quevedo, J.:** "R&D drivers and obstacles to innovation in the energy industry"
- 2013/24, **Huisman, R.; Stradnic, V.; Westgaard, S.:** "Renewable energy and electricity prices: indirect empirical evidence from hydro power"
- 2013/25, **Dargaud, E.; Mantovani, A.; Reggiani, C.:** "The fight against cartels: a transatlantic perspective"
- 2013/26, **Lambertini, L.; Mantovani, A.:** "Feedback equilibria in a dynamic renewable resource oligopoly: pre-emption, voracity and exhaustion"

- 2013/27, **Feld, L.P.; Kalb, A.; Moessinger, M.D.; Osterloh, S.:** "Sovereign bond market reactions to fiscal rules and no-bailout clauses – the Swiss experience"
- 2013/28, **Hilber, C.A.L.; Vermeulen, W.:** "The impact of supply constraints on house prices in England"
- 2013/29, **Revelli, F.:** "Tax limits and local democracy"
- 2013/30, **Wang, R.; Wang, W.:** "Dress-up contest: a dark side of fiscal decentralization"
- 2013/31, **Dargaud, E.; Mantovani, A.; Reggiani, C.:** "The fight against cartels: a transatlantic perspective"
- 2013/32, **Saarimaa, T.; Tukiainen, J.:** "Local representation and strategic voting: evidence from electoral boundary reforms"
- 2013/33, **Agasisti, T.; Murtinu, S.:** "Are we wasting public money? No! The effects of grants on Italian university students' performances"
- 2013/34, **Flacher, D.; Harari-Kermadec, H.; Moulin, L.:** "Financing higher education: a contributory scheme"
- 2013/35, **Carozzi, F.; Repetto, L.:** "Sending the pork home: birth town bias in transfers to Italian municipalities"
- 2013/36, **Coad, A.; Frankish, J.S.; Roberts, R.G.; Storey, D.J.:** "New venture survival and growth: Does the fog lift?"
- 2013/37, **Giulietti, M.; Grossi, L.; Waterson, M.:** "Revenues from storage in a competitive electricity market: Empirical evidence from Great Britain"

2014

- 2014/1, **Montolio, D.; Planells-Struse, S.:** "When police patrols matter. The effect of police proximity on citizens' crime risk perception"
- 2014/2, **Garcia-López, M.A.; Solé-Ollé, A.; Viladecans-Marsal, E.:** "Do land use policies follow road construction?"
- 2014/3, **Piolatto, A.; Rablen, M.D.:** "Prospect theory and tax evasion: a reconsideration of the Yitzhaki puzzle"
- 2014/4, **Cuberes, D.; González-Val, R.:** "The effect of the Spanish Reconquest on Iberian Cities"
- 2014/5, **Durán-Cabré, J.M.; Esteller-Moré, E.:** "Tax professionals' view of the Spanish tax system: efficiency, equity and tax planning"
- 2014/6, **Cubel, M.; Sanchez-Pages, S.:** "Difference-form group contests"

