

Refinancing Europe's Higher Education through Deferred and Income-Contingent Fees: An empirical assessment using Belgian, German and UK data

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Abstract

The arguments for refinancing the European Union's (EU) higher education via higher tuition fees largely rest on preserving the profitability of the educational investment and offering deferred and income-contingent payments. Using income survey datasets on Belgium, Germany and the United Kingdom (UK) we first estimate how graduates' private return on educational investment is likely to be affected by higher private contributions. We then evaluate the effect of income-contingent and deferred payment mechanisms on lifetime net income and its capacity to account for graduates' ability to pay, considering numerous ways of financing the cost of introducing income-contingency. Our analysis reveals that increasing individuals' contributions to higher education costs, through income-contingent and deferred instruments, does not significantly affect the private rate of return of heterogeneous graduates, allows for payments to be indexed to ability to pay, and can be implemented in ways that minimize the risk of adverse selection. These findings prove robust to significant variations between countries' unharmonised higher education institutional structures.

JEL classification: I28, H520.

Keywords: Higher Education Finance, income-contingent loans, risk pooling and risk shifting

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I. Introduction

A debate on the future of higher education financing is raging at the heart of recurrent policy discussions at national and European levels: should tuition fees be increased to support the effort of Europe's higher education sector to strengthen its quality and maintain its attractive position compared to the US and emerging countries? In most European countries, public financing has been considered the traditional approach to financing higher education. Pressures to reform the existing funding structure through a different sharing of the burden between taxpayers and students/graduates are increasing due to the evolution of the higher education market structure, changes in the economic structure, demographic developments, and increased competition within existing public service activities for finite public funds.

In terms of public policy, the simplest way to increase private contributions is to raise tuition fees. Expressed as a percentage of the lifetime wage premium of a typical graduate, higher fees might still appear relatively small and harmless. However, proper evaluation of a higher tuition fee policy requires more than merely estimating the financial hardship imposed on the *average* graduate. Quite evidently, if some prospective students face credit or liquidity constraints they will not undertake higher education, even if wage premia and private returns remain relatively high. By contrast, they should not be deterred if fees are *deferred*. The other major point is that lifetime income heterogeneity among graduates¹ justifies focussing on the *income-contingent* payment of deferred fees. These might produce completely different incentives and degrees of vertical justice from up-front fees or traditional loans. Income-contingent payments are indeed the only way to take account of the fact that graduates face diverse lifetime income prospects.

The case for deferred payments also rests on problems with information (Barr, 2001 and 2004; Chapman, 1997). It is often claimed that private contributions should be a function of a student's income or ability to pay. But the former mainly consists of future earnings that are not known at the time of the investment. Consequently, enforcing this principle requires deferring its implementation to a time when the student's resulting income is verifiable, through an income-contingency scheme. Finally, for political-economic reasons, this mechanism should facilitate the implementation of reforms in the financing of higher education by limiting the immediate potential negative effects of a new mechanism for sharing costs between the various stakeholders. As stated by Barr (2001), higher education could remain free at the point of use.

¹ It seems that traditional estimates of the return on higher education investment have underestimated the level of income heterogeneity among graduates. In the US, there is growing evidence that changes in wage inequality are increasingly concentrated at the very top end of the wage distribution, and observed among highly-educated workers (Lemieux, 2006).

Regarding deferred and income-contingent payment mechanisms, a distinction should be introduced between loan and equity contracts (Barr, 2001, 2004; Greenaway and Haynes, 2003; Jacobs, 2002). An income-contingent loan (ICL)² allows students to raise capital based on their promise to repay a fixed amount, contingent on the additional revenue generated by their investment in higher education. In the case of equity contracts – also known as human capital contracts (HCC) – students commit a fraction of their future income for a predetermined period of time in exchange for capital (Palacios, 2004). Income-contingency is direct in the case of HCC, as payment is defined as a percentage of earnings. For ICL, the level of private contribution depends on the propensity of graduates to earn more (or less) than a predetermined income threshold, generally defined as the mean income among individuals who did not attend higher education.

Income-contingency operates as an insurance against loss of income, but induces costs that need to be shared within the cohort of graduates (risk pooling) or transferred to taxpayers (risk shifting). Risk pooling is a system where the cost of default is shared amongst graduates. The higher cost of providing income-contingency to categories like women or graduates from less profitable fields of study could otherwise be shifted to the taxpayer via subsidies to individuals (borrowers) or investors (lenders)³. Each of these options needs to be carefully examined, bearing in mind the problem of adverse selection inherent in insurance mechanisms.

Using data on income and employment for a small sample of European countries (UK, Germany and Belgium), we estimate payment flows for the various instruments (HCC, ICL) and for different categories of individuals with contrasting lifetime income profiles. Our analysis reveals that private income-contingency instruments are relatively effective at indexing contributions to lifetime income, thus limiting negative redistribution effects. In contrast with tuition fees paid up front or via normal loans, income-contingency generates a significant difference between low- and high-income graduates. Finally, we introduce the insurance dimension of income-contingency, paying particular attention to the cost of this insurance and the problem of adverse selection. We show that the cost, per EUR invested, of providing insurance to graduates ranges from 0.32 EUR (UK) to 0.37 EUR (Germany). This cost can be pooled amongst graduates with the risk of creating adverse selection through an inadequate pooling of high and low risk individuals. We show that payments by graduates with the most profitable prospects (Master's degree graduates) are inflated by up to 19% when pooled with Bachelor's degree graduates who face lower lifetime income. The cost to males of being pooled with female graduates can be more than 20%. To complete the analysis, various policy options are considered in order to

² Student loan terminology is not yet stabilized. Some authors like Palacios (2004) prefer to talk of loans with income forgiveness.

³ Chapman (2005) explains that the mechanism implemented in Australia from 1989 onwards is essentially an ICL system with risk shifting in the sense that the government covers the cost of non-repayment.

address this issue: risk shifting, risk pooling with separation, and risk pooling with compulsory participation of students.

This paper relates to an emerging literature on the use for the financing of higher education of new instruments that somehow overcome all these limitations. Friedman (1955, 1962), in the US, and Glennerster and Wilson (1968), in the UK, initiate the idea of income-contingent student contributions. Barr (2001 and 2004) provides arguments in favour of income-contingent loans (ICL); while Palacios (2004) introduces the concept of human capital contracts (HCC). However, particularly in the European context, the empirical evaluation of these instruments remains limited.

Our empirical framework is connected to the approach developed by Jacobs (2002), investigating, in the case of the Netherlands, the consequences of using graduate tax or ICL systems for financing higher education. We pay greater attention to confronting the outcomes of income-contingent schemes than to those of more traditional instruments like up-front fees (FEE) and finance by taxation (TAX). Our paper also enlarges the analysis, first by considering HCC, and second by referring to a small sample of European countries exhibiting differences as to the way higher education, labour market and fiscal policies are designed. The paper also considers the various ways of financing the cost of income-contingency acknowledging adverse selection. Hence, it provides a more complete assessment of alternative higher education payment mechanisms.

The paper is structured as follows: Section II details the simple empirical model we use to assess the outcomes of different deferred income-contingent solutions (ICL, HCC) and the benchmarks, higher up-front fees (FEE) and taxation (TAX). In Section III we present the income and employment data for Germany, Belgium and the UK, and in Section IV the upper bound estimates of the reduction in the private rate of return (*PRR*), caused by (cumulated) tuition fees of up to 20,000€. This section aims to gauge the financial disincentives for the *average* graduate generated by higher fees, on the pessimistic assumption that they have no positive effect on earning prospects (through the educational improvements they finance). In Section V we show that in order for *heterogeneous* graduates to enjoy the returns computed in Section IV, and to achieve vertical justice, payments should be determined via income-contingent mechanisms. Furthermore, ICL, HCC, FEE, and TAX are compared in terms of their relative capacity to account for students' lifetime ability to pay. Section VI discusses financing the insurance inherent in income-contingency schemes, and in particular how to address adverse selection whilst pooling heterogeneous graduates. Section VII is the conclusion.

II. Model

Refinancing Europe's higher education amounts to identifying ways to raise additional funding per student, INV .⁴ This amount complements⁵ the current level of (cumulated) public funding per student.

I.1. Lifetime income

In order to properly assess the consequences of collecting INV from individuals, we first need to measure lifetime income of different types of graduates and non-graduates. If $y_{j,k}(a)$ represents the level of net income of a representative individual of age a and higher education status j (i.e. graduate ($j=g$) or non-graduate ($j=ng$)), and of type k (bachelor vs. master, male, vs female...), the present value of his cumulated net income, evaluated at, for instance, age 24, is:

$$Y_{j,k} = \sum_a [y_{j,k}(a)(1+\tau)^{a-24}/(1+r)^{a-24}] \quad (1)$$

with:

- a ranging from the age individuals start earning an income till the moment they retire;
- τ capturing total factor productivity gains (technological progress, capital deepening, etc.);
- r representing the usual discount factor⁶.

In all cases hereafter, income should be understood as *net* income, including net wages and replacement earnings. This reinforces our assumption that extra contributions to higher education are in addition to current levels of taxation, and independent from current social transfer programs.

II.2. Higher tuition fees and average lifetime private rate of return

Increasing private contributions to complement current public funding will increase students' lifetime cost of studying. Our first investigation is thus how the lifetime profitability of higher education is affected given an increase in private contributions. If fees are raised, the *average* graduate is asked to contribute $C_g=INV$. Being private, this contribution is deducted from the current lifetime net wage premium ($Y_g - Y_{ng}$). *Ceteris paribus*, this reduces the private rate of return (PRR):

$$PRR_g = (Y_g - Y_{ng} - C_g) / (dur (1-\chi) FY_g) \quad (2)$$

⁴ We assume hereafter that INV corresponds to a cumulated amount covering all years of study.

⁵ Some authors like Jacobs (2002) model private finance mechanisms as *substitutes* to public finance. Although very sensitive when it comes to policy-making, this distinction does not fundamentally affect the results of the modelling exercise.

⁶ The preference for the present is captured by the return on risk-free and long-term bonds.

where

- $C_g=INV$ is the additional contribution of the typical graduate;
- $Y_g - Y_{ng}$ is the cumulated net income premium of a representative graduate evaluated at the age of 24;
- dur is the duration of higher education;
- FY_g is the present value of forgone income for the typical graduate, it is a function of the level of income non-graduates are able to accumulate during the period of study;
- $0 < \chi < 1$ is a parameter reducing the importance of foregone income, reflecting income students get by taking part-time jobs.

Here we focus on the direct and *negative* effect of fees on the private rate of return (*PRR*). We will abstain from considering the induced changes in enrolment rates. Finely modelling and evaluating the price elasticity of higher education demand in Europe is clearly beyond the scope of the paper⁷. Intuitively, a sharp reduction in *PRR* may weaken individual's incentives to undertake advanced studies, or prove to be very unpopular. By contrast, a small reduction might have less of an effect and be more acceptable.

It is important to bear in mind that Eq. 2 represents an *upper bound* of the effect of fees on private returns. This expression ignores the potentially *positive* effect of additional finance on the earnings prospects of individuals. These may arise through improvements to internal efficiency of the higher education system which translate into higher wages for graduates⁸, or higher growth rates induced by human capital externalities.

It is even more important to realize that analysing how the *average* graduate's *PRR* would be affected by higher tuition fees is just a preliminary step. Properly evaluating the higher private contributions proposal requires further considerations: Eq. 2 implicitly assumes that there is no credit or liquidity constraint, and more importantly, Eq. 2 might understate lifetime income *heterogeneity* amongst various types of graduates. The existence of credit or liquidity constraints⁹ could prevent prospective students from undertaking higher education, even if it appears that *PRR* remains relatively high and unaffected by higher tuition fees. Deferred contributions are obviously a way to circumvent the liquidity constraints specific to time of study. Lifetime income heterogeneity amongst graduates¹⁰ is the other major reason why ICL

⁷ The empirical evidence on the elasticity of higher education demand to tuition fees is still debated. Jacobs (2002) reports that estimates for the Netherlands suggest that enrolment is hardly price-responsive. Similarly, in the US empirical evidence is mixed (Heckman and Carneiro, 2003).

⁸ Dale and Krueger (1999) report an elasticity of income to higher education spending of less than 0.1 which is not statistically significant, particularly when they allow for self-selection.

⁹ For a discussion of the prevalence of credit constraints among prospective higher education students, see Chapman (2005).

¹⁰ It seems that traditional estimates of the return of higher education investment have

and HCC might generate completely different private returns, and degrees of vertical justice, than FEE or traditional loans. The evidence is that graduates face heterogeneous lifetime income prospects. Implementing vertical redistribution and ensuring that each type k graduate achieves a return equals to the average one captured by Eq. 2 requires some adaptation of payments; in other words income-contingency. Assuming the terms of the denominator of Eq. 2 play a minor role – implementing income-contingency amounts to indexing a type k graduates' contributions ($C_{g,k}$) on her level of income ($Y_{g,k}$).

$$PRR_g \approx PRR_{g,k} = (Y_{g,k} - Y_n - C_{g,k}) / (dur_k (1-\chi_k) FY_{g,k}) \quad (3)$$

if $C_{g,k}/Y_{g,k}$ is the same for all k

II.3. Instruments of finance

As suggested above, we need to model various schemes of private finance (ICL, HCC), and properly evaluate the shape of the resulting distribution of contributions amongst types k of graduates $C_{g,k}$. We simultaneously model the outcomes of FEE and TAX as benchmarks.

We assume that the various schemes used to raise *INV a priori* apply to all students¹¹. The deferred payment schemes take the form of contracts which take effect when students turn 19 and last a predetermined period D : from the moment the student receives the capital *INV* to cover tuition fees (19)¹² until the moment they make their last payment (19 + D). For simplicity of exposure, we neglect potential differences across countries regarding the length of studies and the timing of labour market entrance. We assume, in the case of ICL and HCC, that graduates start paying when they turn 24. D thus includes a grace period of 5 years. In the case of TAX, the additional public resources financing a particular cohort's higher education takes the form of public debt issued when individuals reach 19. Reimbursement of this public debt, via higher taxes, also starts at age 24 and ends at age 19 + D ¹³. Finally, throughout this paper, interest rate r should be seen as a discount factor, reflecting economic agents' preference for the present, not as a parameter crucially influencing the cost or distributional properties of ICL and HCC.

underestimated the level of income heterogeneity amongst graduates. In the US, there is growing evidence that changes in wage inequality are increasingly concentrated at the very top end of the wage distribution, observed amongst highly-educated workers (Lemieux, 2006).

¹¹ We will discuss this particular point in greater detail in Section VI when examining the problem of adverse selection.

¹² To simplify, we assume that students are paid in full, at the beginning of their studies.

¹³ Strictly speaking, non-graduates start paying taxes before the age of 24. However, this more realistic modelling option, fundamentally, would not change our results.

i) *Human capital contracts*

Characterising the human capital contract (HCC) amounts to finding a value of θ such that the present value of lifetime payments by a typical graduate (all types k pooled) equals the value of the investment¹⁴;

$$INV = \theta Y_g \quad (4)$$

with

- $INV \equiv inv(1+r)^5$ the value of additional investment on higher education (inv), expressed in EUR, at the age of 24 (the end of the grace period of 5 years);
- $Y_g \equiv \sum_a [y_g(a) (1+\tau)^{a-24}/(1+r)^{a-24}]$ the present value of the sum of net income, with $y_g(a)$ the annual income/age function for a representative graduate ($j=g$);
- a ranges from 24 to $19 + D$; where D is the duration of the human capital contract (eg, 25 years), that include a grace period
- r representing the discount factor or interest rate on risk-free capital;

ii) *Income-contingent loans*

Modelling income-contingent loans (ICL) consists of finding the value of the annual instalment Ω such that:

$$INV = \Omega M_g \quad (5)$$

with :

- a ranges from 24 to $19 + D$; where D is the duration of the ICL;
- $M_g \equiv \sum_a [\mu_g(a)/(1+r)^{a-24}]$ the present value of the sum of probabilities of payment for a typical graduate (all types k pooled) over the period considered, with $\mu_g(a) \equiv Prob(y_g(a) > \Theta(a))$ the probability of payment at age a , $\Theta(a)$ being the age-specific annual net income threshold under which no payment is required. It is defined as the average income observed amongst non-graduates¹⁵.

iii) *Benchmarks*

In our analysis, we systematically confront the outcomes of income-contingent instruments like ICL and HCC with those of the more traditional up-front fees and taxation.

¹⁴ We refer here to cumulated investment over the whole period of study.

¹⁵ This particular threshold has an economic justification that can be traced back to the seminal work of Friedman (1955): private contributions should only be levied on the fraction of total income that can be ascribed to college or university attendance.

Up-front fees

We abstract from the idea that fees are paid annually and assume the value of fees (FEE) at age 24 is simply equal to INV .

Income taxation

Raising tax is the other traditional way of financing higher education. We first consider financing by (deferred) higher income taxes (ITAX). In such a framework, the problem is to find the percentage of additional taxation η such that:

$$\alpha INV = \eta [\alpha T_g + (1-\alpha)T_{ng}] \quad (6)$$

where:

- a ranges from 24 to $24+D-5$; where D is the predefined horizon of the public debt;
- $T_g \equiv \sum_a [t_g(a) (1+\tau)^{a-24} / (1+r)^{a-24}]$ the present value of the stream of income tax paid by graduates (all types k pooled), evaluated at age 24, with $t_g(a)$ the expected amount of annual income tax;
- $T_{ng} \equiv \sum_a [t_{ng}(a) (1+\tau)^{a-24} / (1+r)^{a-24}]$ the present value of the stream of income tax paid by non-graduates with $t_{ng}(a)$ the expected amount of annual income tax;
- α is the share of graduates in a cohort ;

After dividing both sides by α , (6) becomes:

$$INV = \eta [T_g + \psi T_{ng}] \quad (7)$$

with $\psi \equiv (1-\alpha)/\alpha$ the relative importance of non-graduates vis-à-vis graduates ; greater than 1 if, as expected in most EU countries, graduates represent a minority of the cohort.

General taxation

A more realistic approach of finance by taxation (GTAX) is to assume that only a (country-specific) fraction $0 < \delta < 1$ of tax receipts comes from progressive income taxation. The residual part could come from fiscal instruments that operate more like a lump-sum levy (LS). In that context, we need to calculate the per-tax payer lump-sum levied LS such that

$$LS = (1-\delta) \alpha INV \quad (8)$$

with δ the relative importance of income tax in the country's total tax receipts/State budget.

and finding $\eta' < \eta$ such that

$$\delta INV = \eta'[T_g + \psi TG_{ng}] \quad (9)$$

Using (5) it is immediate to show that $\eta\delta = \eta'$

II.3. Distribution analysis

In order to assess the impact of each type of finance scheme modelled above (HCC, ICL, FEE, ITAX, GTAX) on the private rate of return (Eq.2), and on vertical redistribution, we compute the present value of the cumulated contribution for each instrument m and each type k of individual ($C_{m,k}$), where k reflects the idea of *heterogeneity* among graduates and other individuals (Y_{jk})¹⁶.

The various contributions made can be written:

$$C_{HCC_{g,k}} = \theta^* Y_{g,k}; C_{HCC_{ng,k}} = 0 \quad (10)$$

$$C_{ICL_{g,k}} = \Omega^* M_{g,k}; C_{ICL_{ng,k}} = 0 \quad (11)$$

$$C_{FEE_{g,k}} = INV; C_{FEE_{ng,k}} = 0 \quad (12)$$

$$C_{ITax_{j,k}} = \eta^* T_{j,k}, j=g,ng \quad (13)$$

$$C_{GTax_{j,k}} = LS^* + \eta'^* \delta T_{j,k}, j=g,ng \quad (14)$$

with:

- $\theta^*, \Omega^*, \eta^*, LS^*$ and η'^* being the respective solutions to Eq. (4), (5), (7), (8) and (9);
- $Y_{g,k} \equiv \sum_a [y_{g,k}(a) (1+\tau)^{a-24} / (1+r)^{a-24}]$) the present value of the stream of net income earned by graduate of type k , with $y_{g,k}(a)$ as her annual net income at age a ;
- a ranging from 24 to $19 + D$;
- $M_{g,k} \equiv \sum_a [\mu_{g,k}(a) / (1+r)^{a-24}]$ the sum of probabilities of payment for type k graduate, $\mu_{g,k}(a)$ being the probability that she pays at age a ;
- $T_{j,k} \equiv \sum_a [t_{j,k}(a) / (1+r)^{a-24}]$, with $t_{j,k}(a)$ as the expected income tax paid at age a either by graduates ($j=g$) or non graduates ($j=ng$);

It is worth having a closer look at Eq.10 and 11. Using the definition of θ^* (Eq.4) and Ω^* (Eq.5) we have indeed that

$$C_{HCC_k} = INV Y_{g,k} / Y_g \quad (15)$$

$$C_{ICL_k} = INV M_{g,k} / M_g \quad (16)$$

First, Eq.15 and 16 show that contributions under HCC and ICL for the *average* graduate are strictly equivalent, from an intertemporal point of view, to those made under FEE. Second, they show why HCC and ICL are bound to result in contributions that vary according to type k . Furthermore in Eq. 15 HCC contributions by each type k are seen to be dependent on only his relative cumulated income ($Y_{g,k}/Y_g$). Similarly, in Eq.16 ICL contributions are indexed on the relative likelihood of payment ($M_{g,k}/M_g$).

¹⁶ The notion of type and how it is built is developed in Section III.

A simple way to capture each instrument’s ability to link contributions to income is to divide the present value of contributions, for each type k , by the present value of their cumulated net income over the period.

$$\frac{\Pi_{m,j,k}}{C_{m,j,k}} = \frac{C_{m,j,k}}{Y_{j,k}} \quad (17)$$

$m = \text{HCC, ICL, FEE, ITAX, GTAX}$
 $j = g, ng$

Finally, it is also useful to stress that, from a distributional point of view, up-front fees (Eq.12) are equivalent to traditional loans. At age 24, the value of contributions made via a loan without income-contingency clause (no possibility to default) is strictly equal to INV , for every type k of graduates.

III. Model specification and data

We used OECD data (Table 1) to quantify the country-specific parameters used across all simulations: α (the share of graduates in the population) and δ (the share of income tax in the total tax receipts of the country).

Table 1: Country-specific parameters

Country	Duration of Master programs	Duration of Bachelor programs	Share of graduates in a cohort α	Share of Masters among graduates β	Share of income taxes receipts in total taxes δ
Belgium	5	3	0.38	0.47	0.63
Germany	5	3	0.22	0.62	0.64
United Kingdom	5	3	0.36	0.20	0.46

Source: OECD (2005)

National household surveys provide our principal data. For Belgium, we use the 2002 wave of the Panel Study on Belgian Households (PSBH). The datasets for the UK and Germany are the 2000 wave in CHER¹⁷. For representative samples of individuals (Table 2) these national surveys provide information on annual net and gross yearly¹⁸ earnings (and thus amount of income tax), participation to labour market, working hours, personal characteristics (age, gender and education) or place of residence. In

¹⁷ Consortium of Household Panels for European Socio-Economic Research, Luxembourg that get its data for Germany and the UK from the German Socio-Economic panel (GSOEP) and the British Household Panel Survey (BHPS).

¹⁸ PSBH and CHER always define earnings and income as ‘last year income’.

the models above, the key variables are the net income profiles ($y(a)$), taxation profiles ($t(a)$) as well as the probability of paying loan instalments ($\mu(a)$). In this section we estimate these profiles or parameters using data on income, employment rates and tax payments of both higher education graduates and non-graduates, separately for three European countries – the UK, Germany and Belgium. In the context of ICL, these data can be used to estimate the risk that a graduate's net annual income falls below a certain threshold and, consequently, exonerates her from paying her annual instalment.

PSBH (Belgium) provides information about *wages*, while CHER (Germany and UK) gives data on both gross and net *income* (earnings + replacement earnings). In the case of Belgium, in order to estimate the level of net (y) and gross income (gy) we add estimates of replacement earnings (*rep*) to net (w) or gross wages (gw). The former corresponds essentially to unemployment, health and disability or early-pension benefits¹⁹.

Individuals' type k is identified by combining information on gender, education (highest degree obtained by respondent), and region of residence. Education is a four-type variable : i) less than secondary ii) completed secondary iii) Bachelor graduates (3 years) and (iv) Master graduates (5 years)²⁰; while the residence variable is a dummy variable equal to 1 if people work in the presumably wealthier regions²¹ and zero if they live elsewhere. At the most disaggregate level the number of types is 16.

For each country, we then use individual income data to estimate income and taxation by age profiles. As a first step, individual net income (y_i) is used to estimate the OLS coefficients of a second order polynomial function of experience (18), separately for each type k as well as for more aggregate categories (i.e. all graduates ($j=g$) and non-graduates ($j=ng$), all types k pooled) :

$$y_{i,j,k} = v_{j,k} + \zeta_{j,k} e_{i,j,k} + \varsigma_{j,k}(e_{i,j,k})^2 + \varepsilon_{i,j,k} \quad (18)$$

where potential work experience (e_i) is defined as the number of years since (theoretical) graduation age (i.e., 17 for secondary school drop-outs, 19 for those with secondary education; 23 for higher education graduates)²².

¹⁹ A presentation of these estimations is given in the appendix.

²⁰ The first two categories of education form what we call the non-graduates, the latter, the graduates.

²¹ Flanders in Belgium, Länder in the former Western Republic of Germany, and Greater London for the UK.

²² Unfortunately, our data do not provide the actual labour market experience.

Table 2: Sample statistics for individual survey data. The sample size and breakdown by education level and gender are also given.

Country	Gender	Less than secondary	Secondary	Higher education (Bachelor*)	Higher Education (Master**)	Total
Belgium	Male	569	639	347	358	1,913
	Female	573	731	510	302	2,116
	All	1,142	1,370	857	660	4,029
Germany	Male	872	2,711	574	943	5,100
	Female	832	2,386	369	756	4,343
	All	1,704	5,097	943	1,699	9,443
United Kingdom	Male	850	316	829	418	2,413
	Female	1,012	292	705	358	2,367
	All	1,862	608	1,534	776	4,780

* non-university ** university

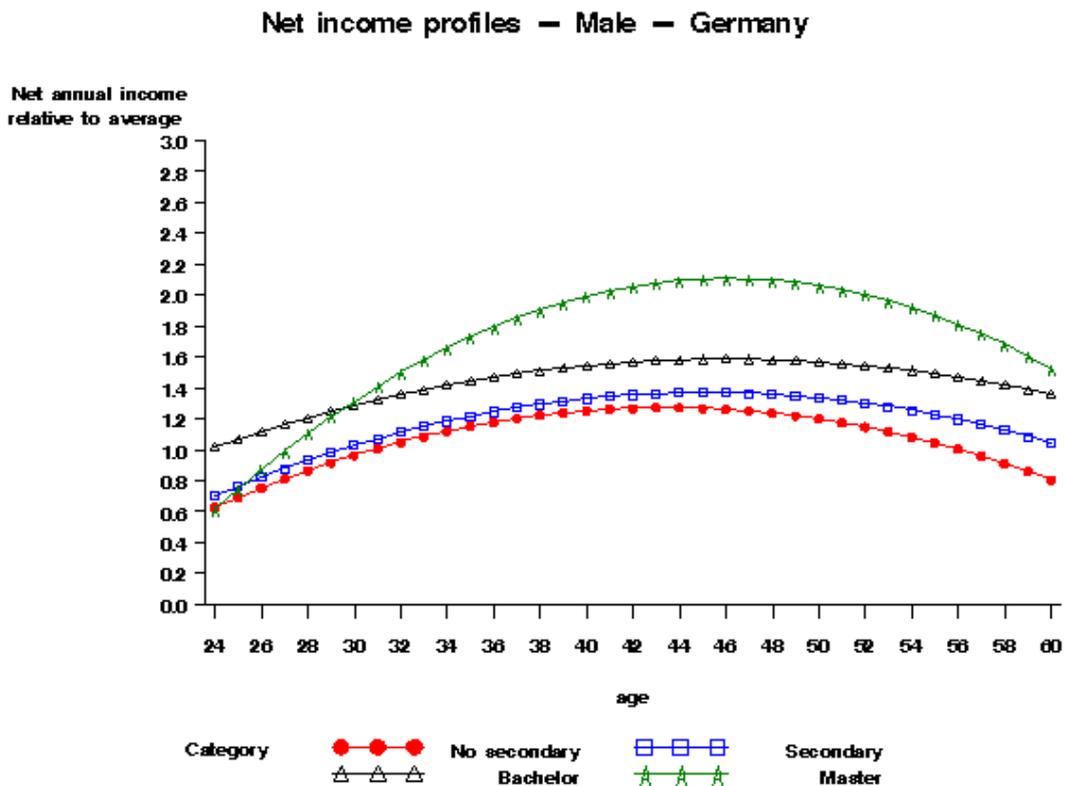
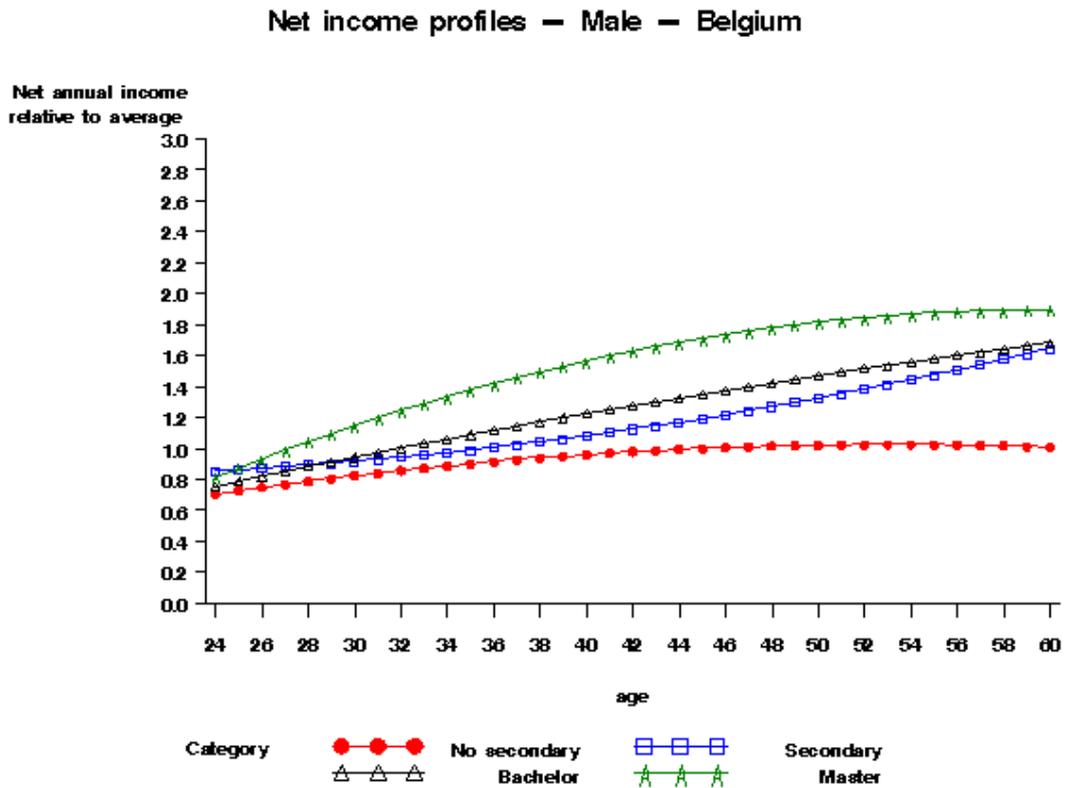
Source: CHER 2000 for Germany and the UK, PSBH 2000 for Belgium

Using (Eq. 18) OLS coefficients, we then compute net income by age²³ profiles ($y_{j,k}(a)$) for each type k , but also for more aggregate categories. Examples of these profiles are displayed in Graphs 1 and 2.

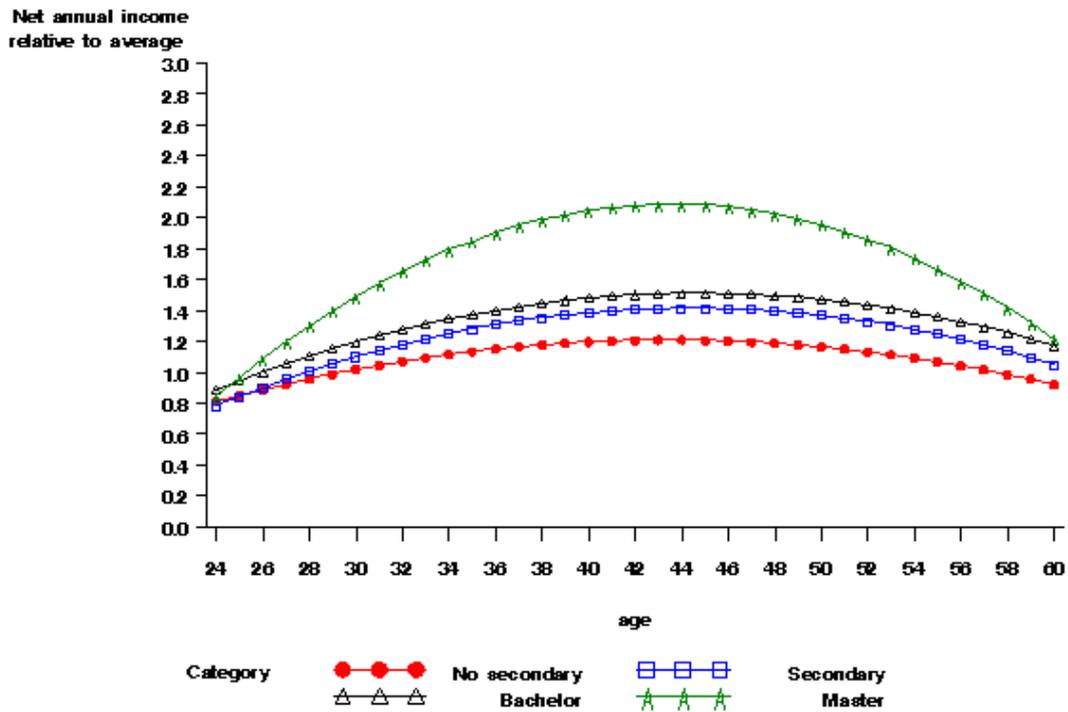
²³

The shift from income/experience to income/age function is immediate. We simply use the relation between age and potential labour experience (i.e. $a \equiv$ theoretical graduation age + e).

Graph 1: Annual net income fluctuations. Breakdown by degree. Male. All regions (1=total population, all ages, average income)

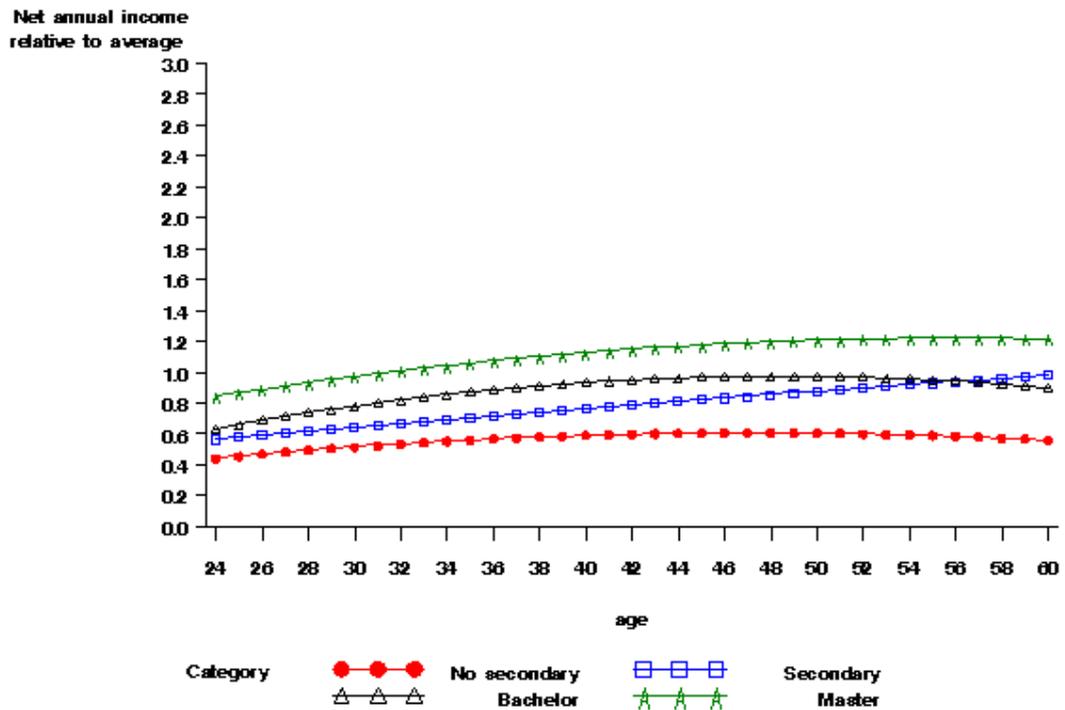


Net income profiles — Male — United Kindom

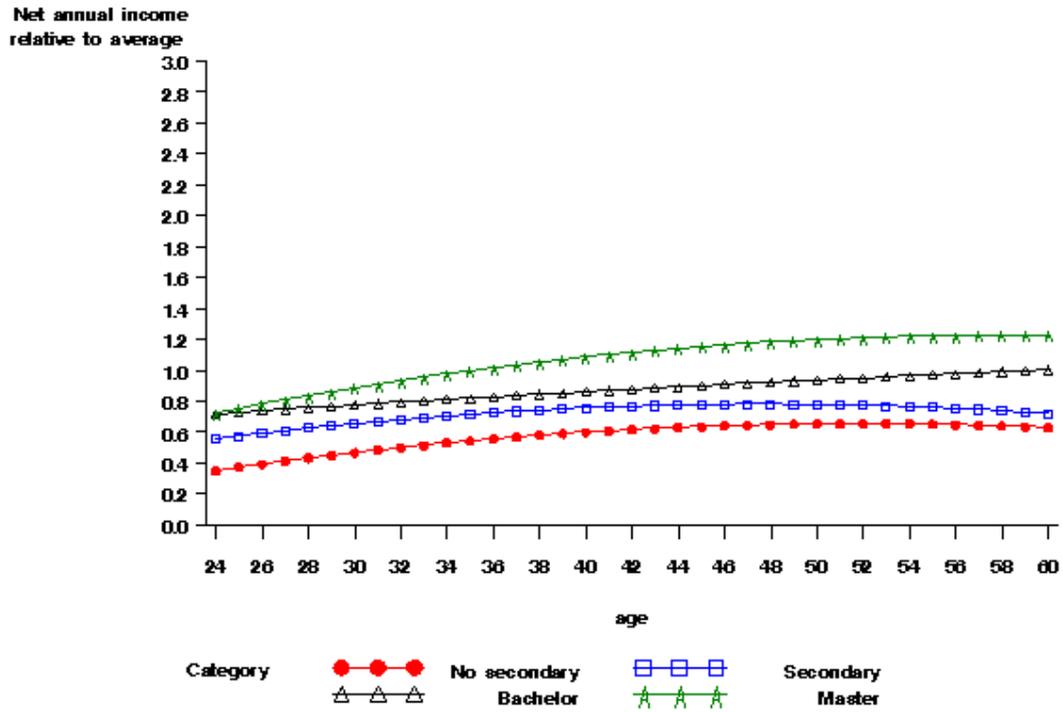


Graph 2: Annual net income functions/profiles. Breakdown by degree. Females. All regions (1=total population, all ages, average income)

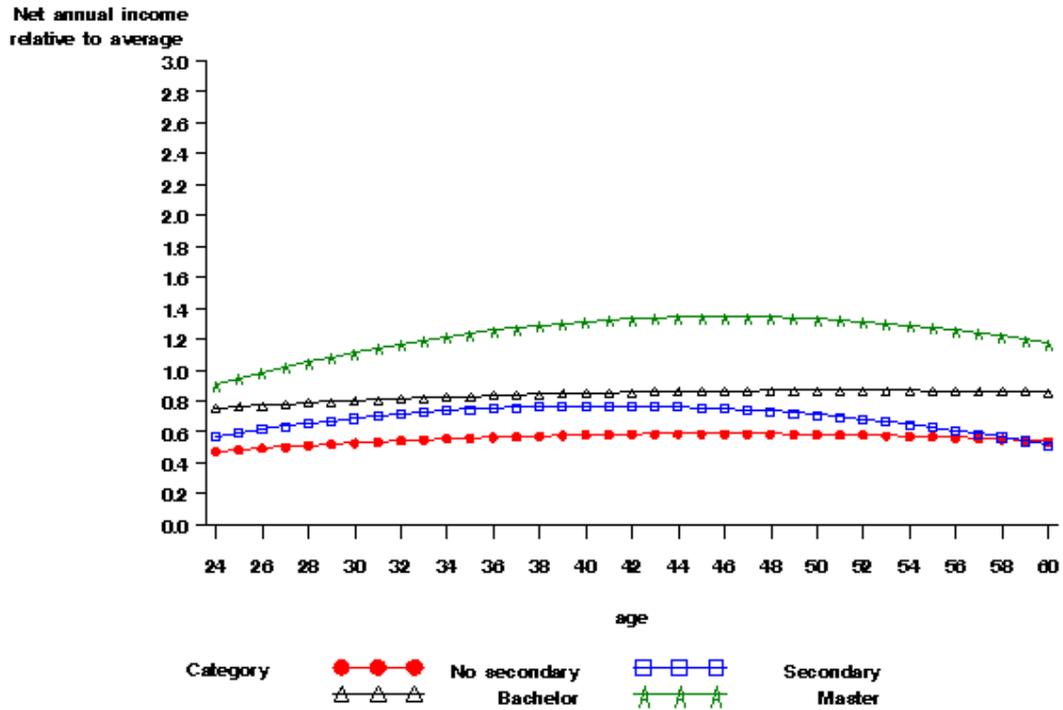
Net income profiles — Female — Belgium



Net income profiles – Female – Germany



Net income profiles – Female – United Kingdom



Next, we estimate the expected *gross* income and income tax by age profile. This is done in two stages. We first estimate the OLS coefficients of the gross income (gy_i) regressed on a second order polynomial of net income (y_i)²⁴. We then compute the gross income by age profiles as such ($gy_{j,k}(a)$) by applying these OLS coefficients to the values generated by net income by age profile ($y_{j,k}(a)$). Taxation profiles are simply generated by the difference between expected net and gross income ($t_{j,k}(a) \equiv gy_{j,k}(a) - y_{j,k}(a)$).

We use the net income/age profiles to compute net present value of cumulated income $Y_{j,k}$ (Eq. 1). Following Jacobs (2002), we assume a 2% average growth rate of the level of earnings (τ), reflecting the idea that technical progress generates productivity gains that somehow benefit all individuals²⁵. We also assume a discount rate (r) of 4%, equal to the historical return on risk-free European bonds. Results, displayed in Tables 3 and 4 suggest, within each country examined here, the presence of sizeable differences across types k of individuals even after progressive income taxation and transfers (Graph 3). They also clearly show, as expected from the human capital literature, that higher education graduates can expect much higher cumulated net income. These estimates also confirm the persistence of significant gender gaps.

To assess the incidence of income-contingency for the ICL case, we define for each individual graduate an age/experience-specific payment dummy ($Pay_{i,g,k}(e)$), by comparing her level income ($y_{i,g,k}(e)$) at a certain point of her career, with an experience-specific threshold $\Theta(e)$. The latter is defined as average net annual income amongst non-graduates with similar professional experience. In technical terms, it is equal to $\Theta(e) = v_{ng} + \zeta_{ng}e + \varsigma_{ng}e^2$, where v_{ng} , ζ_{ng} , ς_{ng} are obtained by estimating Eq.18 using all non-graduates ($j=ng$ and all k types pooled). In other words, higher education graduates should pay only if their annual net income is above the average income of non-graduates. This is a way of ensuring that contributions are levied on only the benefits obtained from achieving higher education²⁶. Each time annual net income is below the (experience-specific) no-payment threshold we conclude a default ($Pay_{i,g,k}=0$), and to normal payment of instalment Ω otherwise ($Pay_{i,g,k}=I$).

²⁴ This is done by pooling all available observations.

²⁵ In the case of Belgium or Germany, but also the Netherlands (Jacobs, 2002), this might be a lower bound. Long-term statistics of hourly wage growth suggest actual rates can reach 3%.

²⁶ M. Friedman's seminal work (Friedman, 1955) suggests that private contributions should be indexed to the fraction of income that can be imputed from higher education.

Table 3: Present value of lifetime (24-65) net income estimated at the age of 24 in EUR. Breakdown by country, education level, gender and region

Country	Gender	Region	Highest degree obtained			
			Less than secondary	Secondary	Higher Education (Bachelor)	Higher Education (Master)
Belgium	Female	Wallonia and Brussels	419,978	565,221	669,357	804,842
		Flanders	403,004	578,869	625,045	832,310
	Male	Wallonia and Brussels	690,404	888,250	847,211	1,096,633
		Flanders	676,380	848,462	962,819	1,121,024
Germany	Female	East	516,126	599,269	682,692	849,727
		West	468,835	605,562	749,238	901,750
	Male	East	864,345	923,025	1,220,946	1,365,637
		West	873,676	981,504	1,188,522	1,373,691
United Kingdom	Female	All except G. London	454,893	544,194	663,286	968,123
		Greater London	449,160	566,464	743,815	1,048,364
	Male	All except G. London	864,519	996,717	1,063,618	1,369,549
		Greater London	884,847	934,262	1,063,980	1,236,351

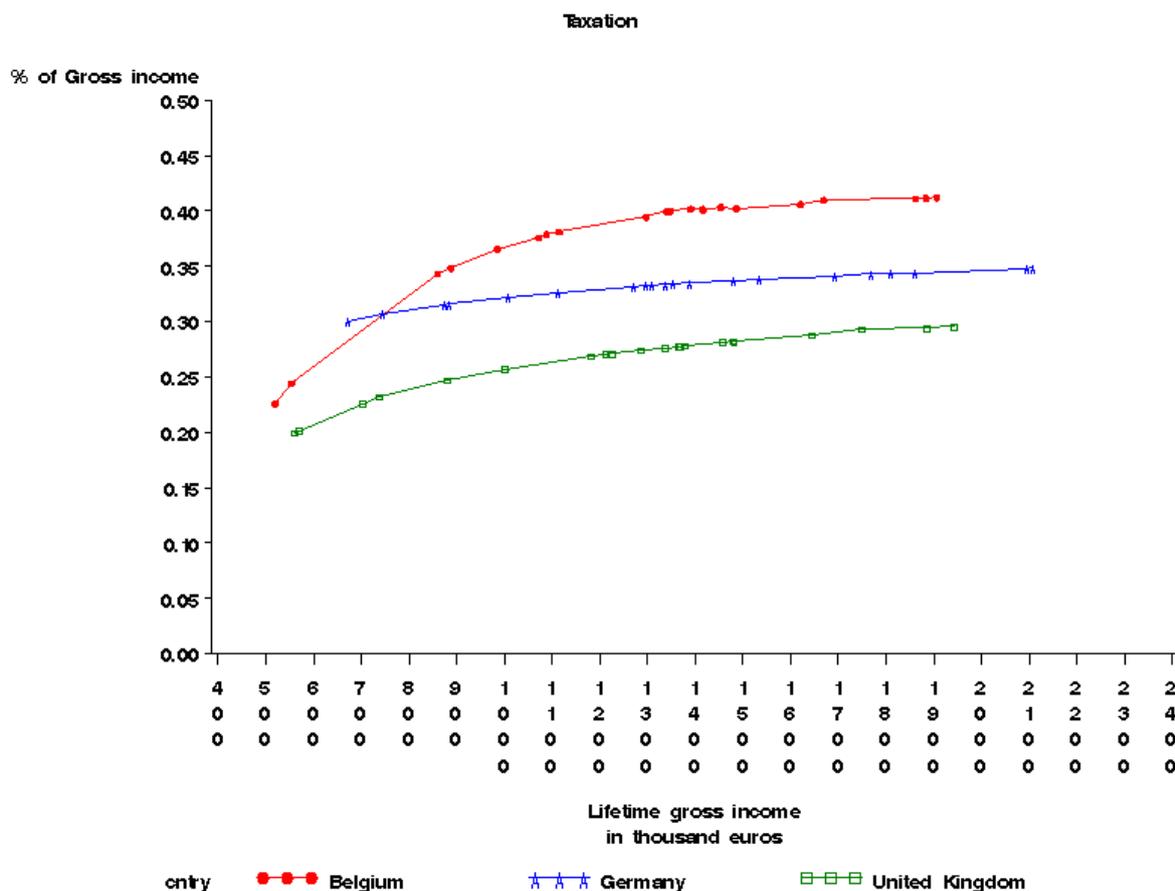
Assumptions: $\tau=0.02$. $r=0.04$

Table 4: Relative present value of lifetime (24-65) net income estimated at the age of 24. Breakdown by education level, gender and region (1= category with maximal lifetime net earnings)

Country	Gender	Region	Highest degree obtained			
			Less than secondary	Secondary	Higher Education (Bachelor)	Higher Education (Master)
Belgium	Female	Wallonia and Brussels	0.37	0.50	0.60	0.72
		Flanders	0.36	0.52	0.56	0.74
	Male	Wallonia and Brussels	0.62	0.79	0.76	0.98
		Flanders	0.60	0.76	0.86	1.00
Germany	Female	East	0.38	0.44	0.50	0.62
		West	0.34	0.44	0.55	0.66
	Male	East	0.63	0.67	0.89	0.99
		West	0.64	0.71	0.87	1.00
United Kingdom	Female	All except G London	0.33	0.40	0.48	0.71
		Greater London	0.33	0.41	0.54	0.77
	Male	All except G London	0.63	0.73	0.78	1.00
		Greater London	0.65	0.68	0.78	0.90

Assumptions: $\tau=0.02$. $r=0.04$

Graph 3: Current average income tax (ie. taxes as % of gross income) according to level of gross income (i.e. tax progressivity)



The specification used for the probability of payment is a logistic function, with a third order polynomial function in potential experience as the argument. Again, the estimation is run separately for each type k as well as for more aggregate categories (i.e. all graduates ($j=g$) and non-graduates ($j=ng$)).

$$\mu_{i,j,k} \equiv Prob(Pay_{i,j,k}=1|e_{i,j,k}) = 1/[1+exp(-(\rho_{j,k} + \zeta_{j,k}e_{i,j,k} + \sigma_{j,k}(e_{i,j,k})^2 + \xi_{j,k}(e_{i,j,k})^3))] \quad (19)$$

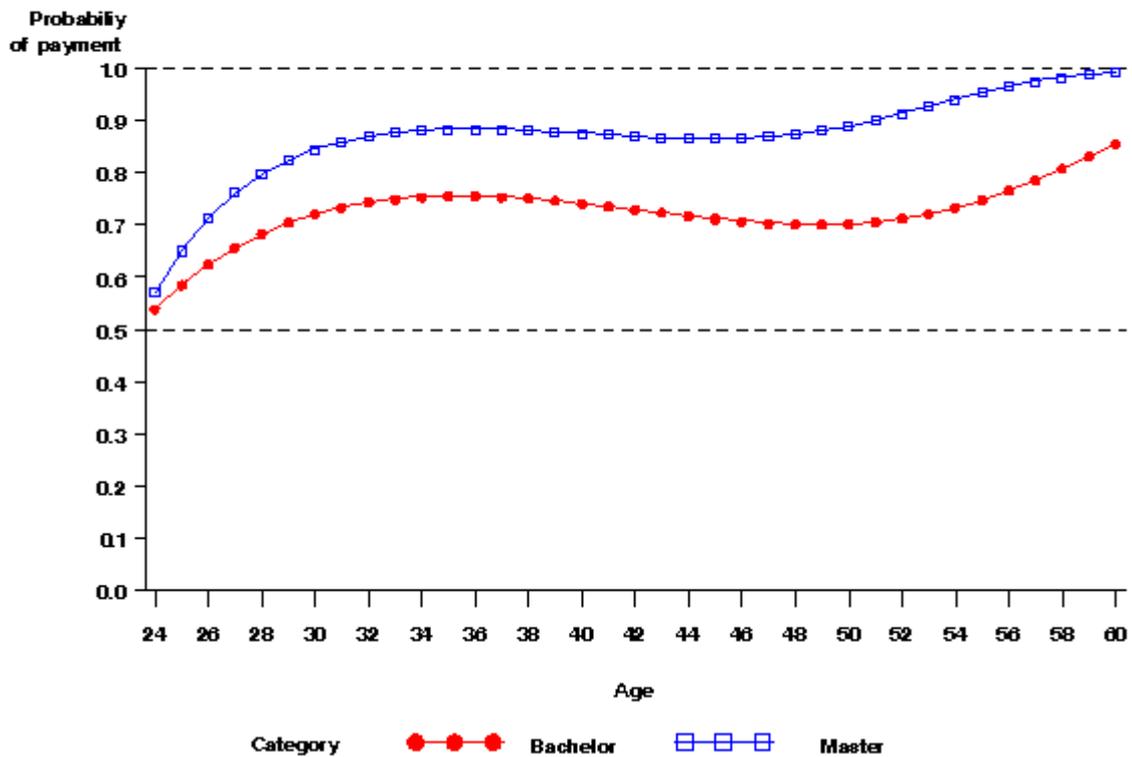
Estimated probability of payment according to age²⁷ ($u_{j,k}(a)$) are plotted in Graph 4 for both Bachelors and Masters graduates. The highest probability of payment (or lowest risk of default) is observed amongst Masters graduates. Graph 4 clearly suggests that in Belgium and the UK, the insurance effect of ICL is likely to be more important for students who attend Bachelor programs. This feature does not emerge in the case of Germany. This graph also indicates that the probability of payment varies with age. In Belgium, and to a lesser extent in Germany, it rises between the age of 24 and 30, particularly for students who graduate from Masters programs. This could be due to

²⁷ Again, the shift from income/experience to income/age function is immediate (i.e. $a \equiv$ theoretical graduation age + e).

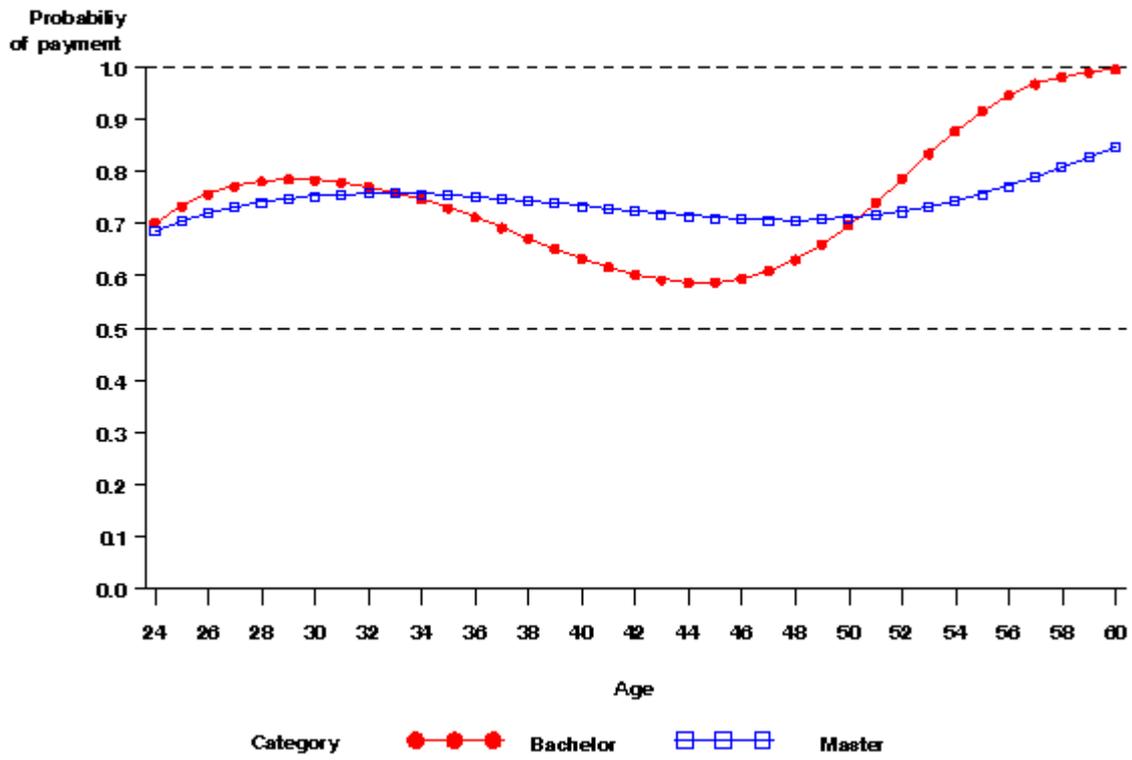
the fact that, in these two countries, graduates on the labour market take longer to realise their income potential. Between ages 30 and 45, in every country considered, the probability of payment declines moderately. However, it rises quite dramatically beyond age 50. A possible explanation for this could be the growing employment gap between graduates and non-graduates, particularly the well-known concentration of early retirement amongst those less educated.

Graph 4: The probability that higher education graduates pay their income-contingent instalment according to age

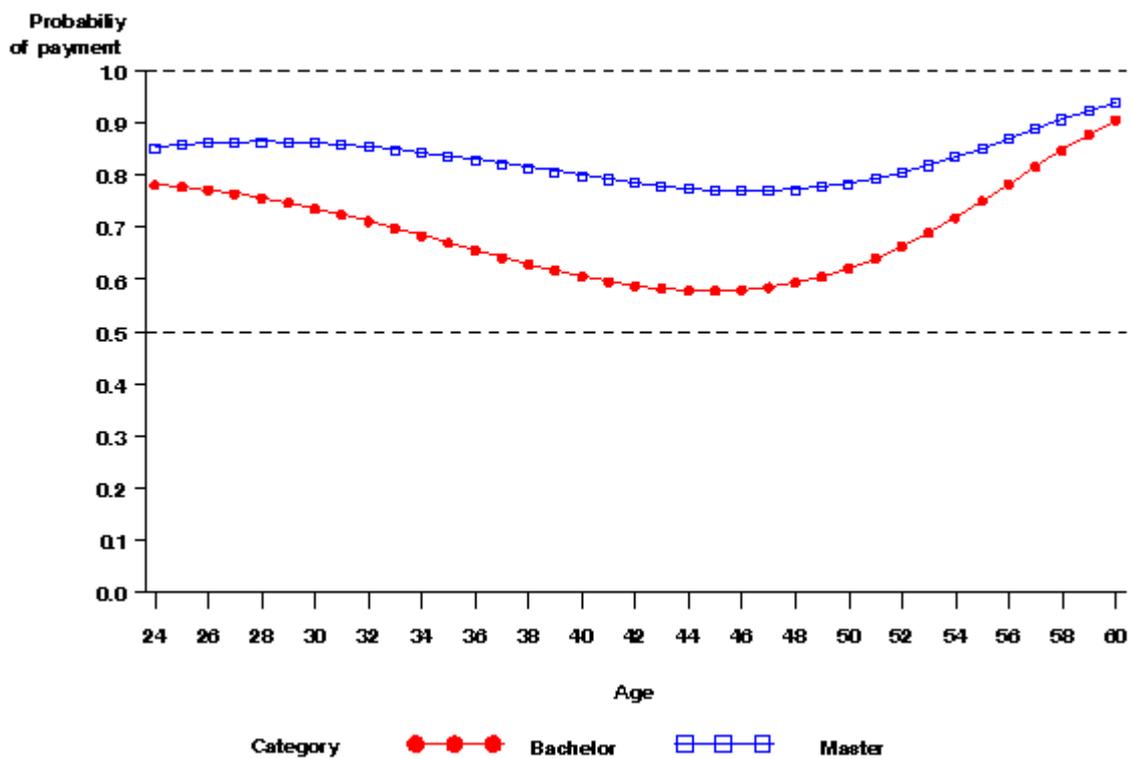
Probability of payment — Belgium



Probability of payment – Germany



Probability of payment – United Kingdom



IV. Fees and the private rate of return

The financial profitability of higher education attendance for the *average* graduate, and its sensitivity to enhanced tuition fees is our first result. We compute the value of the private rate of return (*PRR* Eq.1) for values of investment (*INV*) ranging from 0€²⁸ to 20,000€. The income for student jobs parameter ($1-\chi$) is set to 0.9 meaning that these jobs generate 10% of the annual income of a non-graduate²⁹. Our results are displayed in Table 5. Here we compare the cumulated net income of the average graduate (Y_g) with that of someone who completed upper secondary education (Y_{ng}).

Table 5 shows significant differences across countries in terms of private rate of return (*PRR*). Belgium is the country with the lowest level of private profitability. More importantly, however, Table 5 states that the level of *PRR* is relatively unaffected by increases to private contributions. Raising the private cumulated contribution to higher education costs (C_g) by 20,000 €, in Belgium, would, at most³⁰, reduce the *PRR* by less than 1 percentage point (from 4.66% to 3.87%). In Germany and the UK we observe similar reductions (8.85% to 8.17%. and 6.79% to 5.94%, respectively).

²⁸ The status quo.

²⁹ This is a fairly conservative assumption according to the EU literature (de la Fuente, 2003).

³⁰ Remember that these simulations ignore the possible positive effect of spending on subsequent income.

Table 5: Sensitivity of the marginal (i.e. per year of study) private rate of return (*PRR*) to different values of human capital investment (*INV*)*– Reference = lifetime income of individuals (males or females) with upper-secondary degree

Cumulated investment (<i>INV</i>) in EUR	Belgium	Germany	UK
0 €	0.047	0.088	0.068
1,000 €	0.046	0.088	0.068
2,000 €	0.046	0.088	0.067
3,000 €	0.045	0.087	0.067
4,000 €	0.045	0.087	0.066
5,000 €	0.045	0.087	0.066
6,000 €	0.044	0.086	0.065
7,000 €	0.044	0.086	0.065
8,000 €	0.043	0.086	0.065
9,000 €	0.043	0.085	0.064
10,000 €	0.043	0.085	0.064
11,000 €	0.042	0.085	0.063
12,000 €	0.042	0.084	0.063
13,000 €	0.041	0.084	0.062
14,000 €	0.041	0.084	0.062
15,000 €	0.041	0.083	0.062
16,000 €	0.040	0.083	0.061
17,000 €	0.040	0.083	0.061
18,000 €	0.039	0.082	0.060
19,000 €	0.039	0.082	0.060
20,000 €	0.039	0.082	0.059

Given Eq. 15 and 16, these values correctly reflect the sensitivity *PRR* to higher private contribution of for FEE, ICL and HCC when considering the average graduate.

V. Income-contingent contributions and distributional issues

Two salient points can be drawn from the discussion in Section III. Prospective students might face liquidity constraints, and, as showed in Tables 2 and 3, considerable income heterogeneity exists amongst graduates. Thus we might expect ICL and HCC to produce completely different incentives and degrees of vertical redistribution than up front fees (FEE) presented in Section IV, even if the latter are automatically transformed into mortgage-like loans.

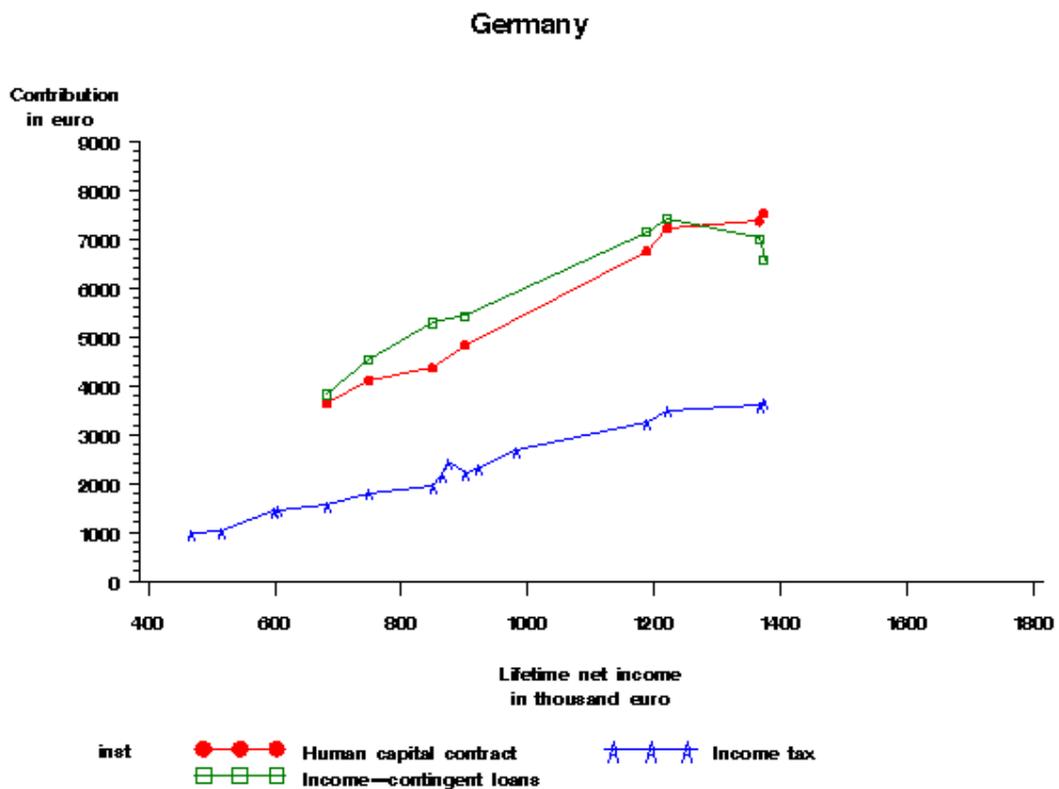
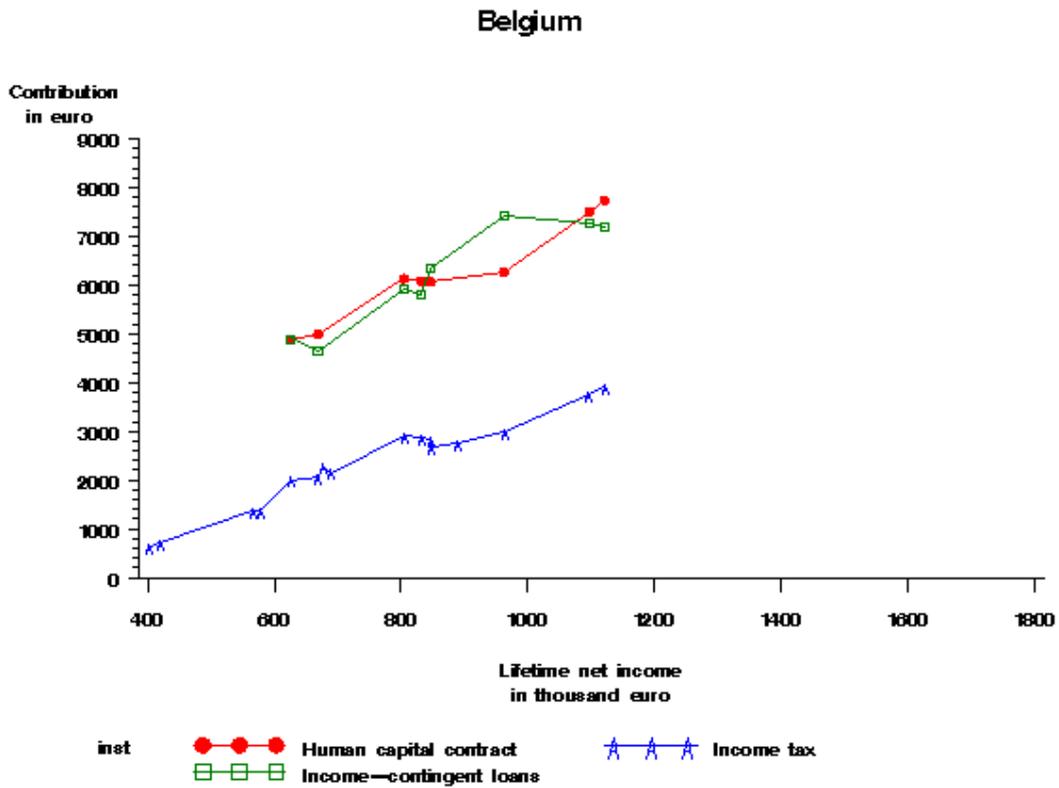
We need to compute contributions C (Eq. 10-14) for each type k of individual to determine how individuals with different cumulated income prospects are likely to be treated, and how their private rate of return is likely to be affected. Only this will tell how various instruments perform, regarding their capacity to account for the ability to pay of individuals, and whether they uniformly maintain the PRR at the level displayed in Table 5.

In all simulations presented below, the amount of money invested (INV) at the age of 18 is arbitrarily set to 5,000 €³¹ (i.e., 6,083 EUR at the age of 24). We account for the fact that the proportion of a cohort that is likely to graduate, α , varies significantly across the three countries examined here (Table 4). The same holds for the share of tax receipts δ that is likely to come from progressive income taxation. The levels of contributions by instrument ($C_{m,j,k}$ Eq. 10-14) (in EUR at the age of 24) are reported on the vertical axis of Graph 5, whilst the horizontal axis corresponds to the cumulated level of net income for each type of individual considered ($Y_{j,k}$)

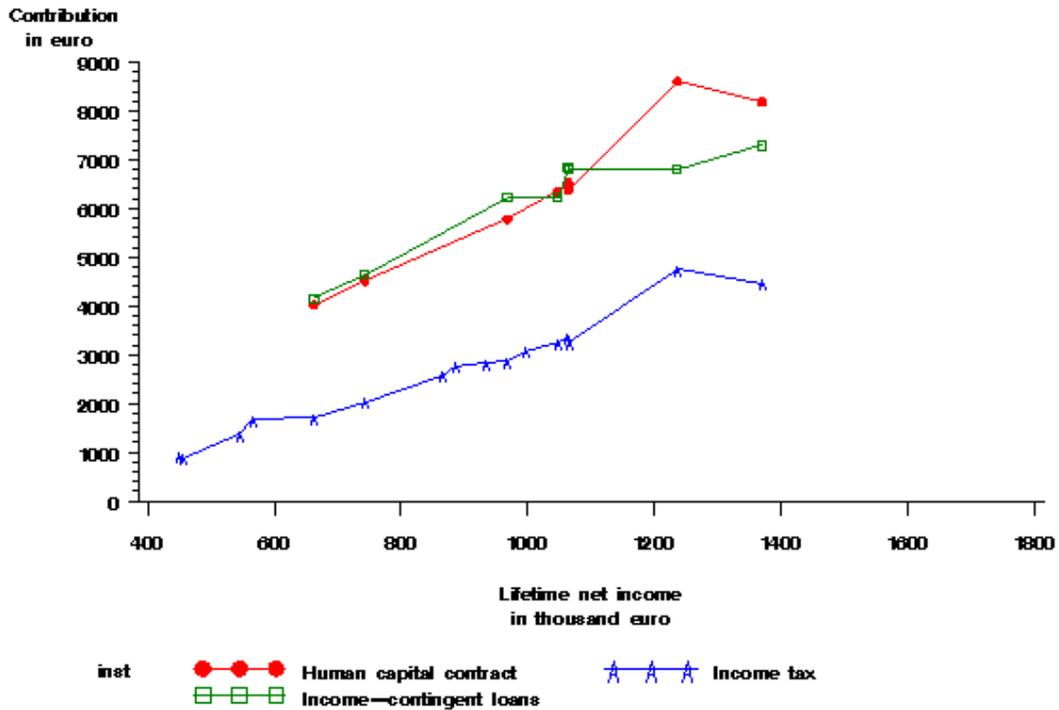
The first interesting result is the comparison between ICL and HCC. Both instruments ensure that those facing lower cumulated income prospects contribute significantly less. Furthermore, the distinction between these income-contingent instruments and the up-front fee (FEE) regime is particularly striking. In the case of HCC, contributions range from 4,000 € to slightly more than 8,000 €. We observe similar figures for ICL where all students invest/borrow the same amount of 5,000 € (i.e., 6,083 € at the age of 24). Despite minor pattern differences across countries, there is broad evidence that income-contingent, private instruments do account for lifetime ability to pay.

³¹ 5,000€ represent 10% (Germany) to 13% (Belgium, the UK) of the 2002 cumulative expenditure per student over the average duration of tertiary studies (OECD, 2004)

**Graph 5: Present value of contribution (C_k) for a 5,000 € investment, according to the present value of income (Y_k) over the duration of the contract ($D=25$).
Breakdown by instrument of higher education finance**



United Kingdom



Graph 6 is based on the same results as Graph 5. Values on the horizontal axis correspond to the income of the various types of individuals ($Y_{j,k}$). Unlike Graph 5, contributions on the vertical axis are now expressed in percentage of total lifetime net income ($II_{m_{j,k}} = C_{m_{j,k}}/Y_{j,k}$ Eq.17).

Expressed in relative terms, the contributions required by HCC and ICL contracts worth 5,000 € represent a fairly small fraction of lifetime net income (between 0.48% for Germany and 0.78% for Belgium). Although, these percentages are logically higher than those graduates would pay as taxpayers, were higher education refinanced via taxation (ITAX and GTAX).

The shape of the curves on Graph 6 tells us whether contributions are indexed on lifetime income or ability to pay. Graph 6 shows whether the private rate of return (PRR) displayed in Table 5 is likely to be valid for all types k of individuals, and, consequently, whether financial incentives could be preserved uniformly across the distribution of income. A flat curve (HCC, ICL) would indicate that the instrument is capable of indexing contributions to income. A rising (GTAX) or declining curve (FEE) likewise shows no such indexing.

An important result, visible in Graph 6, is thus that ICL and HCC do guarantee that all type k graduates face identical reductions of PRR . If we combine this particular result with those of Section IV, we can conclude that increasing individuals' contribution to higher education costs – provided it is done via ICL or HCC – does not significantly affect the private rate of return. This holds not only for the average graduate but also for each type k .

As for vertical redistribution, a flat curve is indicative of the ‘proportionality’ (the contribution is equal to the same fraction of income for each type k (Eq.12)). A declining curve suggests ‘regressivity’ (a declining average contribution) whilst a rising curve would be synonymous with ‘progressivity’ (a rising average contribution). Thus, both HCC and ICL satisfy the principle of ‘proportionality’. Notably in Belgium, finance by income taxation (ITAX) is ‘progressive’. We see, however, that more general forms of taxation (GTAX), particularly in Germany and the UK, could be ‘regressive’. Finally, it should be noted that up-front fees (FEE)³², in each country considered, appear as very ‘regressive’ instruments.

When comparing the two income-contingent instruments (Graph 6), we observe that HCC does not dramatically dominate ICL in its ability to index contributions to income. By definition, HCC is a scheme where contributions are strictly proportional to income (Eq. 4). By contrast, ICL, as it is modelled here, results in discontinuous contributions: below a predefined threshold, a graduate's contribution is nil, whilst above that threshold it amounts to a lump sum (Ω). We did not anticipate that ICL could make wealthier graduates contribute as much (in relative terms) as their poorer peers.

Analytically, this result means that lifetime average probabilities of paying (defaulting on) ICL, estimated for each (broad) type of graduates k are closely linked to income pattern. By dividing both terms in Eq.11 by $Y_{j,k}$ we have $C_{ICL_{j,k}}/Y_{j,k} = \Omega M_{j,k}/Y_{j,k}$, where $M_{j,k}$ is the (discounted) average probability that income is above the threshold Θ (Eq.5). Hence, if $M_{j,k}/Y_{j,k}$ is relatively constant across all types of graduates, ICL generates relative contributions that are constant.

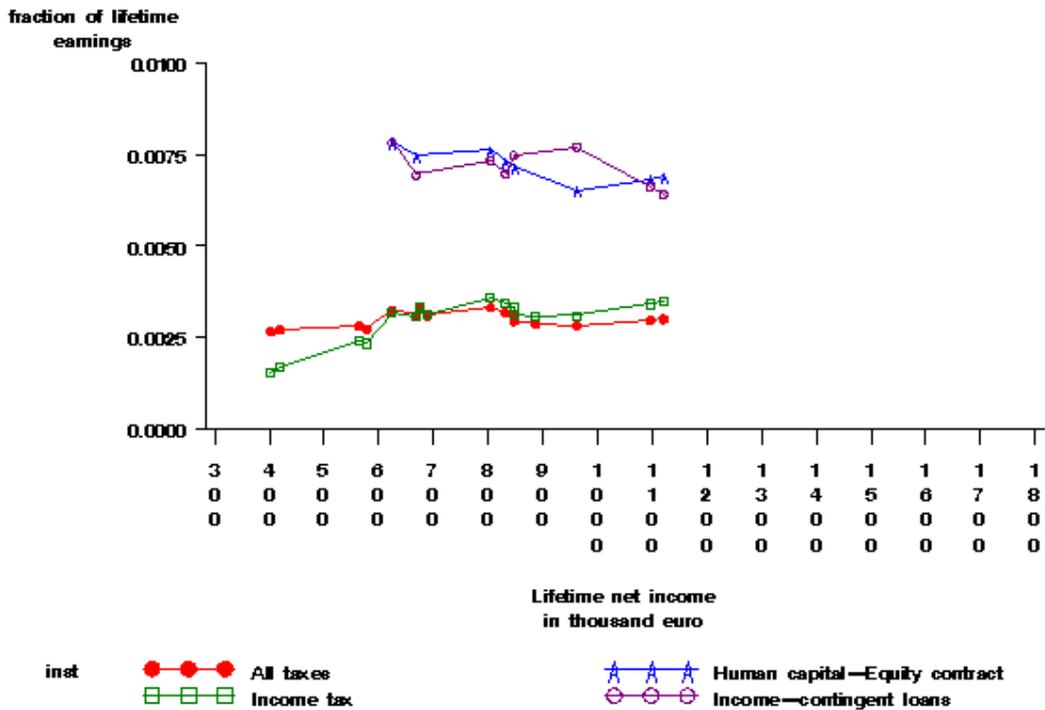
The reason we verify this condition is threefold. First, we retained a relatively high income threshold (i.e. average income amongst non-graduates). It is obvious that lower values of Θ would increase the average probability of payment M to the point it reaches its maximum above a certain level of income; with the consequence that relative contributions would decline³³. The second reason is more empirical. In countries such as Belgium, Germany and the UK there are downward fluctuations in income, even amongst successful graduates. Occasionally, this results in graduates earning less than non-graduates (i.e. M is not equal to its maximum). Third, although we make considerable efforts in this paper to account for the heterogeneity amongst graduates, our categorisation remains coarse (males vs. females, Masters vs. Bachelors). What we fundamentally detect is the capacity of ICL to account for inter-type, but not inter-individual, income differences. Working with the full distribution of income would probably produce results more in line with what we anticipated. Indeed, the probability of graduates who form the very top percentiles of the income distribution ‘crossing’ the threshold line tends to zero. Hence, different values of Y

³² They can be considered equivalent to conventional loans from a distributional point of view.

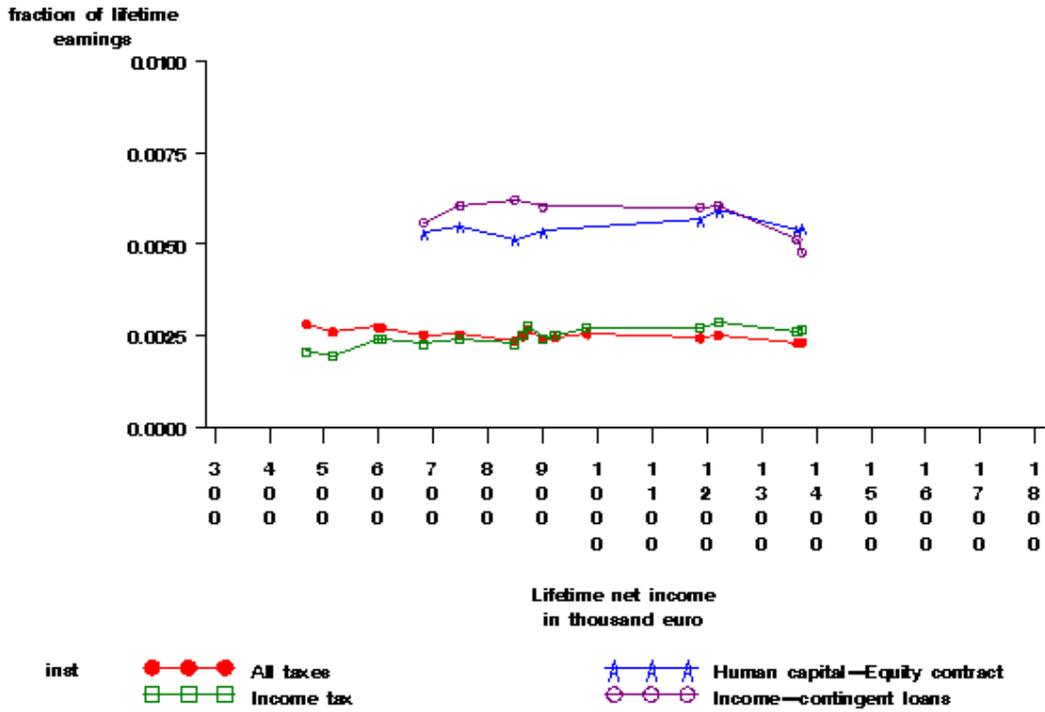
³³ We discuss this point further in the next section.

could lead to identical values of M , with the consequence that M/Y does not remain constant.

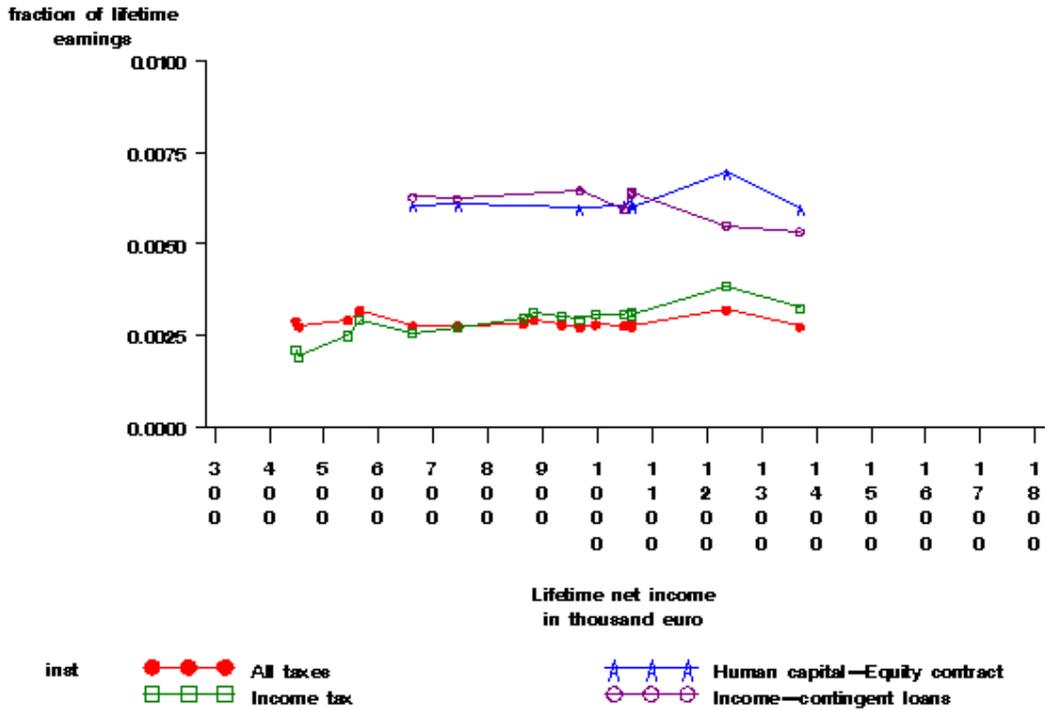
**Graph 6: Present value of contribution for a 5,000 € investment in percentage of net income (C_k/Y_k), according to the present value of income (Y_k) over the duration of the contract ($D=25$); breakdown by instrument of higher education finance
Belgium**



Germany



United Kingdom



VI. Income-contingency as an insurance mechanism

Providing students with income-contingency is certainly a way to avoid distorting private rates of return (*PRR*) between types *k* of graduates. It is simultaneously a way to achieve vertical justice. It is also equivalent to insuring their human capital, partially³⁴. From a political-economy perspective, income-contingency raises three interrelated issues:

- i) the size of the resulting insurance costs
- ii) the importance of implicit transfers³⁵ between (easy to identify) categories of students and
- iii) the various ways of coping with the resulting adverse selection problems.

The cost of income-contingency

Our analytical framework can be used to quantify the cost of income-contingent instruments. The term cost, here, points to the additional resources that (somehow) need to be spent to offer income-contingency to graduates. In this sense, the exercise is equivalent to that of computing the risk premium due to payment default. For example, Eq. 5 describing ICL can be solved with and without using the probability of payment weighing factor μ . So far, we have considered the case with a risk of non-payment ($\mu < 1$) and that gave us a plausible value of the annual instalments with income-contingency (Ω). Assuming the absence of payment default $\mu = 1$, we can estimate the risk-free instalment (Ω^f) that could be requested from graduates. The ratio between the two instalments ($\Omega/\Omega^f = 1 + rp$, with $rp > 1$) reflects the cost of income contingency.

Table 6: Finance by Income-Contingent Loans (ICL); the cost of ensuring income-contingency

Country	Current value of a 1000 € tranche investment* $INV (1+r)^5$	Yearly instalment with risk of default Ω	Yearly instalment with no risk of default Ω^f	Risk premium $\Omega/\Omega^f - 1$	Interest rate charged with no risk of default a	Interest rate charged with risk of default b	Interest rate risk premium b-a
Belgium	1,217	110.89	83.39	0.33	4.00%	6.59%	2.59%
Germany	1,217	114.04	83.39	0.37	4.00%	6.80%	2.80%
UK	1,217	110.39	83.39	0.32	4.00%	6.55%	2.55%

* $D=25$ years

³⁴ Full insurance protection would compensate graduates for the loss of earnings by providing replacement income.

³⁵ The logical consequence of payments indexed on ability to pay, highlighted in Section V.

Our computations (Table 6) suggest a value for rp ranging from 0.32 (UK) to 0.37 (Germany). Thus Income-contingency costs on average up to 0.37 € per EUR invested. An alternative measure is provided by the interest rate risk premium (last column of Table 6). We estimate it using an internal rate of return (IRR) algorithm. This risk premium ranges from 2.55 (UK) to 2.80 (Germany) percentage points. The tentative conclusion is that income-contingency – as specified here with all the distributional benefits it entails (uniform PRR across types k , vertical justice) – is relatively expensive especially when applied to large and heterogeneous populations of students. One could argue that a lower income threshold would reduce the cost of income-contingency. However, this would also induce a countervailing effect. ICL would be closer to up-front fees or ordinary loans, implying that the distributional properties mentioned above, and highlighted in Graph 6, would vanish *pro rata* the lowering of the threshold.

Risk pooling, implicit transfers and adverse selection

One option to provide income-contingency, and avoid high non-take up rates amongst risk-averse students, would be to pool the cost of default amongst students. This is a system where the risk of default and its cost are shared amongst graduates. This principle of pooling was used for the Tuition Postponement Option at Yale University – an ICL scheme – in the early 1970s. It has been widely viewed as inefficient. Its main disadvantage is to put the borrowers at some risk, depending on the likely future income capacity of the borrowing class. More particularly, many potential high earners choose to exit the income-contingent repayment scheme to avoid the risk of getting into a cohort with too many potential low earners. This is a typical illustration of an adverse selection problem.

In order to highlight the potential importance of adverse selection in the European context we compute the implicit transfers taking place under risk-pooling across a large (and diversified) set of students³⁶. Computations reported in Table 7 suggest that, in the case of HCC, the cost for Masters program graduates to be pooled with Bachelors program individuals in Germany represents only a 2% increase in the percentage points of income the lender is likely to request (θ). But this is relatively low compared to Belgium's figure of 13% and the UK's, 19%. Hence, it seems clear that risk-pooling can imply significant redistribution from those with high lifetime income to those with lower income. Estimates in Table 7 reveal that an HCC scheme implemented with Masters-only graduates³⁷ is less expensive than a scheme including Bachelors. This potential reduction of cost could be sufficient to trigger a secession as low risk graduates would be tempted to form a separate scheme synonymous with lower contributions.

³⁶ Remember that we have assumed so far that the various instruments apply to all students.

³⁷ Mainly university programs

Coping with Adverse selection: a menu-based approach

Separation

An option to avoid the negative effect of pooling is to discriminate amongst risk categories. In the context of higher education finance, this would imply investing less money in the education of riskier students. In the case of an HCC, this means imposing that investment (INV) by (say) Bachelors students represents only a fraction $0 < \lambda < 1$ of the one made by their peers. Adverse selection will be avoided when this fraction λ will be such that pooled contribution (θ^p) is equal to the one faced by Masters program graduates in a non-pooling context (θ_{Master}). Using the relationship $INV = \theta Y$ (Eq. 4), we can thus identify λ , by solving:

$$\theta^p \equiv [\beta \theta_{Master} Y_{Master} + (1-\beta) \lambda \theta_{Bachelor} Y_{Bachelor}] / Y^p = \theta_{Master} \quad (20)$$

with:

- $0 < \lambda < 1$
- β being the proportion of Masters graduates in the total population of graduates;
- $Y^p = \beta Y_{Master} + (1-\beta) Y_{Bachelor}$

It is then immediate³⁸ to show that

$$\lambda = \theta_{Master} / \theta_{Bachelor} \quad (21)$$

Results in the last column of Table 7 reveal that the typical HCC investment on a Bachelors student should be equal to a fraction λ equal to 74% (UK), 79% (Belgium), and 90% (Germany) of that of a Masters student. Interestingly, this reduction factor is inferior to what we would expect in systems with uniform annual fees across higher education institutions but *varying lengths* of programs. Considering that Bachelors programs last 3 years, whilst it takes 5 years to complete a Masters, we should end up with a loan size ratio of 3/5 (i.e. 60%). In other words, pooling Bachelors and Masters students, with uniform annual fees (e.g. 1,000 EUR), would precipitate the need for investment size adjustments to counteract adverse selection. This remedy might also be applied across different subject specialisations. To avoid adverse selection induced by having higher-earning graduates (e.g. Engineering majors) subsidising the non-payment of a lower-earning graduates (Fine Arts majors), the latter should simply borrow less money.

³⁸ $\beta \theta_{Master} Y_{Master} + (1-\beta) \lambda \theta_{Bachelor} Y_{Bachelor} = \theta_{Master} Y^p$. Using the definition of Y^p we get $\beta \theta_{Master} Y_{Master} + (1-\beta) \lambda \theta_{Bachelor} Y_{Bachelor} = \beta \theta_{Master} Y_{Master} + (1-\beta) \theta_{Master} Y_{Bachelor}$. *Eliminating equivalent expressions on both sides, and isolating λ , we eventually obtain $\lambda = \theta_{Master} / \theta_{Bachelor}$*

Table 7: Human capital contracts (HCC): 5,000 € investment; percentage of income over the duration of contract (24-44) committed depending on degree of pooling amongst graduates

Country	Category (k)		Percentage of net annual income committed* (θ)	Cost of pooling a/b	Adjustment factor to avoid adverse selection $\lambda = \theta_{Master}/\theta_{Bachelor}$:
Belgium	All graduates pooled	a	1.35%		
	Graduate Master	b	1.20%	1.13	0.79
	Graduates Bachelor	c	1.51%		
Germany	All graduates pooled	a	0.98%		
	Graduate Master	b	0.97%	1.02	0.90
	Graduates Bachelor	c	1.08%		
UK	All graduates pooled	a	1.04%		
	Graduate Master	b	0.87%	1.19	0.74
	Graduates Bachelor	c	1.17%		

* Duration of contract (D)=25 years

Considering the consequence of pooling *male* and *female* Master graduates, Table 8 reveals that in Belgium, female students should be allowed to borrow only 80% of what their male peers borrow/invest. The fraction is lower in the UK (72%) and Germany (63%). Whilst quite similar in magnitude to those reported above, these results shed a completely different light on what can be achieved via separation of risk categories. In fact, Table 8 helps us identify the limits of that strategy. If differentiating (cumulated) tuition fees between Bachelors and Masters students is largely perceived as logical and legitimate, differences of treatment between other categories of students is strongly opposed, or simply illegal. Gender discrimination is prohibited by European law (Gender Discrimination Act).

Table 8: Human capital contracts (HCC): 5,000 € investment; percentage of income over the duration of contract (24-44) committed depending on degree of pooling amongst male and female Masters graduates

Country	Category (k)		Percentage of net annual income committed* (θ)	Cost of pooling a/c	Adjustment factor to avoid adverse selection $\lambda = \theta_{Male}/\theta_{Female}$
	Male and female pooled	a	1.20%		
Belgium	Female only	b	1.35%	1.11	0.80
	Male only	c	1.08%		
	Male and female pooled	a	0.97%		
Germany	Female only	b	1.26%	1.21	0.63
	Male only	c	0.80%		
	Male and female pooled	a	0.87%		
United Kingdom	Female only	b	1.05%	1.15	0.72
	Male only	c	0.76%		

* Duration of contract (D)=25 years

Risk-shifting

An alternative approach may consist of asking society to compensate for the low-earning group (here women), rather than shifting the cost of income-contingency onto the rest of the cohort (males). This is the risk shifting solution that most countries with ICL or HCC schemes, have implemented thus far (Palacios, 2004). Whilst full risk-shifting is clearly an efficient answer to adverse selection, our simulations presented in Table 6 indicate that the cost to the taxpayer would be non-negligible. In the EU context, as indicated by Barr (2001, 2002), full risk shifting could lead public watchdogs³⁹ to classify student contracts as public debt.

³⁹ Eurostat for the EU member states.

Compulsory pooling

Another solution to mitigate the adverse selection problem, in the context of full or partial risk-pooling, is to impose participation in the income-contingent scheme. Borrowing money to finance higher education would be mandatory. This would clearly require the involvement of public authorities as this measure would turn out to be unpopular amongst certain categories of graduates, as the results of Tables 7 and 8 reveal.

The practical response to adverse selection might combine risk shifting, separation and compulsory pooling depending on the exact configuration of the problem as well as the political preferences of different countries.

VI. Conclusion

The principal contribution of this paper is the finding that instruments of private finance, combining deferred and income-contingent payments, offer an opportunity to raise significant sums in order to (re)finance higher education in Europe without significantly eroding the profitability of the educational investment of individuals with heterogeneous lifetime incomes, and simultaneously addressing the risky nature of the investment. These results hold for a sample of countries (UK, Germany and Belgium) with potentially diverging institutional arrangements for their higher education, labour markets and fiscal systems.

We estimate that investments of up to 20,000 € would reduce the current private rate of return by less than one percentage point. This is an upper bound estimate, as it is computed under the pessimistic assumption that the additional resources have no positive effect on individuals' earning prospects. An investment of 5,000 € would represent a cost ranging from 0.47% (Germany) to 0.78% (Belgium) of lifetime (24-65) net income. One of the distinguishing advantages of ICL and HCC, compared to FEE (or ordinary loans), is that these moderate reductions in the rate of return can be achieved across the distribution of graduates' incomes. As ICL and HCC create a significant payment gradient amongst individuals from the same cohort, they simultaneously display strong vertical justice properties.

The comparison between HCC and ICL reveals that they are almost equally effective at indexing contributions to lifetime income. By definition, HCC are synonymous with contributions that are strictly proportional to income. ICL *a priori* modulates contributions in a much less precise way. This is certainly true from a cross-sectional perspective. However, it is less clear from an inter-temporal one, as lifetime *average* probabilities of defaulting on ICL can be relatively well indexed to lifetime income.

Both ICL and HCC are income-contingent and thus contain an insurance component. It is this insurance element that allows contributions to be adapted to an individual's lifetime income. The insurance mechanism is relatively expensive when applied to

large populations of students that are heterogeneous in terms of income prospects. If the cost is pooled amongst graduates, payments contain a premium to cover those who default. The main advantage of pooling is that redistribution takes place within each cohort of graduates. Its drawback is its exposure to adverse selection, as potential high earners might exit the scheme for fear of being in a cohort with too many low earners. Our last set of computations suggests that high-earning graduates would face an HCC price tag inflated by up to 19% (UK) if pooled with low earners.

We also propose an alternative. Investing less money in students opting for less profitable programs potentially eliminates the cost of pooling for high earners. This could be equated with the separation equilibrium solution. Its underlying logic is that students opting for programs, but also fields of study, offering lower income prospects, should borrow less money. But in the case of income differentials by gender (but also ethnicity, religion, region of origin, etc.), policy-makers, and individuals in general, might be unwilling to accept a system that imposes different terms. A solution would then be to ask taxpayers to compensate the lower paid groups, like women. This is the risk-shifting solution. Full risk-shifting is clearly an answer to adverse selection. However, its cost for the taxpayer could be significant. In the European context, complete risk-shifting could also lead to the classification of student contracts as public debt, which would further inflate the already bloated public debt that most European countries struggle with. Another solution to adverse selection would consist of maintaining a certain level of pooling – and thus redistribution – whilst imposing participation. However, given the lack of support for this amongst certain categories of graduates, implementation might generate issues of political economy.

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Appendix

Since we do not observe unemployment and other replacement benefits directly for Belgium, we use two simplifying assumptions to estimate them. First, following Van der Linden and Dor (2001), we consider a replacement ratio of 34%. This value adequately reflects the situation of cohabitants and the fact that benefits are decreasing over time for some categories of individuals. Second, we assume that replacement earnings' benefits are sensitive to past income, since they are indexed on former income within a certain interval. According to Office National de l'Emploi (2003), the proportion of non-employed persons, for which the benefit is proportionally linked to former income, is 29%.

Hence, for each of the 4,029 individuals in the data set the level of income is equal to:

$$y_i = m_i w_i + (1-m_i/12) rep \quad (1)$$

$$gy_i = m_i gw_i + (1-m_i/12) rep \quad (2)$$

with

- $rep = a W + b AW$
- $a = (0.29) 0.34 = 0.0986$
- $b = (1 - 0.29) 0.34 = 0.2414$
- m_i the number of months in 2002 during which individual i had a remunerated job;
- W the average net wage amongst working individuals with the same age, gender and degree as individual i ;
- AW the economy-wide average net wage of working individuals;