

The Economics of Implicit and Deferred Tuition Fees

With an empirical evaluation using Belgian, German & UK micro-data¹

Jan 2006

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Abstract:

Public financing of higher education is said to be regressive as a privileged minority profits from extra human capital, and all the private benefits it generates, while the general public foots the bill. A counter-argument is that higher education students enjoying ‘free’ access are implicitly borrowing public money that they pay back when entering the labour market, via higher and progressive income taxes. Formalizing and quantifying this implicit and deferred fee argument is the focus of this paper. We develop a model that provides an analytical formulation of graduates’ implicit and deferred payment rate and its main determinants. The empirical evaluation, based on Belgian, German & UK individual micro-data, suggests payment rates ranging from 47% (Belgium), 42% (UK) to 30% (Germany). Differences across countries are mainly due to varying attendance rates. Heterogeneity across categories of graduates within each country is important. Systematically however, females with Masters pay the least, and male Bachelors the most.

JEL classification: I28 (Education: Government Policy), H520 (National Government Expenditures and Education).

Key works: Higher Education Finance, Regressive Transfers, Implicit Loans.

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Introduction

In most European countries, public financing has been considered as the traditional approach for supporting higher education. Even if tuition fees have been introduced in various countries, they only contribute for a small amount in addition to resources provided by governments. The average subsidy rate for higher education² in European countries ranges from 76% to 99% (Debande, 2003). In most cases the subsidy rate is above 90%. But this situation is currently debated, leading to discussions on the optimal sharing of the higher education funding between the taxpayers and individuals benefiting from higher education. The expansion of higher education system reflecting strong social demand and increased demand for skilled workers due to technological change is emerging at a time of competitive pressure for available public spending. Ageing population increases the spending on pensions, medical care, and long-term care; and hence is expected to absorb a higher share of public budget.

On a more normative level, the existing economic literature (Johnes & Geske 1993 ; Creedy, 1995) suggests at least two strains of apparently conflicting reasoning on the desirability of public financing. First, many economists consider that using taxpayer money to finance higher education is regressive (Hansen & Weisbrod, 1969 ; Barr, 2001, 2002 ; Chapman 1997, 2001 ; Johnstone, 2004). Despite public financing and decades of political efforts to democratise access to higher education, enrolment and graduates statistics reveal the persistence of a strong social bias in favour of better-off students. A socially privileged minority gains access to the additional human capital acquired through higher education, and all the private benefits it generates, while taxpayers foot the bill.

Other economists (Creedy, 1995 ; Levy-Garboua, 1999 ; de la Fuente & Jimeno, 2005 ; Vandenberghe, 2004) reply that higher education students enjoying ‘free’ higher education are implicitly borrowing public money that they start repaying when entering the labour market. Financing higher education with tax money imposes an obvious burden on those who do not invest in higher education. But it is not a ‘free’

² Defined as the share of direct public expenditure in educational institutions and total public subsidies to households and other private entities in total sources of funds for higher education.

good from the point of view of the graduates who must pay higher taxes than otherwise during their working lives (Creedy, 1995). The view here is thus that, in order to properly assess the distributive characteristics of public financing, one needs to account for payments by graduates that are implicit and deferred, and mainly correspond to inflated and proportionately higher lifetime fiscal contributions. This is, in a nutshell, the implicit and deferred fee argument.

The central aim of this paper is to formalize and quantify the idea of implicit and deferred fees. It is to develop and estimate a model of finance by public money, in which i) the general level of taxation is inflated by the need to fund higher education ii) the *ex post* contributions by graduates (ie, the magnitude of implicit fees) vs. non-graduates (ie, the importance of potentially regressive transfers) are clearly identified. This means developing a framework in which both the *level* and the *determinants* of the rate of implicit payment by graduates can be quantified. This also means assessing these empirically, with the help of individual micro-data from different countries. The whole exercise should help gauge the distributional consequences of public funding. The objective is also to explain what drives the heterogeneity of situations across countries and categories of graduates (males, females, Masters, Bachelors...).

We abstract here for the controversial discussion about the existence and the magnitude of ‘spillovers’ from higher education (Creedy & François, 1990). In our model, public funding of higher education does not affect the level of the growth, and consequently the general level of income and tax receipts³. On the other hand, we also ignore the ‘ability bias’ argument (Dale & Cart, 1999) that states that only part of graduate lifetime wage premium -- and consequently higher tax contributions made by graduates -- should be ascribed to higher education.

This paper relates to a fairly old literature on the desirability of public financing of higher education (Nerlove, 1970). Although recent theoretical work (Creedy & François, 1990 ; Barbaro, 2004) better

³ The available empirical evidence suggests that such spillovers exists for primary and secondary education (Psacharopoulos, 1985) and possibly for research. At best, they would be low for higher education in general.

captures its distributional consequences -- by explicitly modelling the underlying financing by income taxation -- empirical evaluation remains limited. Hansen & Weisbrod (1969) were the first to use taxation data to assess the distributional effect of public financing of higher education. They concluded that public financing was regressive (ie, implicit reimbursement partial), even after accounting for taxes paid by parents. In this paper, we use EU rather than US data. In the EU context progressivity of taxation rates are likely to be higher⁴ and thus the idea of implicit and deferred payment a priori more relevant. We also focus on students' future fiscal contributions. Although this strategy raises technical difficulties (properly estimating future income and taxation flows is not an easy task), it is more in line with the idea that higher education is fundamentally an *investment* whose distributional consequences should be evaluated within a lifetime framework. This paper also indirectly relates to an emerging literature on private finance schemes in higher education. The distributional characteristics of public financing highlighted here could serve as a benchmark in exercises focussed on fees, loans, income-contingent loans, equity contracts or graduate taxes (Barr, 2001 & 2004; Palacios, 2004 ; Jacobs, 2002 ; Glennerster, Merrett & Wilson, 2003, Vandenberghe & Debande, 2005).

The main empirical result is that implicit and deferred tuition fees represent, on average, less than 50% of higher education public costs. Belgium is the country where the typical graduate implicitly pays the most (47%) followed by the UK (42%) and Germany (30%). There is also a fairly high level of heterogeneity inside each countries across categories of graduates, with payment rates possibly ranging from 70% (males with Bachelor degrees in Belgium or the UK) to 18% (females with Masters in Germany).

Section 1 exposes the simple model we developed to assess the outcomes of a system where the funding of higher education partially operates as an implicit and deferred tuition fees mechanism. This section exposes how a rate of implicit payment of could be computed. Further on, we show that inter-country and intra-country differences are fundamentally driven by differences in average participation rates, relative

⁴ A political economy perspective would even suggest that this is potentially the consequence of 'free' higher education. Individuals are more willing to pay higher and more progressive taxes as they get free access to many goods and services.

gross income, relative taxation rates, and relative length and cost of study. Section 2 contains the presentation of the EU data exploited to evaluate this model empirically. In section 3, using OECD institutional data and individual micro-data on income and tax flows, we produce realistic account of inter and intra countries differences in terms of implicit payment rates. Section 4 concludes.

1. Model

As stated, ‘free’ higher education can be partially conceived as an implicit and deferred fee mechanism. Elements supporting this conception are essentially threefold. First students tend to become taxpayers. Second, the general level of taxation is inflated by the budgetary requirements of ‘free’ higher education. Third, graduates pay more of these additional taxes than non-graduates given their higher income level as well as tax progressivity.

The first element means adopting a lifetime perspective. The third element implies building taxation profiles (t) that properly capture graduates vs. non-graduates lifetime fiscal contributions. The second element requires establishing witch percentage ($0 < \eta < 1$) of the flow of lifetime taxes paid by graduates and non-graduates can somehow be imputed⁵ to higher education, as opposed to any other sector (roads, health...). Imagine a Minister of finance incrementally estimating how much tax revenues she will need. She starts with traditional departments like justice and police, then maybe add roads and defence, health, compulsory education.... At some point comes higher education. If she adopts a balanced-budget policy – what she must/should do in the long-run -- she will lift her tax revenue needs *pro rata* the size of the higher education budget. In other words, what is used to fund higher education is somehow just equal to the share of higher education spending in the State budget, itself equal to the total of tax revenues. Consequently, the level of higher education spending/investment itself can be used to define η .

⁵ The term ‘imputed’ here does not mean hypothecation, as we do not refer to an situation where tax revenues are explicitly earmarked for higher education (Le Grand, 2003). As far as we know, tax hypothecation for higher education does not exist in the EU countries examined here.

1.1. Finance by income taxation

Higher education decision-makers spend an amount (make a human capital investment) INV on a fraction α of each cohort. Without loss of generality, we focus hereafter on a representative cohort. Public funding INV can then be assimilated to a piece of public debt, issued when individuals are aged 18, that is repaid gradually beyond that point by both graduates and non graduates⁶. Non-graduates start paying for that investment immediately, provided they make enough money to pay income taxes. While graduates logically start repaying later: at the age 22 for Bachelor graduates and 24 for Master graduates.

Assuming the State budget is equal to total income tax revenues, the share of additional income taxes required by 'free' higher education η is equal to

$$\eta = \alpha INV / (\alpha TG + (1 - \alpha) TNG) \quad [1]$$

with:

- α is the share of graduates in a cohort ;
- $INV \equiv S (1+r)^{24-18=5}$ the value of cumulated higher education spending (S), expressed in Euros at the age of 24;
- $TG \equiv \sum_a [t_{a,g} (1+\tau)^{a-24} / (1+r)^{a-24}]$ the present – ie, at the age of 24 -- value of the lifetime stream of income tax paid by graduates, with t the expected amount of annual income tax paid;
- $TNG \equiv \sum_a [t_{a,ng} (1+\tau)^{a-24} / (1+r)^{a-24}]$ the present value of the lifetime stream of income tax paid by non-graduates and still t the expected amount of annual income tax paid;

⁶ With interest rates on public debt adequately reflecting the preference for the present and in the absence of structural shifts (cohort size changes, participation rates changes...), this is equivalent to direct tax transfers from the 'stock' of past cohorts forming the current tax base to the current generations of students.

- a ranging from 18, 20, 22 or 24 (the moment of labour market entrance) to 65 (the end of working live);
- r the discount rate;
- τ capturing the general tendency of wages and thus taxes to grow, due for example to technological progress⁷ ;

The second term of the denominator in [1] reflects the contribution of non-graduates (those who do not attend higher education). It is implicit from the definition of TG and TNG above that the data we will be using are *cross-sectional* and not longitudinal. Transforming these data in lifetime tax contribution profiles need to be done with some care. As suggested by Jacobs (2002), the main reason why cross-sections differ from time-series is that there is wage growth due to total factor productivity gains (technological progress). This justifies the presence of τ capturing the general tendency of wages -- and thus tax revenue -- to grow in real terms.

Equation [1] can be restated, after dividing the numerator and the denominator by α , as follows:

$$\eta = INV / (TG + \theta TNG) \quad [2]$$

with $\theta \equiv (1 - \alpha) / \alpha$ the relative importance of non-graduates vis-a-vis graduates, superior to 1 if graduates represent a minority of the cohort. Further, we can exploit the fact that graduates are likely to pay more taxes than non-graduates due to higher lifetime contributions ($\lambda \equiv TG/TNG > 1$). This can be use to rewrite expression [2].

$$\eta = INV / TG(1 + \theta/\lambda) \quad [3]$$

⁷ We assume here that wage progression is uniform across the education distribution. This assumption might be irrelevant in the presence of strong skill-biased technological progress resulting in a rising higher-education/college premium (Taber, 2001). The latter is well documented in the context of the US or the UK. The evidence is less clear for continental Europe, and Belgium in particular (OECD, 2000).

We can now define the graduates' rate of implicit payment RIP of their educational costs

$$RIP = \eta TG / INV \quad [4]$$

Using the definition of η [3], RIP can be rewritten as

$$RIP = \lambda / (\lambda + \theta) \leq 1 \quad [5]$$

Expression [5] tells us that for the average graduate in the country, the rate of implicit payment of higher education is necessarily inferior or equal to 1 as $\theta \geq 0$. In other words, if we exclude the unrealistic situation where every one is a graduate ($\alpha=1$ or $\theta=0$), each Euro spent on higher education will be partially subsidized by non-graduates' tax contributions.

But most importantly, expression [5] tells us that the rate of payment (RIP) is function of the relative magnitude of :

- $\theta = (1-\alpha)/\alpha > 1$ the parameter reflecting the relative importance of non-graduates vis-a-vis graduates in the country. This is the *non-participation effect*. The higher it is, the higher *ceteris paribus* the tendency of non-graduates to foot the bill;
- $\lambda = TG/TNG > 1$ the parameter capturing the tendency of graduates to pay more taxes. This is the *lifetime tax contribution effect*. The higher this effect the higher the implicit tendency of graduates to reimburse.

Note finally that the tax effect can be easily decomposed into i) a lifetime gross *income effect* (Y) ie, graduates earn more over their career and ii) a *progressivity effect* ie, they face higher lifetime taxation rates (χ).

$$\lambda = TG/TNG = (\chi(YG)/\chi(YNG)) * (YG/YNG) \quad [6]$$

with

- $YG \equiv \sum_a [y_{a,g} (1+\tau)^{a-24} / (1+r)^{a-24}]$ the present – ie, at the age of 24 -- value of the lifetime stream of gross income by graduates, with y the expected amount of annual gross income;
- $YNG \equiv \sum_a [y_{a,ng} (1+\tau)^{a-24} / (1+r)^{a-24}]$ the present value of the lifetime stream of gross income earned by non-graduates and still y the expected amount of annual gross income;
- $\chi(YNG) \equiv TG/YG$ and $\chi(YNG) \equiv TNG/YG$.

1.2. Heterogeneity among graduates

Higher education systems are heterogeneous in terms of types and length of studies. For example, the typical investment on a student attending a Bachelor program ($dur=3$ years) is obviously less important than the one made on someone undertaking a Master ($dur=5$ years). In addition, annual per student costs ($INVY$) can vary across programs or fields of study. As a consequence, implicit borrowings vary significantly among graduates. This justifies assuming annual implicit loans of different size across categories k of graduates ($INVY_k$). Total value of investment for a typical category k is thus

$$INV_k = dur_k INVY_k \quad [7]$$

Similarly, tax contributions are likely to vary a lot among graduates. Hence, it might be interesting to estimate the rate of implicit reimbursement by category k of individuals (Bachelors, Masters....). In algebraic terms this means computing

$$RIP_k = \eta TG_k / INV_k \quad [8]$$

with

- η the solution of equation [2];
- $TG_k \equiv \sum_a (t_{a,g,k}(1+\tau)^{a-24} / (1+r)^{a-24})$ the present value of the lifetime stream of income tax paid by category k graduate, where $t_{a,g,k}$ is the annual tax paid by that category k of graduate;

It is worth restating RIP_k using the definition of η [3] as well as that of RIP [4]. We indeed obtain

$$RIP_k / RIP = (INV / INV_k) (TG_k / TG) \quad [9]$$

which reveals category k 's reimbursement rate will deviate from the country average (RIP);

- negatively, the more higher education spends on category k relative to the average graduate (INV / INV_k).
- positively, the higher the tax contributions generated that category of graduates relative to the average graduate (TG_k / TG), that in turn can be decomposed into gross income and a progressivity factors, like in [6].

The first element is simply a *relative cost effect* while the second is a relative tax contributions or *benefit effect*.

1.3. Partial finance by a lump-sum tax

We have so far assumed that the State Budget is principally funded by (progressive) income taxes. A more realistic approach is to assume that only a fraction ($0 < \delta < 1$) of the State budget is covered by income tax

revenues. The rest could come from fiscal instruments operating more like a lump-sum levy (LS), *a priori* much less favorable to the idea of implicit reimbursement by graduates. In that context, provided we have information on the plausible value of δ , the modelisation would consist of first computing the lump sum required:

$$LS = (1 - \delta) \alpha INV \quad [10]$$

with

- α the share of graduates in the country ;
- δ the relative importance of income tax in the total tax receipts of the country.

and then to compute the fraction of income tax revenue needed $\eta^S < \eta$ such that

$$\eta^S = \delta INV / (TG + \theta TNG) \quad [11]$$

or equivalently given [2]

$$\eta^S = \delta \eta \quad [12]$$

These notations can be used to derive a new formulation of the rate of implicit reimbursement of educational investment by graduates

$$RIP^S = (LS + \eta^S TG) / INV \quad [13]$$

or equivalently given [10], [12] and [4]

$$RIP^S = (1 - \delta) \alpha + \delta RIP \quad [14]$$

It is easy to show⁸ that $RIP^s \leq RIP$.

An expression similar to [14] captures the rate of reimbursement of category k graduates

$$RIP_k^s = (1 - \delta) \alpha + \delta RIP_k \leq RIP_k \quad [15]$$

Note finally that decompositions of [5] and [9] apply to RIP and RIP_k in [14] and [15].

2. Data

In the simple model above, the key variables are the tax contribution profiles (t) of non-graduates and graduates, and graduates' rate of implicit payment (RIP). The former will be estimated here after, while the results for the latter are presented in section 3. In our approach, we estimate the value of the profiles or parameters using real information on tax payments of both graduates and non-graduates.

2.1. Sources

Our individual data come from national households surveys. For Belgium, we use the 2002 wave of the Panel Study on Belgian Households (PSBH). For UK and Germany the 2000 wave in the CHER⁹ data set; itself a compilation of the 2000 German Socio-Economic panel (GSOEP) and the 2000 British Household Panel Survey (BHPS). For representative samples of individuals these national surveys provide data on annual net and gross yearly¹⁰ earnings and thus amount of *income tax*, participation to labour market, working hours, personal characteristics (age, gender and education) or place of residence. These data sets

⁸ That condition is equivalent to showing that $\alpha \leq RIP$ or, as $RIP = \lambda / (\lambda + \theta)$, that $\alpha \leq \lambda / (\lambda + \theta)$. Equivalently again, given $\theta = (1 - \alpha) / \alpha$, the condition becomes $\alpha \leq \alpha / (\alpha + (1 - \alpha) / \lambda)$ which is necessarily true as $(1 - \alpha) / \lambda > 0$.

⁹ Consortium of Household Panels for European Socio-Economic Research., Luxembourg.

¹⁰ PSBH and CHER always define earnings and income as 'last year income'

are useful to evaluate the relationship between higher education (Bachelor or Master¹¹ programs) and income taxation at different stages of individuals' career, relative to less educated people (Table 1).

PSBH (Belgium) provides information about *wages* while CHER (Germany & UK) immediately gives data on both gross and net *income (earnings + replacement earnings)*¹². For Belgium thus, in order to estimate the level of net (*w*) and gross income (*y*) we add estimates of replacement earnings (*rep*) to net or gross wages. The former corresponds essentially to unemployment, health and disability or early-pension benefits.

Insert Table 1 about here (sample characteristics)

Finally, we used OECD data (Table 2) to determine the values of the few country-specific parameters used across all simulations: *INV* (value of higher education cost/investment), α (the share of graduates in the population) and δ (the share of income tax in the total tax receipts of the country).

¹¹ Typically organised within universities

¹² In CHER= xxb16 gross income=

[EARNINGS] pxxi03a wage/salary regular take home pay

+pxxi03b wage/salary lump sum

+pxxi04 self-employment income

[REPLACEMENT EARNINGS]

+pxxi09 unemployment benefits

+pxxi10 health and disability related transfers

+pxxi12a other transfers, education related

+pxxi13a pension income – old-age related

+pxxi13b pension income – survivor benefit

2.2. Tax contribution profiles

We do not use these individual data directly to compute income taxation. The amount of missing values about net and (even more importantly) gross income would represent a significant loss of information. Our strategy is inferential as it aims at using individual data to estimate plausible income taxation by age profiles.

We first use individual net income data (w_i), to estimate the OLS coefficients of a 2nd order polynomial function of experience ([16]), separately for non-graduates and graduates, but also sub-categories of graduates (Bachelor, Master, male, female...).

$$w_i = \pi + \rho \exp_i + \zeta (\exp_i)^2 + \varepsilon_i \quad [16]$$

where potential work experience (\exp) is defined as the number of years since (theoretical) graduation age (ie; 17 for secondary school drop-outs, 19 for secondary education; 21 for Bachelors, 23 for Masters). Note that the dependent variable covers part-time workers as well as people without earned income. Strictly speaking thus, it combines the wage and employment benefits of education. In the Belgian and also German context, the second effect is particularly important. As shown by Karasiotou (2004), in continental Europe up to 50% of the total labour market benefit of education is generated by higher employment rates.

Second, using OLS coefficients (π, ρ, ζ) from [16], we compute expected net income by age¹³ profiles ($w_{a,j,k}$) for graduates ($j=g$) and non-graduates ($j=ng$), as well as for different categories k of graduates (Bachelor vs Master degree, female vs males, people living in richer vs poorer regions).

¹³ The shift from wage/experience to wage/age function is immediate. We simply use the relation between age and potential labour experience (ie, $a \equiv$ theoretical graduation age + \exp)

A third step implies computing expected income tax by age profiles ($t_{a,j,k}$). This is done in two stages. We first estimate the OLS coefficients of the individual gross income (y_i) regressed on a 2nd order polynomial of net income (w_i).

$$y_i = \sigma + \varphi w_i + \zeta (w_i)^2 + v_i \quad [17]$$

We then compute the expected gross income ($y_{a,j,k}$) by applying OLS coefficients (σ , φ , ζ) derived from [17] to the values generated by the net income by age profile ($w_{a,j,k}$). Our income taxation profiles are obtained simply by taking the difference between expected net and gross income ($t_{a,j,k} \equiv y_{a,j,k} - w_{a,j,k}$). Examples of these profiles are displayed in graphs 1 & 2.

Insert graph1 (male) & graph 2 (female) about here

Results exhibit sizeable differences in lifetime contributions. They also clearly show that higher education graduates are likely to pay more taxes on income. These estimates also confirm the persistence of significant gender gaps.

Note also that our profiles can be used to estimate present values of lifetime gross income and taxes and thus of the level of progressivity inherent to the current level taxation in Belgium. Results are displayed in graph 3.

Insert graph3 about here

3. Estimated rate of implicit payment

Computations of rates implicit payment (RIP , $RIP_{,k}$) presented here are based on the following technical assumptions. Following Jacobs (2002), we assume that the general level of wage and tax receipts grow at an annual rate of 2 percent ($\tau=0.02$). This captures the fact that technical progress generates productivity gains that somehow benefit all individuals, and eventually produces extra tax receipts¹⁴. We also assume a discount rate (r) of 4 percent, equal to the historical return on public (risk free) European bonds. Investment is made at age 18, and payment starts at age 18, 20, 22 or 24. All values are expressed in Euros at the age of 24. The details of parameters used in our simulations, country by country, is presented in Table 2.

Insert Table 2 about here

3.1. Country averages

Assuming income tax systems remains unchanged and form the major source of funding for higher education, we estimate (Table 3) that the average rate of implicit payment (RIP) for a typical graduate ranges from 0.47% (Belgium), 0.42% (UK) to 0.30% (Germany). In others words, for every Euro spent on higher education, from 53 cents (Belgium) to 70 cents (Germany) is paid by the rest of the cohort that does not attend higher education. Bearing equation [5] in mind, Graph 4 and Table 3 show that these differences are essentially driven by the relative importance of non-graduates in the population (θ). The lower that parameter (and thus the greater higher education attendance), the higher the rate of payment.

There are also differences in terms of relative tax revenues generated by graduates λ , the UK being the country where graduates pay the most ($\lambda=1.61$), followed by Germany ($\lambda=1.50$) and Belgium ($\lambda=1.44$). But this factor plays a minor role in explaining the gaps in terms of RIP compare to attendance rates

¹⁴ In the case of Belgium, Germany and the UK, this might be a lower bound. Long-term statistics of hourly wage growth suggest actual rates can reach 3%.

captured by θ . Table 3 contains a further decomposition of λ into gross income vs. progressivity component (equation [6]). Using Germany as a benchmark, results show that UK graduates' higher propensity to generate tax revenues is due to higher progressivity ($\chi(YG)/\chi(YNG)=1.13$ vs 1.05), while Belgian graduates' lower contributions is caused by a lower gross income premium.

Insert Graph 4 about here

Insert Table 3 about here

3.3. Breakdown by category of graduates

Table 4 contains the detailed value of the rate of deferred payment for various categories of graduates (RIP_k). It shows essentially that there is a lot of intra-country variation. Bachelor graduates are likely to pay a greater proportion of what higher education has invested in them than students who attend university and get Master degrees. For Bachelor males, the rate can reach 70% (Belgium, UK), while it is only of 47 to 49% for males who graduate from Masters in Belgium, and 50 to 56% in the UK. In Germany, Bachelor males are expected to reimburse up to 49% of what they received, while males with Masters barely reimburse 32%. A similar discrepancy exists between Bachelor vs Master females.

Insert Table 4 about here

Table 5 focuses on the relative magnitude of the payment rates (RIP_k/RIP) and its determinants. It confirms that female with Master degrees tend to pay the least, and males with Bachelor diplomas the most. And the reasons for this asymmetry is that relative cost (investment) and tax contribution factor tend to combine and reinforce each other – although in opposite directions – for these two particular categories of graduates, while they tend to cancel out for the others. Indeed, female who opt for Master degrees cost

more ($INV/INV_k < 1$) and at the same time pay less taxes during their career ($TG_k/TG < 1$). While the opposite holds for male undertaking Bachelor programs: they cost relatively less than the average graduates and almost systematically pay more taxes.

Insert Table 5 about here

3.3. Gender gap

Another major result is that female graduates (Bachelor or Master) are likely to reimburse much less their male counterparts. In the UK, a female with a Bachelor degree will repay a maximum of 44% of the initial investment. And one with a Master degree is expected to pay back up to 40% of what she received via ‘free’ participation to university. Percentage for men are respectively 70% and 56%. A similar pattern emerges in Belgium and Germany.

These results should be considered with caution. The gender differences exhibited in Table 4 could be partially offset if we could account for the fact that girls tend to be over represented in less expensive study programs (social sciences, liberal arts, psychology...). In the absence of detailed information about higher education cost by gender, and given the sensitive nature of the issue we opted for additional simulations that are reported in Table 6. The idea is simply to deflate the value of (INV_k) in order to capture the idea the girls could cost less than boys given the gender asymmetry as to fields of study chosen. We arbitrarily set the level of investment for girls to 70% of what is for boys. Results for Bachelor females, are that the gap is still relatively important across all countries, ranging from -17 to -7%. Its only the French-Speaking Belgium (Wallonia & Brussels) that the gender gap is eliminated. For Master graduates the gap is eliminated in Belgium and the UK. It is reduced in Germany but still ranges from -4 to -5 points of percentage. The tentative conclusion could be that an *ex ante* lower level of spending on female students could compensate for lower *ex post* tax contribution. However, the reader should bear in mind that a spending level reduced by 30% as assumed here requires major structural differences, both in

terms of cost per field of study (social sciences vs. engineering) and attendance rates by gender for each of these fields.

Insert Table 6 about here

3.4. Partial finance by a lump-sum tax

Our last set of results relates to the situation when it is – realistically -- assumed that some fraction δ of public spending on higher education is covered by a lump-sum tax. Results are reported in Table 7. They logically indicate a reduction of the rate of implicit reimbursement in contrast with the case where all costs are covered by progressive income taxes. The magnitude of the reduction however depends on country-specific parameters. Those that were used here lead however preserve the hierarchy identified so far. It is in Belgium that the rate of payment is the higher (44%) and in Germany that it is the lowest (27%), the UK logically occupying an intermediate position (36%).

4. Conclusion

In this paper, using a simple lifecycle framework and micro-data from a small sample of EU countries (Belgium, UK and Germany), we estimate how much graduates are likely to pay for their higher education costs via higher deferred income taxes. We show that Belgium is the country where the typical graduate pays the most (47%) followed by the UK (42%) and Germany where he pays the least (30%). Accounting for partial funding by lump-sum tax logically leads to lower payment rates. Yet the initial hierarchy among countries remains.

Differences across countries are primarily due to differences in terms of the rate participation rate. It is indeed lower in Germany than in the UK and Belgium. The propensity of graduates to generate more taxes over their lifetime varies across countries. But this factor is of lesser importance in explaining inter countries differences.

We also identify a fairly high level of heterogeneity inside each country, across categories of graduates (Master vs Bachelor, male vs female). Some of our results give credit to those who claim that 'free' higher education is just a form of implicit loan that graduates tend to reimburse at a further stage of their life. We show indeed that male students attending Bachelor/non-university programs eventually pay a fairly high proportion of higher education costs. It is of 70% in Belgium and the UK. But payment rates are lower for male students taking Master degrees: in Belgium (49% and less), in the UK (56% and less) and particularly in Germany (32% and less). And implicit payment rates are systematically lower for females, particularly in Germany among Master graduates (19% and less). For these categories, the idea that public financing might be regressive has still a strong appeal. At the extremes with thus have: females with Masters paying the least, and males with Bachelor degrees paying the most. Reasons are that the former cost more and at the same time pay less lifetime taxes lifetime, while the opposite holds for the latter.

These results have to be considered as part of the debate on higher education reform and the search for alternative funding schemes. They shed some new light on the distributional characteristics of public financing of higher education. Properly assessing these calls for a lifetime perspective. It also implies evaluating the situation country by country, and separately for each category of student within each country.

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Tables and Graphs

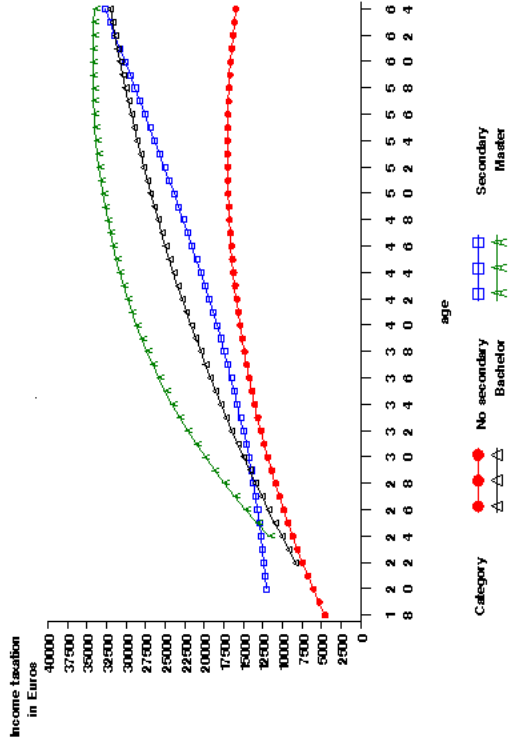
Table 1 – Sample statistics. Sample size and breakdown by education level and gender

Country	Gender	Less than secondary	Secondary	Bachelors*	Masters**	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

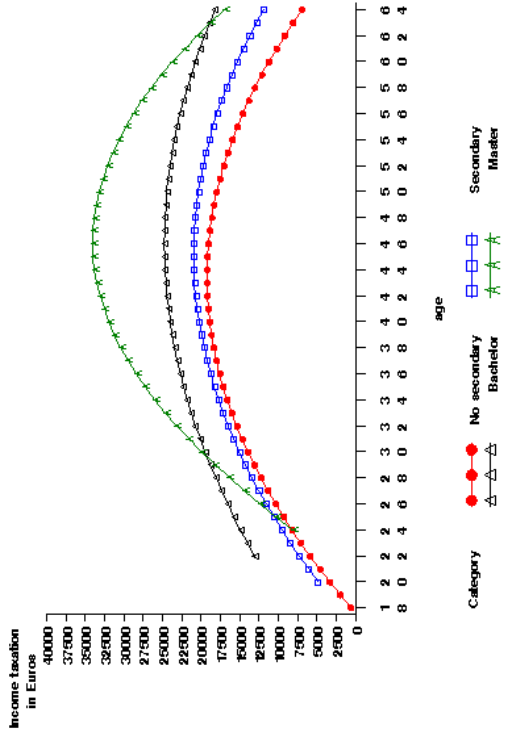
* non-university ** university

Graph 1 – Annual income tax profiles. Breakdown by degree. Males.

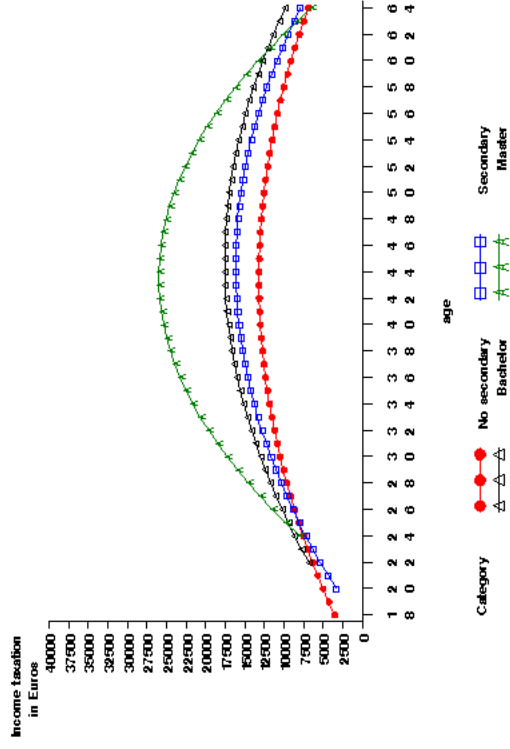
Taxation profiles – Male – Belgium



Taxation profiles – Male – Germany

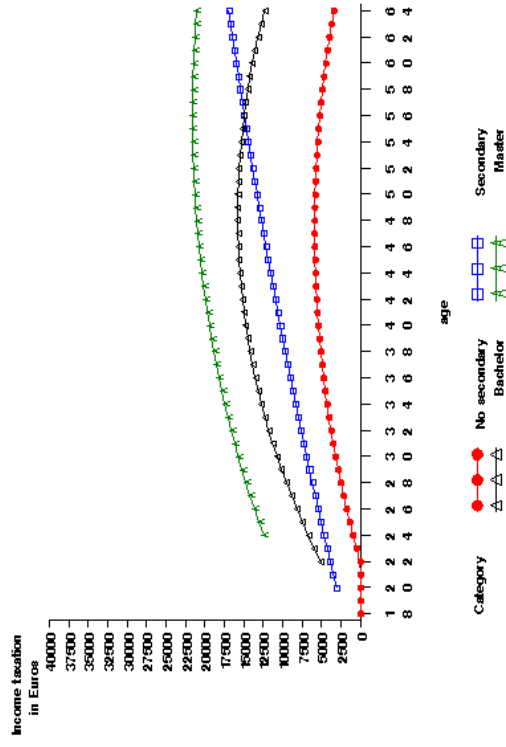


Taxation profiles – Male – United Kingdom

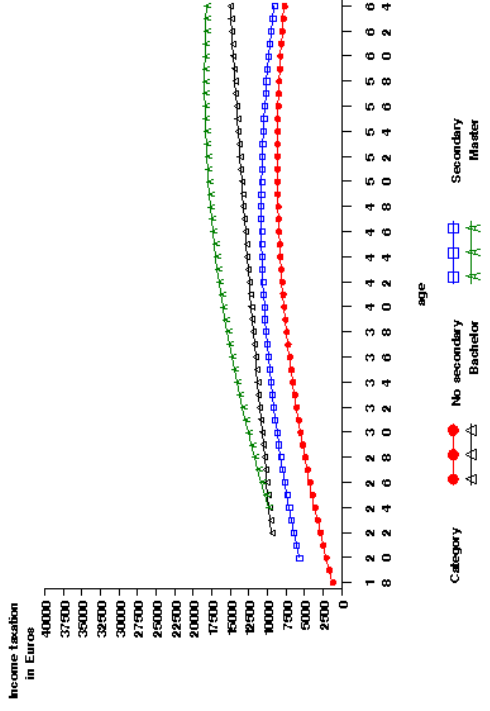


Graph 2 – Annual income tax profiles. Breakdown by degree. Female

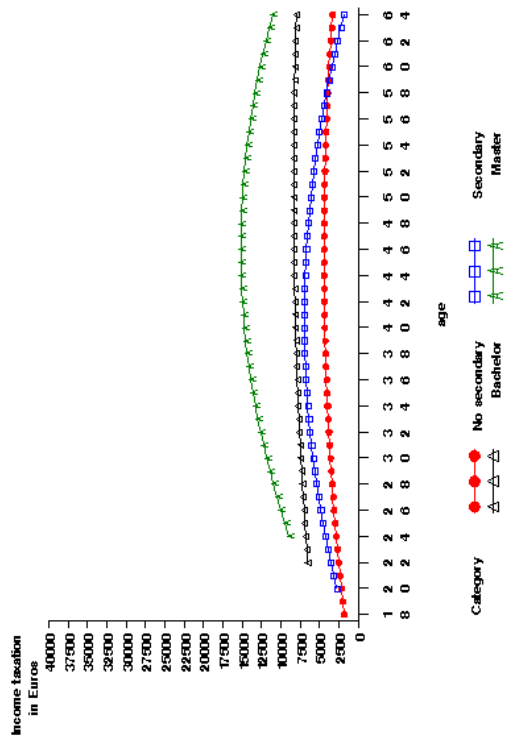
Taxation profiles – Female – Belgium



Taxation profiles – Female – Germany



Taxation profiles – Female – United Kingdom



Graph 3– Average lifetime tax (taxes as % of gross wage) according to level of lifetime gross wage (ie, tax progressivity)

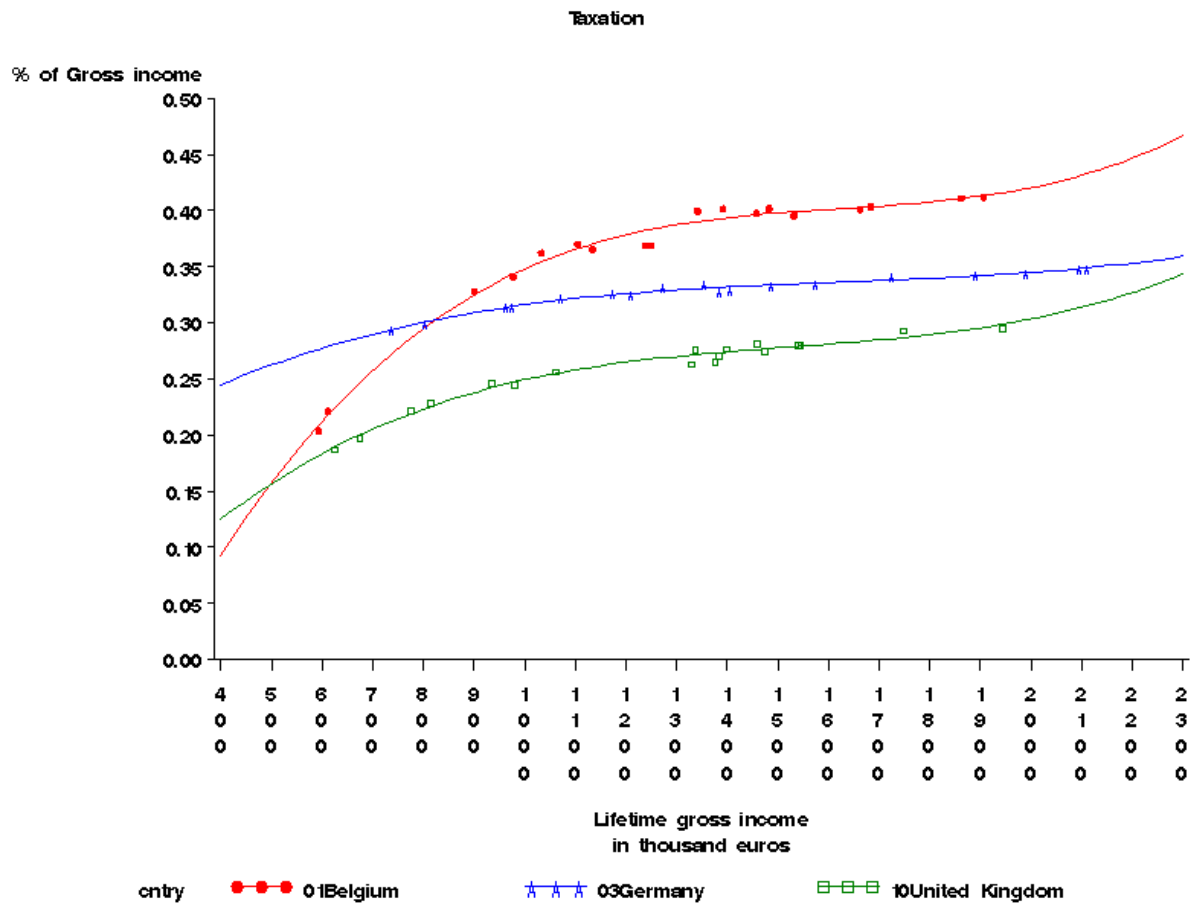


Table 2 – Value of parameters used in stimulations

Country	Discount rate r	Long term annual growth rate τ	Annual cost in Euros INV^i	Duration of Bachelor programs dB	Duration of Master programs dM	Proportion of graduates in the population α^i	Proportion of Masters among graduates β^i	Cumulated investment per graduate in Euros INV^i	Proportion of income tax in total budget γ^i
Belgium	0.04	0.02	13,907	3	5	0.38	0.47	54.794	0.63
Germany	0.04	0.02	12,605	3	5	0.22	0.62	53.445	0.64
United Kingdom	0.04	0.02	12,903	3	5	0.31	0.74	57.805	0.46

$${}^iINV = \beta * INV^i * dM + (1 - \beta) * INV^i * dB$$

* 3 year programs (non-university).

** 5 year programs (mainly university)

¹OECD (2004, 2005)

Graph 4 – Finance by Income Taxation. Rate of deferred & implicit payment by graduates and its determinants

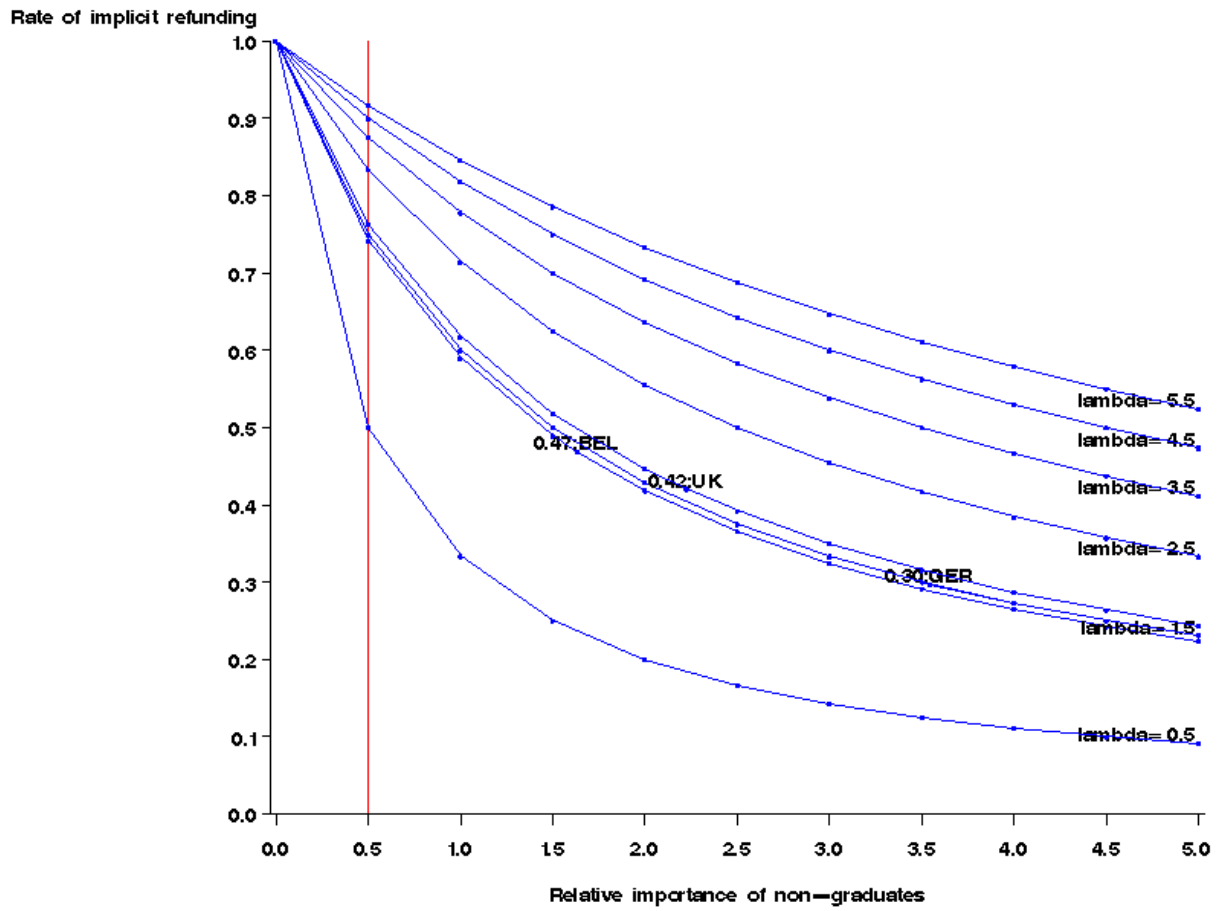


Table 3 – Finance by Income Taxation . Rate of implicit payment and its determinants

Country	Rate of implicit payment $RIP = \lambda / (\lambda + \theta)$	Relative importance of non-graduates θ	Relative tax contributions of graduates ie, relative gross income of graduates $\lambda = TG/TNG$	Income factor YG/YNG	Progressivity factor ie, Relative taxation rates $\chi(YG) / \chi(YNG)$ **
Belgium	0.47	1.63	1.44	1.31	1.10
Germany	0.30	3.55	1.50	1.43	1.05
United Kingdom	0.42	2.23	1.61	1.43	1.13

* $\chi(YG) = TG/YG$; ** $\chi(YG) = TNG/YNG$

Table 4 – Rate of implicit payment (RIP_k) of higher education public investment. Breakdown by country and category (k) ie. higher education degree. gender and region

Country	Region	Female		Male		National average RIP
		Bachelors*	Masters**	Bachelors*	Masters**	
Belgium	Wallonia & Brussels	0.42	0.33	0.60	0.47	0.47
	Flanders	0.39	0.35	0.70	0.49	0.47
Germany	East	0.25	0.18	0.49	0.31	0.30
	West	0.27	0.19	0.46	0.32	0.30
United Kingdom	All except G London	0.37	0.36	0.70	0.56	0.42
	Greater London	0.44	0.40	0.70	0.50	0.42

* 3 year programs (non-university).

** 5 year programs (mainly university)

Table 5 – The determinants of the relative rate of implicit payment ($RIP_{,k} / RIP$) of higher education. Breakdown by country, gender and region

Country	Region		Female		Male	
			Bachelor*	Masters**	Bachelor*	Masters**
Belgium	Wallonia & Brussels	$RIP_{,k} / RIP$	0.90	0.71	1.28	1.01
		INV/INV_k	1.31	0.79	1.31	0.79
		TG_k/TG	0.69	0.90	0.97	1.28
	Flanders	$RIP_{,k} / RIP$	0.82	0.74	1.50	1.04
		INV/INV_k	1.31	0.79	1.31	0.79
		TG_k/TG	0.63	0.94	1.14	1.32
Germany	East	$RIP_{,k} / RIP$	0.83	0.61	1.65	1.05
		INV/INV_k	1.41	0.85	1.41	0.85
		TG_k/TG	0.59	0.72	1.16	1.24
	West	$RIP_{,k} / RIP$	0.92	0.65	1.56	1.06
		INV/INV_k	1.41	0.85	1.41	0.85
		TG_k/TG	0.65	0.77	1.10	1.25
United Kingdom	All except G London	$RIP_{,k} / RIP$	0.89	0.85	1.67	1.33
		INV/INV_k	1.49	0.90	1.49	0.90
		TG_k/TG	0.59	0.95	1.12	1.48
	Greater London	$RIP_{,k} / RIP$	1.05	0.95	1.67	1.19
		INV/INV_k	1.49	0.90	1.49	0.90
		TG_k/TG	0.70	1.06	1.12	1.32

* 3 year programs (non-university).

** 5 year programs (mainly university)

Table 6 – Rate of implicit payment. Sensitivity of the gender gap (Female – Male) to the relative size of investment (INV_k)

Country	Region	Investment adjustment factor	Bachelor*	Masters**
Belgium	Wallonia & Brussels	0.7	0.00	0.00
		1	-0.18	-0.14
	Flanders	0.7	-0.15	0.01
		1	-0.32	-0.14
Germany	East	0.7	-0.14	-0.05
		1	-0.24	-0.13
	West	0.7	-0.07	-0.04
		1	-0.19	-0.12
United Kingdom	All except G London	0.7	-0.17	0.03
		1	-0.33	-0.13
	Greater London	0.7	-0.07	0.07
		1	-0.26	-0.10

* 3 year programs (non-university).

** 5 year programs (mainly university)

Table 7 – Rate of implicit payment assuming partial finance by a lump-sum tax

Country	Finance by income taxation <i>RIP</i>	Partial finance by lump-sum tax $RIP^s = (1 - \delta)\alpha + \delta RIP$	Proportion of income tax in total budget γ^*	Proportion of graduates in the population α^*
Belgium	0.47	0.44	0.63	0.38
Germany	0.30	0.27	0.64	0.22
United Kingdom	0.42	0.36	0.46	0.31

*OECD (2004, 2005)