Measuring Education Services as Intangible Social Infrastructure

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Abstract

The starting point for this paper is that society's consumption of education services is the acquisition of schooling knowledge assets whose change in value should be included in saving and net investment. We estimate the nominal value of education services produced by the public sector by using the Jorgenson-Fraumeni lifetime income approach. Enrolments by education type are multiplied by the amount by which lifetime earnings at that age, sex and education change with additional qualifications taking account of the extra time required to achieve that additional education. Implementing this approach requires a number of assumptions including estimating wages net of experience and taking account of international students who pay for the cost of their tuition. The model is estimated using data for the UK covering the time period 2001 to 2014 and uses a range of assumptions. The ratio of our preferred measure to education expenditures is much greater than one, suggesting that society obtains a high economic benefit from education.

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1. Introduction

The public sector produces services, such as education and health, that can be viewed as intangible social infrastructure which add to investment, savings and wealth. Typically this is not included within the national accounts framework. These services provide benefits to society in many forms including increasing the productivity of workers as well as social gains such as arguably contributing to stable democracies. This paper estimates the value of education services and compares this to education expenditure, using the lifetime income approach put forward by Jorgenson and Faumeni (1989, 1992a, 1992b).

The next section sets out the conceptual framework for modelling education services as social infrastructure. Section three sets out the lifetime income model. We then apply this approach to data for the UK over the period 2001 to 2014. Section four discusses the data used and section five presents results. Finally, we conclude in section six.

2. Framework: Education as Social Infrastructure

Many studies show that returns to education accrue to private individuals in the form of higher wages rather than as paybacks to producers of education services. A fundamental feature of the educational process as modelled, for instance, by Jorgenson and Fraumeni (JF) (1989, 1992a, 1992b) is the lengthy gestation period between the application of the educational inputs (mainly the services of teachers and the time of their students) and the emergence of human capital embodied in graduates of educational institutions. In the JF framework, the *household* invests time and money via purchases of teacher services (either at the cost for public institutions in national accounts or actual outlays in the case of private services) to build human capital. Household production is out of scope for GDP as traditionally defined and the JF approach to modelling human capital production and investment is usually considered relevant for building a "human capital" satellite account. It is not necessarily relevant as an approach for measuring educational output in headline GDP. In this paper, we reconsider the utility of the JF approach for measuring educational output.

Our approach begins with the view that the service capacity of a nation's education system is, in effect, social infrastructure. In this view, spending by educational institutions to improve the capacity of the educational system to deliver improved teacher services would be inside the asset boundary of GDP, i.e. such spending would be considered an intangible investment as in Corrado, Hulten and Sichel (2005, 2009). In other words, a school system's expenditure on teacher training is an investment if it increases the effectiveness of the system to deliver educational services in future periods[1].

But what about the output of educational institutions? If an education system plays a part in producing human capital, we need a framework that views the production of education services as

[1] This expanded view of investment by educational institutions has been implemented in the database produced by the SPINTAN project, which covers 22 EU countries, the United States, Brazil, and China. See www.spintan.net for further details.

the production of a societal asset as opposed to regarding education services as an input to the production of human capital within households. The basic idea is that society's consumption of education services is in fact the acquisition of schooling knowledge assets, ΔE, whose change in value, $P^{ES}\Delta E$, should be included in saving and wealth *even though it is not used in current production (or consumed)*. Rather, the assets are held in inventory, within the school system, until students graduate and enter the working age population, after which the value is unchanged (by the school system) [2]. In this view, the real output of an education system, Q_{ES}, is the knowledge stock of this year's graduates plus the increment to knowledge held by students still within the system, or $Q_{ES} = E^{Grad} + \Delta E^{InSchool}$. Under certain assumptions, this implies $Q_{ES} \equiv \Delta E$ because at any point in time the value of last year's graduates is unchanged (and entrants at the lowest level are assumed to have a zero stock).

The production function F^E for education services is then given by:

(1) $Q_{t,ES} = F^E(K_{t,ES}, L_{t,ES})$

which implies

(2) $E_t = F^E(K_{t,ES}, L_{t,ES}) + E_{t-1}$

where E_{t-1} is the beginning-of-period knowledge stocks held by this year's students, and education services production is the schooling-produced increment to those stocks. There is no depreciation of schooling-produced knowledge stocks while students are enrolled in school. K_{ES} and L_{ES} are the education system's fixed capital and labor services inputs.

These simple accounting relationships are directly related to the JF lifetime income approach to human capital measurement. Some observers have suggested that the JF 'market' component of human capital production be used to replace the existing measures of education services in conventional GDP (e.g. Ervik, Holmoy and Haegeland, 2003). Our 'inventory' approach is a different adaptation of the JF model for inclusion in conventional accounts. Like the JF work, however, and as discussed in Christian (2010, 2012), our approach includes values, volumes and prices as basic elements, and in that capacity embraces human capital within the conventional boundary of the SNA.

Mincer's (1974) seminal contribution mapped the theory of investments in human capital to the empirical literature on the returns to schooling. According to Mincer's model, at the end of each period of schooling, individuals (a) have a level of human capital consistent with that level of schooling, and (b) choose the optimal level of schooling (i.e. years in school) up to the point that the opportunity cost of one more year of schooling equals foregone earnings. This implies an individual's return to schooling must be commensurate with these foregone earnings. The Mincer framework underpins the JF lifetime income approach which is discussed in the next section.

[2] Note that this 'inventory' view follows the logic of Ruggle's approach to accounting for consumer durables (Ruggles, 1983; see also Moulton, 2001) and the SNA's approach to the treatment of valuables.

After recognition of schooling-produced knowledge assets, real investment in national accounts includes the net acquisition of knowledge capital held within the education system, ΔE, which is equivalent to the real gross output of the education system. Investments in schooling-produced knowledge assets tend to be a function of the age structure of a society and thus a relatively stable fraction of GDP in most advanced countries. This suggests that the implications of capitalizing education as social infrastructure for *real* GDP and productivity change will largely depend on trends in the implied price index for education services. Notwithstanding, recognition of schooling assets as societal wealth packs an extra punch for net savings and real net expenditures (relative to real GDP, that is) due to the fact that, in moving from GDP to real net expenditures, no depreciation charge is taken.

3. The Jorgenson Fraumeni framework

This section suggests a method of integrating the JF (1989, 1992a, 1992b) lifetime income approach to measuring human capital with the treatment of education as social infrastructure as argued above. The JF framework is set out below, followed by a discussion of conceptual issues that arise when using the framework to estimate the value of a society's investments in education.

3.1 The Jorgenson-Fraumeni framework

Lifetime income

We begin by abstracting from non-market activities, employment outcomes and labour force dropouts and simply assume that any student enrolled in school will in the following year, if they leave education, earn the market wage corresponding to that level of education.

The JF framework calculates the value of human capital stocks based on lifetime incomes by sex (s), age (a) and education level (e). Their original papers calculate this for all persons in the population. A more common approach is to calculate the stock only for the working population (e.g. Gu and Wong (2010) as well as Wei (2004)).

Let: y = current market income
li = lifetime income
δ = discount rate
g = average income growth
$senr$ = enrolment probability
sr = survival rate
pop = population.

The JF framework calculates lifetime income by sex, age and education for essentially two groups. It is assumed that no-one of the age of 40 or above is enrolled in education. The first group, for those aged 40 and over, is the most straightforward. The simplest assumption is to say that lifetime income is 0 beyond some age, say 70. For those aged 70, lifetime income (li) in year t is just current labour income (y).

(3) $li_{s,a=70,e,t} = y_{s,a=70,e,t}$

For those aged 69 lifetime income is current labour market income plus discounted future income of those aged 70 with the same education and gender, conditional on survival:

(4) $li_{s,a=69,e,t} = y_{s,a=69,e,t} + sr_{s,a=70,e,t} \frac{1+g}{1+\delta} y_{s,a=70,e,t}$

In general the lifetime income of those aged 40 or older is given by:

(5) $li_{s,a,e,t} = y_{s,a,e,t} + sr_{s,a+1,e,t} \frac{1+g}{1+\delta} y_{s,a+1,e,t} \qquad | \; a \geq 40$

This valuation for individual i at time t is the value of current income plus the income of those one year older of the same age, sex and educational attainment times growth in income discounted to the present, plus the income of those two years older and so on up to age 70. It therefore assumes that the best estimate of a person's income next year is that earned this year by a similar person who is one year older. The nature of the income growth term (g) is discussed further below.

For persons aged between 5 and 39, lifetime income takes account of if they are enrolled in education ($senr$) or not ($1 - senr$). For these age groups:

(6) $li_{s,a,e,t} = y_{s,a,e,t} + sr_{s,a+1,e,t} \frac{1+g}{1+\delta} \left[senr_{s,a,e,t} \, li_{s,a+1,e+1,t} + \left(1 - senr_{s,a,e,t} \, li_{s,a+1,e,t}\right)\right] \qquad | \; 5 \leq a < 40$

Thus, if a person aged a is enrolled in education level e, their lifetime income depends on that for a person one year older with level $e+1$. If the same individual is not enrolled in education, their lifetime income depends on that for an individual one year older with education level e. Finally, lifetime income for those aged 0 to 4 is calculated the same way as for those aged 40 and over except that earnings are zero and education is set at the lowest level.

Value of human capital

The total value of the human capital stock in year t can be calculated by summing the lifetime earnings by s, a and e:

(7) $HC_t = \sum_s \sum_a \sum_e pop_{s,a,e,t} \; li_{s,a,e,t}$

Note if the working population is used as the weighting factor in (5), then those enrolled in compulsory education (usually aged 5-15) no longer feature. This is an issue for calculating the output of the education sector as discussed below.

In measuring the nominal value of education as social infrastructure we concentrate on the portion of the population enrolled in education. Following Christian (2010), we estimate "*investment from education of persons enrolled in school*" as:

(8) $VES_t = \sum_s \sum_a \sum_e enr_{s,a,e,t} \; (li_{s,a+1,e+1,t} - li_{s,a,e,t})$

Enrolments (enr) are multiplied by the amount by which lifetime earnings at that age, sex and education change with the addition of one extra year of education and the one extra year of age required to achieve that additional education.

3.2 Valuing net investment in human capital for persons enrolled in education

There are a number of issues to resolve in order to value equation (8). These include the attribution of lifetime earnings to education, the utilisation of human capital through employment probabilities, the nature of the income growth term (g) as well as the discount rate (δ), the education progression of students and the treatment of foreign students. Finally, for the comparison of the monetary value of education services and education expenditures over time the relevant components of education expenditure have to be identified.[3]

Attribution

What is the income of a person one year older with the same education level capturing? In Mincer's canonical wage equation, in which individual j's wage is a return to human capital, there are two key terms: one is a return to schooling and the other one a return to work experience. This suggests that $HC_j = E_j + LX_j$ where HC_j is individual j's total human capital and LX_j is the portion acquired through work, i.e. labor market, experience. From the point of view of the schooling system, this suggests schooling-produced knowledge assets can be defined as the present discounted value of expected wages of graduates upon entry to the labour market, i.e. when the return to experience is virtually nil. Then the income stream arising from education services should be constant at the graduation earnings through time. In that case the lifetime income stream only depends on how long the person is in the workforce after graduation.

The other extreme is to assume that all future labour income is attributable to the level of educational attainment of the individual. This amounts to using the full JF calculation. However, in our context it is difficult to justify this assumption [4]. A practical solution might be to derive the wages on graduation as a T-year average from the point of graduation. This could be justified by assuming some degree of asymmetric information whereby firms do not pay the full marginal product immediately in case the worker turns out to be a lemon. We set T at three years for all qualifications and derive average earnings for those aged 16 and 17 if no formal qualification is obtained.

Another approach is to use Mincer regressions, controlling for other influences, such as experience, which was the method used by O'Mahony and Stevens (2009) and O'Mahony et al. (2012). While this method allows for direct modelling of the probability of employment, it leads to difficult econometric issues, mostly relating to identifying the difference between age and experience. We

[3] Ideally we would also include separate deflators for outputs and expenditures – see discussion below. This will be addressed in future work.

[4] This assumption is embedded in previous work by Christian (2010) and Gu and Wong (2010).

pursue this approach by modelling the following Mincer regression by sex and four age bands (age 16-19, 20-24, 25-29 and 30-69):

(9) $lnpay_{it} = \beta_1 exp_{it} + \beta_2 training_{it} + \beta_3 PT_{it} + \gamma' edu_{it} + \delta_t,$

where $lnpay$ is the logarithm of the individual i's gross weekly pay of the first and the second job (should the respondent have one) at time t multiplied by 52 weeks, exp represents the individual's years of work experience, $training$ is a dummy variable to control for any job-related education/training respondents carried out in the last 4 weeks and PT reflects if the individual is part-time employed. The experience variable is constructed by taking the average graduation age at each qualification level and deducting that from the current age at time t. We control for education attainment using a vector of covariates (edu) representing the highest qualification obtained and employ individual year dummies for 2002 to 2014. From this model we obtain coefficients on each of the formal qualification levels and predicted average wages by sex and age band. We then multiply these coefficients (1+coefficient) by the predicted wages of respondents without any formal qualification to obtain a wage gradient by sex and age. Most importantly, it depends on someone's qualification net of that person's work experience.

The calculations should also take account of the opportunity costs of staying in education beyond the age of compulsory education. However, these foregone earnings are likely to be small relative to lifetime earnings and, hence, they are not further adressed in this work.

Employment probabilities

If we ignore employment probabilities, we are estimating the potential human capital only adjusting for permanent exits, such as death and end of working life retirement. This would be equivalent to ignoring utilisation rates for physical capital. We deal with this by multiplying current income by employment rates, as is standard in calculations of human capital stock for the working population (Jones and Fender, 2011).

Growth in income and the discount rate

Constructing values for equation (8) requires assumptions about the growth in income g and the discount rate δ. A relevant question in our context is if g, which determines income growth, includes productivity and/or inflation gains. In other words, are nominal holding period gains to schooling part of the value of human capital? It seems that something of the sort must be there if g is, say 2% or 3% as in the human capital measurement literature. Thus, part of the nominal change in human capital may be in fact a holding period (i.e. capital) gain in a national accounting sense. The total change in the value of schooling produced assets is given by:

(10) $\Delta(P^{ES}E) = P^{ES}\Delta E + \Delta P^{ES}E$

where from before $P^{ES}\Delta E$ is the acquisition value of schooling-produced human capital, and the second term on the RHS is the holding gain (where other changes in volume and higher order terms are ignored). Looking at this equation makes it abundantly clear that the value of school system production is the first term on the RHS. The second term is not included as per the usual exclusion of asset valuation changes from GDP. In this case, it makes sense to set $g = 0$ if, as argued above, changes in individual's income after graduation mostly reflect experience and training which again suggests a zero value for g. On the other hand, if education effectiveness needs time to mature, especially perhaps for university graduates, and it is thought desirable to take a T-year average as discussed above, then setting $g > 0$ is likely necessary.

In addition, we need to assume a value for δ. In the JF framework this is the annual discount rate to construct the present value of the future income stream but it is not discussed in any detail in that literature. Theoretically, this should be a rate of time preference, which in this case would be a social rate. An empirical strategy for estimating the social rate of time preference (SRTP) for a country is set out in the OECD capital manual; updated SRTP estimates for each SPINTAN country are reported in Corrado and Jaeger (2015).

In the estimates below, we set $g = 2\%$ and $\delta = 3.5\%$ which are the usual assumptions employed in human capital stock calculations (Jones and Fender, 2011; Christian, 2010; Gu and Wong, 2010). Note that in equation (8) we are taking the difference between two lifetime earnings which depend on common values for g and δ. Therefore, the impact of assumptions on the values of these two parameters is minimal in our calculations. This is in contrast to the values of human capital stocks which are very sensitive to the parameter values (Jones and Fender, 2011).

Education progression

The UK data are available by type of qualification rather than years of education, divided into four groups: GCSE or equivalent (the typical exam qualification attained usually at the age of 16), A-level or equivalent (the typical exam qualification for those who stay on at school, usually attained at age 18), further education (FE – post secondary but below tertiary, typically vocational qualification that can either be a follow on from GCSE or sometimes from A-level) and higher education (HE- tertiary education leading to a degree or equivalent). This means that assumptions need to be made to implement equation (8) in regard to progression across different types of qualifications. We aggregate all students up to the age of 16 and compare their lifetime income when they have GCSE with the lifetime income of someone with the same age but without any qualification. Lifetime income of students aged 18 and 19 who have A-levels are compared with lifetime incomes of those with GCSE aged 17 and 18. FE are compared with GCSE for those aged up to and including 18 and with A-levels for students up to and including age 21. HE is compared to A-levels rather than FE as most students go to University following A-levels rather than progression via FE qualifications. This comparison is carried out for all students aged between 16 and 39.

Foreign Students

The knowledge assets of graduates exiting the country needs to be excluded in this calculation if the probabilistic full resource cost of the annual education of foreign students is charged to them (i.e. their charges reflect the costs of their education discounted by the probability they enter the domestic labour force). In this way P^{ES} retains its interpretation as the domestic price of schooling-produced domestic knowledge assets because the cost incurred in producing a foreign graduate is fully offset in revenues, which are subtractions from nonmarket production values estimated on the basis of production costs.

Deflators

These calculations are in nominal values. Real education output can be estimated as weighted enrolments, with weights equal to the present value of the lifetime return to an additional year in education. For example, Gu and Wong (2010) estimate a volume index of education output as:

$$(11)\quad lnQ_t - lnQ_{t-1} = \sum_{s,a,e} \bar{v} \left[\ln(enr_{s,a,e,t}) - \ln(enr_{s,a,e,t-1})\right]$$

where $\bar{v}$ is the share of individuals with s, e, a in the total value of investment in education, averaged over year $t-1$ and t. The price index of education services (P^{ES}) can then be estimated by dividing the nominal value of education services by the volume index of education services.

Christian (2012) also discusses the alternative of measuring real net investment in education by deflating nominal net investment in education by the consumer price index. He terms this an outcome based measure as it captures the amount of goods and services that could be consumed by the education services rather than the amount produced, i.e. it captures the opportunity cost of foregoing current consumption for investments in schooling. A third alternative is to divide $P^{ES}E$ by the number of school system graduates in the workforce (aged < 40).

As noted above we have not constructed deflators for education output in this version as we do not have deflators for the expenditure values. This will be addressed in future work.

Education services and education expenditures

What is the relationship between the nominal value of investment given by equation (8) and expenditures on education as currently measured in national accounts (i.e. education costs)? It could be a measure of rate of return, or effectiveness of the school system, so that

$$(12)\quad P^{ES}\Delta E = \gamma * expenditures$$

where γ (≅ 1+rate of return) can be equal to, greater than, or less than one. We usually think of 'effectiveness' as a correction for quality but here it is more like a rate of return. If $\gamma > 1$, it can be interpreted as a measure of societies' return from investing in education and can be compared to returns from investment in other assets. If $\gamma < 1$, then one could say that there is a penalty exacted from society due to the resources of the school system not being used effectively or, put differently, due to the labour market not using schooling-produced human capital effectively (i.e. when there is long-term unemployment).

The potential policy relevance of γ suggests that the assumptions used to derive equation (8) - the attribution of lifetime earnings to education, the treatment of employment probabilities, the choice of the income growth and the discount rate, the education progression of students and the treatment of foreign students - need to be conceptually valid and empirically well understood. Given the large number of assumptions required, γ is best compared over time or across countries rather than putting too much weight on its absolute value. Note further that if the LHS of equation (12) replaces education expenditures in intangibles-augmented growth accounts, the contribution of the education services sector to productivity growth is boosted (or diminished) directly by γ.

In this paper we are primarily concerned with the societal return from general government expenditures and so we exclude other sources of education financing, such as fees paid by households (for private schools and for universities), and revenue generation by universities from such activities as residences and catering, income from intellectual property rights, research grants, income from health and hospital authorities etc. (see further discussion below).

4. Data sources

We use standard data sources to carry out the computations described above for the UK. These are:

- The cross-sectional quarterly Labour Force Survey for earnings and employment rates by gender, age and qualification.
- The cross-sectional quarterly Labour Force Survey for population estimates by gender, age and qualification which are benchmarked to published ONS estimates by gender and age.
- The longitudinal quarterly Labour Force Survey for enrolment probabilities by gender, age and qualification.
- Department for Education and Skills for school and FE enrolment rates by gender and age.
- Higher Education Statistics Agency (HESA) for unpublished HE enrolment rates by gender, age and students' domicile prior to enrolling in HE.
- ONS Life Tables for survival probabilities.
- Education expenditures from Classification of the Functions of Government (COFOG) tables.

Enrolment numbers on students in primary and secondary education are obtained from maintained schools (which account for approximately 94% of all pupils in the UK) as well as special schools. Maintained schools are state-funded and funding is disbursed by the Local Authority. As we are comparing with public expenditures, we omit private schools, which account for about 9% of total pupils enrolled in education in the UK. Furthermore, we exclude enrolments of part-time students in FE and those aged greater than 21 as these students are likely to be taking courses that are paid for by the individuals themselves or by their employers.

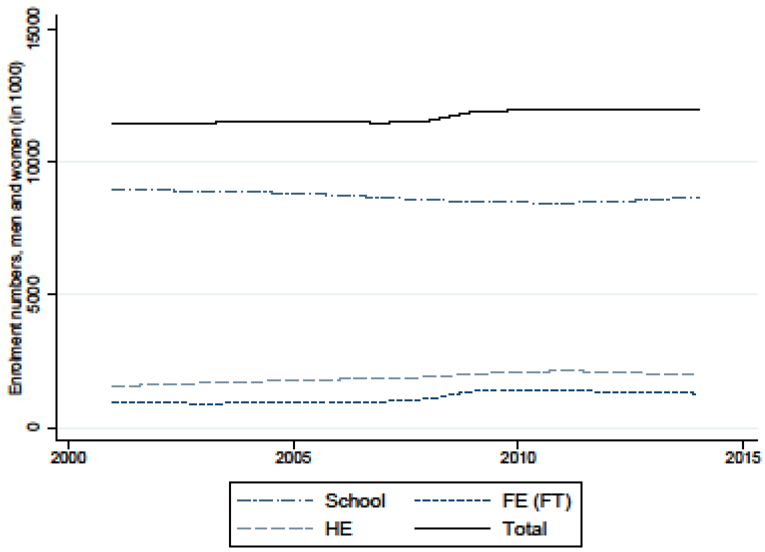
In this paper, we distinguish between EU and non-EU students, using unpublished data from HESA , since only the latter are considered 'foreign' in the UK. EU citizens, at least up to now, have the right to remain. This is a crude assumption since some graduates from other EU countries return to their native country and some non-EU graduates remain in the UK. As a result, we are likely to underestimate education services to the extent that some non-EU students remain and work in the UK post-graduation and we overestimate the value by implicitly assuming that all EU students stay and work in the UK. Since data on foreign nationals working in the UK cross classified by their domicile of study is limited and the net effect is expected to be small, this treatment of foreign and domestic students is employed.

Data on general government expenditure is aggregated across the following functions: pre-primary and primary education, secondary education, post-secondary and non-tertiary education, tertiary education, R&D, subsidiary services to education, education not definable by level and education n.e.c. In the national accounts, tertiary education is classified to non-profit institutions serving households (NPISH). Universities receive some funds from general government but also receive revenue from other activities as noted above, which are classified to NPISH and not in COFOG, as well as income from financial and non-financial corporations and fees paid by households. Satellite accounts for education are being prepared by ONS that will allow division of expenditures by government, NPISH, households etc. However, currently only preliminary estimates are available for one year, so we concentrate here only on general government expenditures.

5. Results

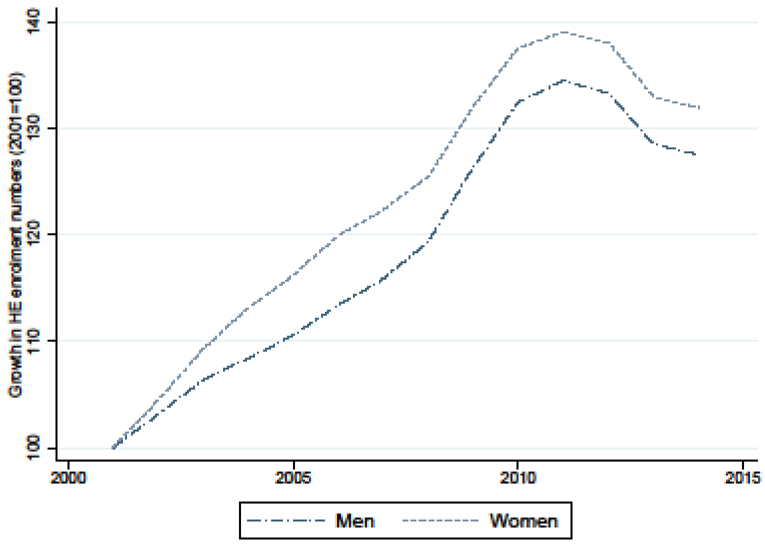
It is useful first to look at enrolment numbers in the period under study to get an idea of the composition of the UK education sector. Figure 1 shows the total numbers and the division by three groups, school, FE and HE. School is by far the largest group, reflecting that pupils typically spend 11 to 13 years in this form of education whereas they spend only three to four years in HE and about two years in FE. This shows a slight upward trend in aggregate enrolments (shown by the black solid line), which is the result of two opposing trends: a generally downward trend in school enrolments at least up to the year 2012 and increases in both FE and HE. Moreover, at first look, it appears that the financial crisis may have had an impact on FE enrolment with high growth rates during the crisis period and some fall off after that.

Figure 1: Number of enrolments in UK education, 2001-2014



When looking at the growth in HE enrolments (indexed at 2001) in Figure 2, a decline in HE enrolment growth for both genders after 2010/2011 can be observed. This decline is likely to be a consequence of the introduction of full cost fees for most university programmes in 2012. The graph further suggests higher growth among females, a trend that is observed in many countries.

Figure 2: Growth in enrolments in HE by gender (index 2001=100), 2001-2014



A different illustration of growth in HE enrolments is shown in Figure 3, which displays growth in foreign compared to domestic HE male and female students (index 2001=100). It shows that much of the growth in this sector in recent years has been in the international market with foreign students in 2014 comprising 15% of the student population, from 8% in 2001. The figure shows further that growth trends have been very similar across both genders regardless of their native country. The obvious exception are foreign students in recent years, where growth has slowed down for males but has continued to be strong for female foreign enrolments.

Figure 3: Growth in enrolments in HE by domicile and gender (index 2001=100), 2001-2014

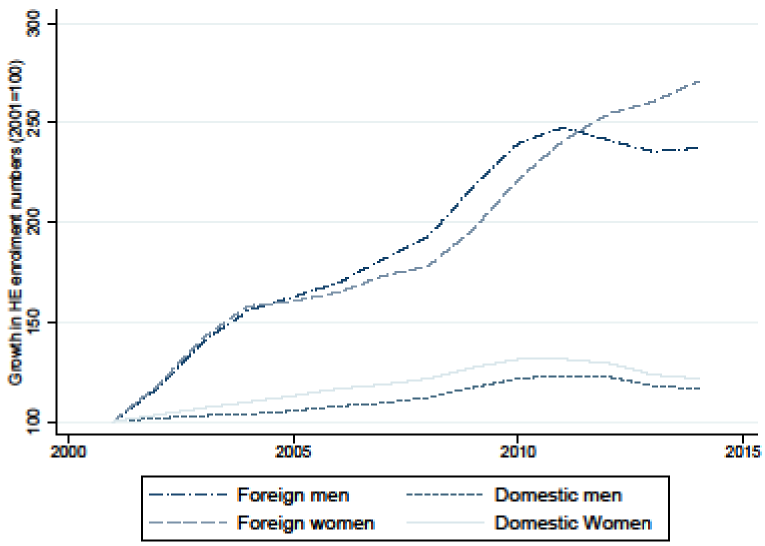


Table 1 shows a snapshot of the nominal value of education services for 2013 under a number of scenarios. When we account for attribution taking a T-average wage after graduation, the nominal values decline by about 26%. Removing foreign students reduces this by a 13%. Taken together the two adjustments lead to nominal values of education services that are about 65% of the unadjusted values. When attribution is accounted for by using a Mincer wage regression, the nominal values decline by about 44%. When also removing foreign students, the two adjustments lead to nominal values of education services that are about 48% of the unadjusted values. While the effects of these adjustments are very similar across both genders when taking a T-average, the adjustments are somewhat larger for females when a Mincer wage regression is applied instead.

Table 1: Education outputs, comparison of variants, 2013

	Investments (in £ million)			Ratio to A		
	Men	Women	Total	Men	Women	Total
3 year average after graduation						
A. baseline: including employment propensity	240,149	233,702	473,850	1.00	1.00	1.00
B: A + attribution	174,113	175,688	349,800	0.73	0.75	0.74
C: A + excluding foreign students	205,514	206,243	411,757	0.86	0.88	0.87
D: + B + C	150,131	155,527	305,657	0.63	0.67	0.65
Mincer wage regression						
A. baseline: including employment propensity	240,149	233,702	473,850	1.00	1.00	1.00
B: A + attribution	149,189	114,298	263,486	0.62	0.48	0.56
C: A + excluding foreign students	205,514	206,243	411,757	0.86	0.88	0.87
D: + B + C	128,093	101,428	229,521	0.53	0.42	0.48

Table 2 shows the ratio of the investment estimates in Table 1 for the total in 2013 to general government expenditure. Without adjustments the value of educational services is more than five times as high as the costs, suggesting a high societal return from this activity. With adjustments for attribution and foreign students the ratio is smaller but remains significantly greater than 1. It is 3.4 and 2.6 when using a T-average wage after graduation and the Mincer wage regession to account for attribution, respectively. Therefore, on this measure society obtains a high economic benefit from education.

As mentioned above, expenditures do not include fees paid by households and expenditures classified under NPISH. A crude calculation using data from the education satellite accounts suggests that if domestic university fees were included, then the ratio in the final row of the first panel would decline from 3.4 to 3.1. If we additionally included all financing classified to NPISH, the ratio would fall to 2.5. However, arguably much of the activities of universities is not directly related to producing education services and so it is difficult to justify including these items in the expendiuture totals.

Table 2: Ratio of total education investments to expenditure, comparison of variants, 2013

	Total investments (in £ million)	Ratio to expenditure
3 year average after graduation		
A. baseline: including employment propensity	473,850	5.3
B: A + attribution	349,800	3.9
C: A + excluding foreign students	411,757	4.6
D: + B + C	305,657	3.4
Mincer wage regression		
B. baseline: including employment propensity	473,850	5.3
B: A + attribution	263,486	3.0
C: A + excluding foreign students	411,757	4.6
D: + B + C	229,521	2.6

Finally, in this section we present the time series for the ratio of investment to expenditure, shown in Figure 4. It uses the figures adjusted for both types of attribution treatments together with the removal of foreign students. While this graph plots the series for education services and expenditure separately, Figure 5 shows the ratio of the two. Here the results are not so sanguine as they show a downward trend over the entire period. The pronounced downward trend in the early years reflected a reduction in school enrolments which coincided with an increase in expenditures in that sector. Since 2009 enrolments in schools increased slightly while enrolments of domestic students in HE declined towards the end of the period shown, with expenditures declining. The net effect is no discernible trend in the ratio of outputs to expenditure in the second half of the period.

Figure 4: Growth of educational services and expenditures (index 2001=100), 2001-2014

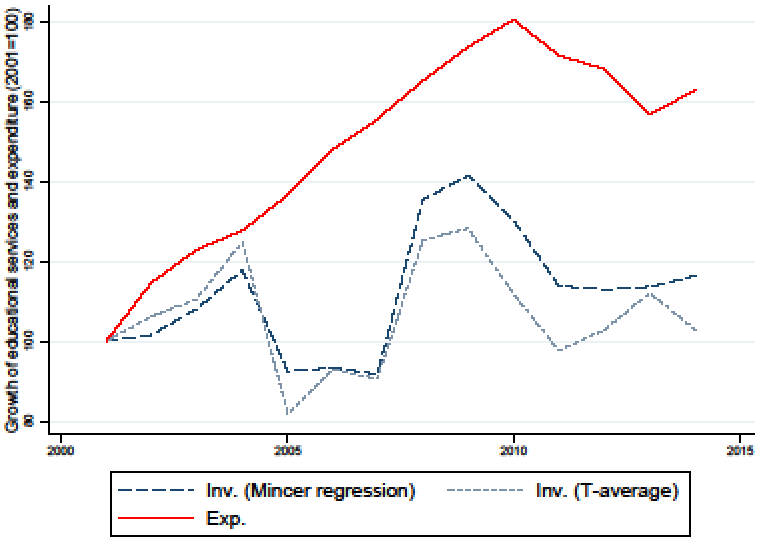
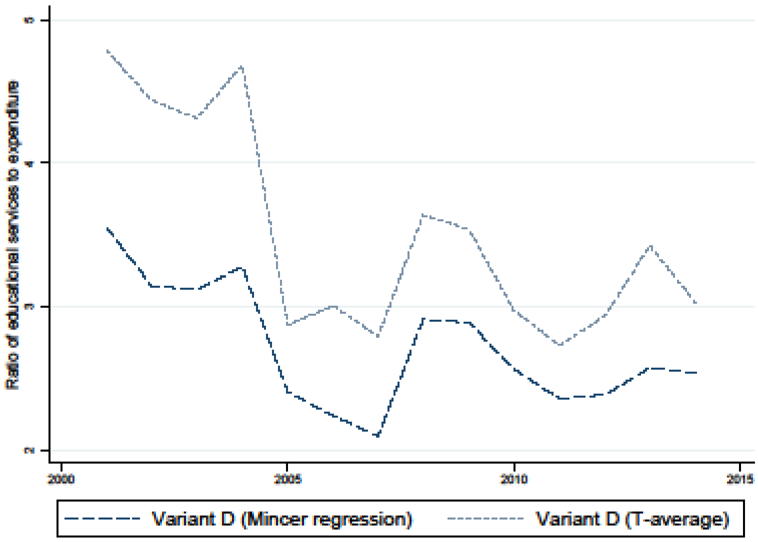


Figure 5: Ratio of the value of educational services to expenditures, 2001-2014



6. Conclusion

Using a lifetime income framework, this paper estimates values for education services that exceed expenditures for the UK in 2013. However, there is some suggestion that the ratio of education services values to expenditures has been declining over the past decade or so, largely due to declining enrolments in schools coinciding with increased expenditure. Ideally, we would want to use separate deflators for output and spending to consider real ratios. Also more refined measures of expenditure are needed. Together with a cross-country comparison with the US, these will be considered in future analysis.

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