Measuring the UK’s Human Capital Stock

Methodology Guidance

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Introduction

For over three centuries economists have been interested in valuing the productive capacity of the workers in an economy. Responses to the recent ONS consultation on measurement of human capital identified that this measure of human capital has several potential policy applications. First, it can be used as a measure of an economy’s future well-being as the empirical work on economic growth suggests that countries with higher levels of human capital, other things being equal, have greater potential output and income in the future. In addition, the measures can be used in the assessment of the impact of an ageing population, changes in retirement ages and in the evaluation of the economic benefits of different levels of education.

ONS have adopted the technical definition for human capital provided by the Organisation for Economic Co-operation and Development (OECD), which defines human capital as;

“the knowledge, skills, competencies and other attributes embodied in individuals or groups of individuals acquired during their life and used to produce goods, services or ideas in market circumstances.” (OECD, 2001)

In addition to this definition it is important to underline that human capital can be invested in at any time of life through a number of methods.

Despite advances in accounting systems, present day national accounts are still considered by some to be limited in their analysis of human capital. Recognising this, the Atkinson Review (Atkinson, 2005) and the Commission on the Measurement of Economic Performance and Social Progress (CMEPSP, 2009) recommended the development of measures of the stock of human capital. There is international acceptance of the need to improve measures of human capital and ONS is a member of an international consortium developing such measures.

In December 2010 ONS published the first estimates of Human Capital in the UK (Jones and Chiripanhura, 2010), and further experimental estimates were published in 2011 (Jones and Fender, 2011). Developments to these statistics have remained ongoing, and following a public consultation, this paper presents the current methodology developed by ONS to produce the experimental estimates of the UK’s human capital stock.

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1 Other members of the consortium are 14 other OECD countries (Australia, Canada, Denmark, France, Italy, Japan, Korea, Mexico, Netherlands, New Zealand, Norway, Poland, Spain, and the United States), two accession countries (Israel and Russia) and one non-member country (Romania). Eurostat and the ILO are also members of the consortium. The consortium is assisted and coordinated by the OECD Secretariat.
Why is Human Capital Important?

Macroeconomic Effects

At a macroeconomic level, the accumulation of human capital is theorised as being an important driver of output growth (Solow, 1988; Romer, 1989a, 1989b and 1994). However, difficulties in controlling for other influences on growth, establishing the direction of causation and data limitations means that the link between human capital and growth was not always fully supported by empirical work e.g. Barro and Lee (1993, 1996). More recent work using better data and more sophisticated analytical techniques, is more supportive of the relationship between growth and human capital (Barro and Sala-i-Martin, 2004; Durlauf et al., 2005). Thus, to the extent that relationship holds, those countries with higher levels of human capital have greater potential for future growth, other things being equal.

Microeconomic Effects

At the microeconomic level, individuals' labour market outcomes are linked to their human capital. Steedman (1996) reports that in the UK adult population, individuals with low skills or levels of education are more likely to be unemployed and face social exclusion.

The economics literature contains hundreds of studies showing positive associations between human capital (in particular educational attainment) and earnings (see Card, 1999, Psacharopoulos and Patrinos, 2004 for reviews). There is, however, some disagreement over the reason(s) for this association. The obvious explanation is that education directly increases the productivity of individuals. Early empirical studies by Denison, (1962), Kendrick (1976), Jorgenson and Griliches (1967) and others found that the impact of human capital on productivity is positive. An alternative explanation may be that those people who acquire more education are more able and/or more motivated than those who do not, and earn more because of this. Closely related to this is the idea that educational attainments perform a signalling function by identifying more productive workers rather than directly raising productivity. The idea is that more able individuals find it less costly, in terms of time and effort, to acquire higher levels of education. Thus, the acquisition of qualifications indicates ability and motivation rather than directly increasing productivity (Spence, 1973 and Weiss, 1996).

Inequality and Human Capital

During the 1980s, the demand for less-skilled workers in developed countries fell sharply. Bartel and Lichtenberg (1987) argued that technological innovation alters demand in favour of better educated workers because they have a comparative advantage in implementing new technologies. The reduced need for unskilled workers has led to a relative fall in the real wages of low-skilled workers. This in turn contributed to the widening of the income distribution in many industrialized nations including the UK and the US (Berman et al, 1998).

Part of the observed pay gap between men and women is related to the acquisition of human capital. Mincer and Polachek (1974) suggested that, on average, women have a

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2 It may be that as countries become richer they are able to devote more resources to education and training etc.
weaker attachment to the labour market than men and therefore have less incentive to acquire human capital in the workplace, other things being equal.

Inequality might also persist over time as educational attainments are highly correlated between generations in families (Gang and Zimmerman, 2000; Francesconi et al., 2005). Parental educational attainment has an impact on their children’s future outcomes. Greenwood (1997) and Maynard and McGrath (1997) summarise the literature on these effects. They report that higher parental education is associated with lower incidence of teenage childbearing; lower levels of child abuse and neglect; better performance in school and in the labour market by the children; lower criminal propensities in children; and better health. These impacts are significant even after controlling for parental income.

Externalities

Investment in human capital may also generate externalities. These are outcomes that are due to the investment decision of some individuals but affect people who did not invest in education and for which no compensation is paid. Several examples have been suggested in the literature. Lucas (1988) and Jovanovic and Rob (1989) consider technological externalities, where the free movement of workers between firms within the same industry sectors and similar production technologies facilitates the transfer of knowledge and ideas. Acemoglu (1996) presents a model in which imperfect information in the employer-employee matching process generates an externality. Higher earnings may underestimate the value of acquiring human capital since jobs which require more schooling are likely to be more desirable on both monetary and non-monetary grounds (Rosen, 1985).

Social Effects

Evidence on many of the social effects of human capital and in particular education is reviewed in more detail by Behrman and Stacey (1997) and Haveman and Wolfe (1984). Human capital has been related to improved health outcomes (e.g. Grossman and Kaestner 1996); lower crime rates (Grogger, 1998 and Lochner and Moretti, 2004); measures of social capital, trust and social participation (Helliwell and Putman, 1999; Milligan et al., 2003 and Schuller et al., 2001).

Diminishing Returns

The literature presented so far suggests that greater expenditure on human capital brings important benefits. However, it is important to note that there may be diminishing returns to spending on education for higher levels of economic development (Hanushek and Dongwook, 1995). The rapid growth in educational attainment and levels of literacy in the past decade suggests that human capital is not in short supply in OECD countries. Moreover, a number of economists have suggested that there may be some ‘over-education’ taking place in Europe and the United States (see Sloane, 2003 for a review of the literature).
The Accounting Treatment of Human Capital

Capital theory is one of the most difficult and contentious topics in economic theory and accordingly the measurement of capital is one of the most complex dimensions in the official national accounting system. It has taken many years for statisticians to develop and establish the existing physical capital measurement system as it is within the System of National Accounts (SNA) 2008. Even so, there is still disagreement on several important issues.

One such debate concerns the accounting treatment of human capital; in particular whether expenditure on goods and services such as education and training should be treated as consumption or investment expenditure. This question stems from the observation that, similar to investment in other assets, individuals devote resources to their education incurring direct costs such as tuition fees, books etc and the indirect cost of the earnings foregone whilst studying in the hope of gaining a return on this investment in the form of higher earnings (Shultz, 1960, 1969 and 1971; Becker, 1975). Similarly, governments invest significant resources in the education system in the anticipation of securing benefits to society.

The European System of Accounts (ESA10) (Eurostat, 2010) defined economic assets as “a store of value representing the benefits accruing to the economic owner by holding or using the entity over a period of time. It is a means of carrying forward value from one accounting period to another”

OECD (1996) set out four conditions that must be met by a resource for it to be treated as an asset of an entity for accounting purposes:

- It must be an economic resource:
- The resource must be controlled by the entity:
- The cost at the time of acquisition must be objectively measurable: and
- In day-to-day transactions, capital and labour markets place value on the output potential of the asset.

SNA 2008 acknowledged that investment in human capital exhibits many of the characteristics of a fixed asset in that ‘it raises the productive potential of the individuals concerned and is a source of future economic benefit to them.’ SNA 2008 and ESA10, however, exclude human capital from the asset boundary arguing that human capital is:

- Non-physical.
- Non-appropriable. SNA 2008 purports that expenditure on human capital investments should not be treated as fixed assets because, “they are embodied in the individuals as persons” and “cannot be transferred to others and cannot be shown in the balance sheets of the enterprises in which the individuals work”.
- Difficult to measure

Although, both SNA 2008 and ESA10 encourage users to explore alternative conventions in the form of satellite accounts.
Appelbaum and Hood (1993) argued that non-appropriability need not necessarily be a problem since if equipment can be measured by its original cost, human capital should also be measured by its original cost. In the event that an employee leaves the organization, the remaining unamortized cost can be written off. For example, professional sports teams’ players are traded and thus human capital can have the exchangeability characteristic.

Several authors have countered the SNA’s argument that the human capital is difficult to measure and have proposed several methods for doing so. These methods and the issues involved are discussed in the next section.

The estimation method used for measuring human capital is quite different from that conventionally used for physical capital, where the directly available information covers the quantity of new capital goods added to the existing capital stock. The magnitude of the stock is indirectly derived using the perpetual inventory method. As the owners and users of capital goods are often one and the same, the quantity of capital services has to be imputed indirectly as well. For human capital, the value of labour services is directly observable from labour market transactions. The associated stock of human capital can be directly estimated by how much this labour is worth, the present value of discounted lifetime labour income streams. Because the changes in the human capital stock between the beginning and the end of an accounting period must equal the sum of human capital flows, the amount of investment in human capital is indirectly derived by decomposing the stock changes into various components.
Alternative Methods for Measuring Human Capital

It is generally acknowledged that there are three main approaches to measuring the human capital stock:

- using educational attainment
- using the value of the inputs that enter the production of human capital (input or cost-based approach)
- using the output that stems from human capital that is typically measured by labour market income (also called the income based approach).

The Educational Attainment Based Approach

The educational attainment approach estimates human capital based on educational output indicators. This method is based on the assumption that these indicators are closely related to investment in education and this is a key element in human capital formation. Human capital encompasses more dimensions but education is arguably the most important component. A variation of this approach is to test individuals directly to determine whether they have certain attributes relevant to economic activity and then value these attributes accordingly. Several measures have been used in the literature. For example, adult literacy rates (Romer, 1989 and Azariadis and Drazen, 1990); school enrolment rates (Barro 1991, Mankiw et al. 1992, Levine and Renelt 1992 and Gemmell 1996); and average years of schooling. The main limitation of these approaches is that they miss most of human capital attained beyond that elementary level, such as numeracy, logical and analytical reasoning and scientific and technological knowledge. Thus, they are unlikely to be good proxies for human capital in developed countries (Judson, 2002). Establishing the direction of causality may also be difficult as high enrolment may result from high productivity growth, rather than vice versa (Wolff, 2000).

Psacharopoulos and Arriagada (1986 and 1992) and Barro and Lee (1996) used a measure that has several advantages over literacy rates and school enrolment rates. First, it is a valid stock measure. Second, it quantifies the accumulated educational investment in the current labour force. Wachtel (1997) showed that under particular assumptions, the number of schooling years is equivalent to cost-based measures of human capital. The studies that have attempted to develop data series on years of schooling can be divided into three groups based on the method they employ: the census/survey-based estimation method (e.g. Psacharopoulos and Arriagada, 1986 and 1992), the projection method (e.g. Kyriacou, 1991); and the perpetual inventory method (Lau et al., 1991).

This proxy has a number of short-comings. First, the years of schooling measure fails to allow for the costs and returns of education varying at different levels. Thus, this measure incorrectly assumes that one year of schooling always raises human capital by an equal amount. For example, a worker with ten years of schooling is assumed to have ten times as much human capital as a worker with one year of schooling. This assumption is at odds with the empirical literature which has typically documented diminishing returns to education (Psacharopoulos, 1994). Second, no allowance is made for differences in quality of education across time and location. Behrman and Birdsall (1983) found that neglecting
quality of schooling biased estimates of returns to schooling. Since the quality of schooling varies more considerably across countries than within one country, overlooking quality is likely to create more severe biases. Third, this measure unrealistically assumes that workers of different education categories are perfect substitutes for each other as long as their years of schooling are equal.

While informative for a number of purposes, these indicators are less suitable for other uses such as the assessment of the ‘sustainability’ of a development path, which require comparing changes in the aggregate stock of human capital with those in the stocks of other types of assets. Such comparisons typically require a common monetary metric.

Cost of Production Approach

The cost of production method values the human capital stock as being the depreciated value of the monetary amount spent on investment in human capital. Kendrick (1976) and Eisner (1985, 1989) provide seminal examples of this approach. One advantage of this approach is that it provides an estimate of the resources invested in the education and other human capital related sectors, which can be useful for cost-benefit analyses.

This approach has several limitations. The first is that it is only supply-side based, yet the value of human capital is also determined by the demand for it. This makes cross-sectional and inter-temporal comparisons difficult. This method also fails to take account of the heterogeneity of individuals. As an illustration, consider two children one of whom is innately less able than the other. To the extent that it more expensive to educate the less able child to a particular attainment level the cost-based approach will overestimate that child’s human capital while underestimating the human capital of the more able child. Similarly, differences in the quality of education providers are ignored in this method. For example, schools vary in their quality as do the teachers within schools. Hanushek (2000) and Lavy (2002) found that after social background, the quality of teaching is the best predictor of how well students do in school.

Another difficulty of this approach is identifying which costs should be included and how they should be measured. Simply reclassifying all human capital expenditures as investment rather than consumption may not be correct. To the extent that individuals enjoy their courses or have their range of interests, tastes and activities extended, educational expenditures also provide some consumption benefits. Thus, the difficulty lies in determining which part of educational expenditure is investment spending and which part is consumption (see Schultz, 1961 and Shaffer, 1961 for a discussion). Part of the expenditure on schooling could also be regarded as a form of childcare in that it provides children with a safe environment allowing their parents to use their time in other ways. Similarly, Kendrick (1976) classified the costs of raising children to the age of fourteen as human capital investments, reasoning that these expenses, typically on necessities such as food and clothing, compete with other types of investment. This contradicts Bowman (1962) and Machlup (1984) who argued with this view, maintaining that basic expenditures should be considered as consumption.

Calculating the depreciation rate is an important element of this method. Like physical capital, human capital depreciates over time, because of:

- The wear of skills due to ageing, or illness;
• The atrophy of skills due to insufficient use;
• Job-specific obsolescence due to technological and organizational change;
• Sector-specific obsolescence due to shifts in employment; and
• Firm-specific skills obsolescence due to displacement (Grip and Van Loo, 2002).

Grip and Van Loo also suggested ways in which the obsolescence of human capital could be measured as:

• Objective methods such as testing;
• Subjective method e.g. asking workers or their employers;
• Workers’ wages; and
• The probability of losing employment.

All measures have limitations. The last two indirect methods have the advantage that they measure the labour market effects of skills obsolescence that are the main concern on human capital obsolescence in a knowledge economy: a lower productivity and lower labour market participation.

The two main methods used to calculate depreciation in the literature are: the straight-line method (Eisner, 1988) in which a constant proportion of the original human capital is assumed to become obsolete in each period and the (modified) double declining balance method (Kendrick, 1976), in which depreciation is assumed to be higher in the early years of an assets life. The rationale behind this method is that physical capital depreciates faster in early years of life, so using the double declining balance method provides consistency across different types of capital. The appreciation of human capital is often ignored in the literature, despite some empirical evidence that showed that human capital can appreciate at younger ages (Mincer, 1958, 1974; Graham and Webb, 1979).

Some aspects of education aim to create ‘skills for life’ e.g. education attainment that enables individuals to enjoy leisure activities during and after their working life and these skills may appreciate or depreciate depending on use and wider factors.

The Output or Income Based Approach

The output or income based approach measures human capital by summing the discounted values of all future income streams that all individuals in the population expect to earn throughout their lifetime (Farr, 1853; Jorgenson and Fraumeni, 1989, 1992a and 1992b). This method is ‘forward-looking’ because it focuses on expected returns to investment, as opposed to the ‘backward-looking’ method whose focus is on the historical costs of production.

One advantage of this approach is that there is no need to assume an arbitrary rate of depreciation since it is already implicitly captured. The main limitation of this approach is that it relies on the assumption that labour is paid according to its marginal productivity. In practice, factors such as market power, trade unions, discrimination, etc all affect wages.
This measure is also sensitive to the choice of discount rate and the retirement age. This method relies upon accurate data on earnings, life tables and employment rates.

A variation of the income-based approach is presented by Mulligan and Sala-i-Martin (2000) who calculated an index measure of human capital. Specifically, they measure human capital as the total labour income per capita divided by the wage of the uneducated. The rationale for this method is that labour income incorporates not only the workers’ human capital but also the physical capital available to them, such that for a given level of human capital workers in regions with higher physical capital will tend to earn higher wages. Therefore, to obtain a ‘pure’ measure of human capital, the effect of physical capital should be taken into account. This method assumes that uneducated workers always have the same human capital, although they do not necessarily earn the same income.

A drawback which is common to all these approaches is that, as noted above, formal education and training are not the only determinants of human capital. Some of an individual’s capital is innate to them and is in some sense, a non-produced asset. Thus, the asset created by education could be regarded as improvements in human capital by education and training. Another drawback of these measures is that they focus on individual’s human capital and aggregate them to arrive at the population measure. This ignores spillovers between workers so that the whole may be more than the sum of the parts.

This paper applies the output or income based measure to value human capital in the UK. This method is preferred to a cost of input approach or a quality adjusted student count approach to measuring the output of education for several reasons. First, it allows output to be measured independently of inputs. Accordingly, the productivity of the education sector can be estimated. Students and the time they spent on education are inputs to the education process, not outputs. Second, it is difficult to quantify elements of the education process that produce higher output, accordingly it makes sense to use labour market evaluations as representing the worth of an educated individual. Quality-adjustments applied to student counts are typically very small and perhaps not fully representative of the difference between students (the inputs) and educated individuals (the output). Finally, the Atkinson Report (2005, para. 9.33-9.34) recommends exploring a lifetime income (human capital) approach such as that implemented by Jorgenson and Fraumeni.
Methodology

This section sets out how the output or income based approach is implemented. The methodology is described in two parts. The first part describes how the dataset is constructed and the second shows how the dataset is used to derive estimates of the human capital stock.

Stage One: Construction of the Database

The first stage is the construction of a database containing the economic value of labour market activities for various categories of people. This database contains information on the number of people, their earnings (when employed), enrolment rates for different levels of education, employment rates, and survival rates. All these data should, ideally, be cross-classified by gender, age and levels of educational attainment but this was not possible in all cases. For example, in practice, most data on survival rates do not distinguish between different categories of educational attainment (i.e. survival rates differ only according to the age and gender of each person).

The main sources of data used in the analysis are the Annual Population Survey (APS), which is an annual version of the Labour Force Survey (LFS), and the longitudinal LFS. Previous estimates of Human Capital released by ONS used only the LFS. However, prior to the publication of the 2013 release and following user consultation in early 2013, the decision was made to alter the data source to the APS to take advantage of the larger sample size.

Both surveys are conducted by the Office for National Statistics. The APS and LFS collect household and individual data from a nationally representative sample. This source was chosen ahead of other data sources because it contains relevant demographic and labour market information. The survey is also on-going and has a collection of previous waves allowing the construction of a time-series of estimates back to 2004.

In common with other studies, this paper focuses on effective human capital (that is, human capital of people of working age) as this is more relevant for growth and for comparative purposes than estimates that cover the whole population. Thus, the paper focuses on individuals aged between 16 and 64 years, as these limits mark the end of compulsory education and the current retirement age. This is the convention that has been adopted by members of the international consortium developing measures of human capital and is a somewhat arbitrary choice that, while not crucial, could easily be relaxed and extended to other age groups.

Previous estimates (Jones and Chiripanhura, 2010 and Jones and Fender, 2011) have valued the human capital of those people not in employment as zero. This is consistent with the OECD’s guidance on the measurement of physical capital which states that, "be counted as part of the capital stock all that is required is that assets are present at production sites

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3 The data has population weights that allows results for population to be derived from the sample onto the population it represents.

4 The retirement age for women is 60 years. However, we take 64 years as the general retirement age given the impending changes to the regulations.
and capable of being used in production or that they are available for renting by their owners to producers.” (OECD, 2001b pp 31). However, following the responses to the consultation on measuring human capital, from the 2013 estimates of human capital, ONS will also produce estimates of ‘full’ human capital, including the unemployed, which will be published alongside the human capital of those in employment.

Responses to the Labour Force Survey question on highest educational attainment are classified into 49 categories. To make the analysis practicable, these results are compressed into 7 wider categories:

- Degree or equivalent
- Higher education
- GCE A level or equivalent
- GCSE grades A-C or equivalent
- Other qualifications
- No qualification
- Don’t know

The survival rate is the conditional probability that a person who is alive in year \( t \) will also be living in year \( t+1 \). Information on survival rates, by gender and individual year of age, was derived from country life-tables published in ONS’ interim life tables.

**Stage Two: Using the Dataset**

In the second stage, the dataset is used to produce estimates of the human capital stock. Under competitive market conditions, the market price of an asset is related to the rental income that the asset is expected to earn through the following equation (the scrap value is ignored).

\[
V_t = \sum_{t=1}^{T} \frac{f_{t+t-1}}{(1 + \delta)^t}
\]

Where;

- \( V_t \) = the real market value of an asset at the beginning of year \( t \),
- \( f \) = the real rental income earned in each period,
- \( T \) = the service life of an asset in years,
- \( \tau \) takes values of 1, 2, 3,...,\( T \),
- \( \delta \) = the discount rate.

The corresponding equation for a labour asset involves using total labour earnings as the rental income and working life as the service. Therefore the real market value of an asset at the beginning of year \( t \) is the present value of lifetime labour income.
Lifetime labour income is calculated for a representative individual in each classification category (i.e. by gender, age and educational attainment) in the database. A key assumption used here is that an individual of a given age, gender and educational level will, in year t+1, have the same labour income and other characteristics (e.g. employment rate, mortality rate, etc.) as those of a person who, in year t, is one year older but has otherwise the same characteristics (e.g. gender and educational level).

Based on this assumption, the lifetime labour income of an individual was computed as follows;

- For individuals aged 65 and over (i.e. former default retirement age), their lifetime labour income is zero since, by assumption, these people will not receive earnings after withdrawing from the labour market.
- For people aged 16 to 64 (i.e. ‘study-and-work’ stage), their lifetime labour income (LLI) is estimated as in equation two.

\[
LLI_{age}^{edu} = EMR_{age}^{edu} ALI_{age}^{edu} + \left( \sum_{edu} LLI_{age+1}^{edu} PROB_{age}^{edu} \right) \left( 1 - MORT_{age} \right) \left( \frac{1 + r}{1 + \delta} \right)
\]

Where;

- \( LLI_{age}^{edu} \) = the lifetime labour income of an individual at a given age and educational attainment level,
- \( EMR_{age}^{edu} \) = the employment rate of the individual at a given age and educational attainment level,
- \( ALI_{age}^{edu} \) = the individuals current annual labour income at given age and educational attainment,
- \( PROB_{age}^{edu} \) = the probability that the individual at a given age and educational attainment level will change to a different educational attainment level in a single years time,
- \( MORT_{age} \) = the mortality rate for an individual at a given age,
- \( r \) = the labour productivity growth rate,
- \( \delta \) = the discount rate.

The summation in the second part of the equation takes into account the probabilities that people may improve their educational attainment multiplied by the income they are likely to earn given a change in their educational attainment. The summation sums for all six education attainment levels that an individual may obtain in the next year. At the start of each period, the representative individual in the next year can either continue their work, holding the same educational level as before or they may have improved their educational attainment level and will thus receive a different income. The chance that an individual changes from one educational attainment level to another the next year is given by \( PROB_{age}^{edu} \). An assumption is made that people cannot go down in educational attainment, as this lacks logic and can be assumed to be an error, thus all probabilities of a lower educational attainment in the next year are equal to zero.
The mortality rate is used in the equation to create a survival rate. It is a straightforward idea that an individual must be either alive or not alive in the next year. If the probability that they are not alive in the next year is given by $MORT_{age}$ then the probability that they are alive in next year is given by $(1 - MORT_{age})$. Therefore, their income in the next year is the expected value of the outcomes of these courses of action.

The empirical implementation of equation two is based on backwards recursion. In this approach, the lifetime labour income of a person aged 64 (i.e. one year before assumed default retirement) is simply their current labour income because their lifetime labour income at 65 is zero by construction. Similarly, the lifetime labour income of a person aged 63 is equal to his labour income plus the present value of the lifetime labour income of a person aged 64, and so forth.

In estimating lifetime labour income using this methodology several practical assumptions are made, some of which are used as well by other studies in the field (e.g. Gu and Wong, 2008; Le et al, 2006; Liu and Greaker, 2009; Wei, 2004, 2007). The most important assumptions are as follows:

- The rate of labour productivity growth is assumed to be 2 per cent per annum, as estimated by Lindsay (2004).
- The discount rate is assumed to be 3.5 per cent per annum, as recommended by HM Treasury’s Green Book (2003), which provides guidelines for appraisal and evaluation in central government.
- Individuals can only enrol in a higher educational level than the one they have already completed.
- No further enrolment is allowed for people having already achieved the highest educational level.

The lifetime labour income measures estimated through equation two are applied to all individuals in each age/educational category to compute human capital stock for each respective category. Summing up the stocks of human capital across all classified categories yields the estimate for the aggregate value of the human capital stock, given by:

$$HC = \sum_{age} \sum_{edu} LLI_{age}^{edu} N_{age}^{edu}$$

Where:

- $HC$ = Monetary value of the stock of human capital.
- $N_{age}^{edu}$ = the number of individuals in the corresponding age and educational attainment category.

Equation three can be applied separately to both males and females to estimate the stock of human capital.
‘Full’ and ‘Employed’ Human Capital

As previously discussed, previous ONS estimates of Human Capital have valued the human capital of those people not in employment as zero – thereby estimating ‘employed human capital’. This is consistent with the OECD’s guidance on the measurement of physical capital which states that, “be counted as part of the capital stock all that is required is that assets are present at production sites and capable of being used in production or that they are available for renting by their owners to producers.” (OECD, 2001b pp 31).

However, following the responses to the consultation on measuring human capital, from 2013, estimates of human capital produced by ONS will also include estimates of ‘full’ human capital. These estimates will include the human capital of the unemployed, valued at the lifetime labour income of an employed individual with the same characteristics.

Valuing the human capital of the unemployed at the same rate as an individual with the same characteristics that is employed is a key assumptions here which could be disputed. This assumption does not take into account any long term scarring effects of unemployment which have been shown to be important (Nilsen & Reiso, 2011). Further work on the estimates could look at taking better account of this.

Limitations

As acknowledged in methodology section, this approach has some weaknesses. First, it relies on the assumption that labour is paid according to its marginal productivity. In practice, a range of institutional factors affect earnings. These measures are also sensitive to the choice of the discount rate and the retirement age. This method relies upon the use of current age-earnings profiles to project future earnings flows. The approach assumes that the attainment of educational qualifications is the main driver of higher earnings. Non-educational factors such as ability and family background are not taken into account. Thus, the estimated effect on lifetime labour incomes of education is likely to be over-estimated.

Further work

Non-wage benefits could be incorporated into the returns qualifications. This is an important consideration when interpreting the relative valuation of human capital for women and men reported. These experimental estimates of human capital are calculated using market factors only. Human capital is also important for non-market activity. Thus, one cannot conclude that male human capital is more ‘valuable’ to society than female human capital. Future work could incorporate imputations of the value of non-market labour activity, including household production and leisure into the measures of human capital.

The discounted lifetime income framework only considers formal education in its estimates of investment in human capital that enhances individuals’ skills and knowledge, with the component of on-the-job training being mixed with its estimation of human capital. The standard human capital theory also emphasises the role of on-the-job training in human capital formation. This could be combined with the stock estimates to produce a capital accumulation account.

In addition, the importance of a regional breakdown was identified through public consultation and therefore this is an area which requires further work.
References


Jones and Fender (2011) Human Capital Estimates, 2010


