Department
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The economic value of key intermediate qualifications: estimating the returns and lifetime productivity gains to GCSEs, A levels and apprenticeships

Research report

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Hugh Hayward, Emily Hunt & Anthony Lord - Department for Education

Acknowledgements

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Executive summary

Improving individuals' outcomes is a key goal of education. It is therefore important from a policy perspective to understand the impact of qualifications in the labour market. Do more qualified individuals earn more, and are they more likely to be employed? If the answer is yes, is it possible to estimate the monetary benefits to society of a more educated workforce? Having robust and up-to-date evidence on the economic benefits of achieving qualifications is critical to educational investment decisions – and a key driver of this research project.

Numerous UK studies estimate the wage returns and the increased probability of being employed (employment returns) to individuals who hold particular qualifications. These are derived using data from either the Labour Force Survey (LFS) or from cohort studies which follow individuals throughout their lives. However, such estimates typically pre-date the recession, and in some cases, are insufficiently granular for policy appraisal purposes[1].

Recent studies have also estimated the lifetime benefit to achieving qualifications through higher economic output (or productivity). However, these have focused on vocational qualifications, rather than GCSEs or A levels.

This paper makes a contribution to the literature by providing more up-to-date, robust and granular estimates of the economic value of key intermediate qualifications. Our specific focus is on GCSEs, A levels and apprenticeships at levels 2 and 3. We estimate the economic value of qualifications in two ways:

- First, we estimate the wage and employment returns to specific qualifications by comparing the wage and employment outcomes of individuals who hold those qualifications to similar individuals qualified to the level below. This is the most policy relevant comparison group. We distinguish between the marginal return – for individuals who hold the qualification as their highest – and the average return – which includes all individuals who hold the qualification.

- Secondly, we use these returns to estimate the economic benefit to society generated by individuals achieving these qualifications. This is in the form of the higher lifetime productivity of individuals with the qualification of interest. We also take an in-depth look at how to estimate lifetime productivity returns[2].

There are three key messages that emerge from our analysis:

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[1] Existing estimates typically compare people holding five or more GCSEs graded A*-C with people holding low or no qualifications. This will hide a wide variation in outcomes: some of this group will have just scraped five C grades and others will have achieved ten A*s (with similar diversity in the comparison group). Most interventions result in more marginal improvements in GCSE attainment for which no returns estimates exist. Existing estimates also fail to distinguish whether individuals have achieved English or maths GCSE passes, which is of policy interest.

[2] This explicitly builds on the recommendations made by the Centre for the Analysis of Youth Transitions in 2013 for improving the DfE appraisal methodology. These were set out in CAYT Report Number 4 (2013) 'Assessing the economic benefits of education: reconciling microeconomic and macroeconomic approaches'.

- Intermediate qualifications are highly valued in the labour market: achieving GCSEs, A levels and apprenticeships is associated with significantly higher lifetime productivity.

- Even achieving at very low levels – just 1 or 2 GCSE passes compared to none – is associated with large productivity gains.

- Modest incremental improvements in GCSE attainment also have sizeable lifetime productivity returns, right across the GCSE spectrum.

These are based on the following key estimates[3]:

- Individuals achieving five or more good GCSEs (including English and maths) as their highest qualification are estimated to have lifetime productivity gains worth around £100,000 on average, compared to those with below level 2 or no qualifications. This is equivalent to around 3 additional years of work (based on the average output of an individual with five or more GCSEs as their highest qualification). Restricting the comparison group to just those with no qualifications boosts the returns to five or more good GCSEs (including English and maths) to £283,000 for men and £232,000 for women.

- Individuals who just cross the five good GCSE threshold have considerable lifetime productivity returns compared to those who don't. Men holding 5-7 good GCSEs (including English and maths) as their highest qualification have lifetime productivity gains worth around £73,000 compared to those with only 3-4 good GCSEs; for women, the figure is £55,000.

- Men with 2 or more A levels as their highest qualification have lifetime productivity returns of around £90,000 compared to those with 5-7 good GCSEs; for women the figure is around £76,000.

- Men with level 2 apprenticeships as their highest qualification have a lifetime productivity gain of around £139,000 compared to those qualified to level 1 or level 2; the premium for women is around £67,000. This figure is even higher for those who acquire level 3 apprenticeships as their highest qualification, with lifetime returns for men of around £175,000, compared to those who have level 2 qualifications, and around £78,000 for women.

These returns estimates are sizeable even when we use our most conservative assumptions. Our findings have a number of policy implications. First, the 1% of pupils who leave school at age 16 without any qualifications do so at a large economic cost to themselves and to society in terms of lost output. Secondly, there is a strong economic imperative that all children fulfil their educational potential, as even modest GCSE improvements – at all levels – deliver large returns. Thirdly, the very high returns observed

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[3] All of the lifetime productivity estimates are based on first quarter 2013 prices and discounted using HMT 'Green Book' guidance.

for men who acquire apprenticeships, demonstrates that high-quality vocational qualifications offer significant economic returns, and are a route which young people should be encouraged to consider alongside traditional academic alternatives.

Literature review

There is a rich microeconomic literature on the economic value of qualifications. These studies focus on estimating the wage and employment returns to various qualifications. To do this they use survey data on individual's wages, qualifications and various demographic characteristics to run regression models which estimate the returns to individuals holding certain qualifications, controlling for other characteristics. Studies estimate the return to everyone who holds the qualification of interest (known as the 'average return') and to the subset of individuals who hold it as their highest qualification (the 'marginal return').

In this section we summarise the main findings from the recent UK literature on returns to qualifications, based on three key studies: Greenwood et al (2007), McIntosh (2007), and BIS (2011). All of these studies are based on the Labour Force Survey (LFS). The LFS is a large, nationally representative cross-sectional dataset that is widely used in estimating returns to education due to its rich data on qualifications and labour market outcomes. As the Office for National Statistics undertakes the survey on a quarterly basis, the data has the benefit of being very timely. However the key drawback of estimating returns using the LFS is that it lacks information on various background characteristics (e.g. early test scores) which would improve the accuracy of the returns estimates.

Main findings from the literature

Strong wage and employment returns:

- Individuals who gain five or more good GCSEs as their highest qualification have marginal wage returns of between 15% (BIS, 2011) and 25% (Greenwood et al, 2007) compared to those who hold no qualifications. This range across studies is similar when comparing everyone who holds five or more good GCSEs to those who don't, controlling for other qualifications held ('average returns').

- Greenwood et al. (2007) find that individuals who acquire two or more A levels as their highest qualification have very high marginal wage returns; 44% compared to those holding no qualifications. The average returns figure is much lower when comparing everyone who holds A levels to those who don't, at between 9% (BIS, 2011) and 14% (Greenwood et al, 2007).

- BIS (2011) consider how the average wage return to holding five or more good GCSEs varies by age. They find that, for men, the wage return rises with age, whereas for women the return is quadratic ("n" shaped), with the peak return in middle age. When considering the average wage return to holding one or more A levels compared to those who don't hold these qualifications, they find the return by age is fairly even for men (with a high return in the final years of working life). For women, similar to the findings for GCSEs, there is a quadratic rise and fall, with a peak return in middle age.

- Individuals who acquire level 3, and to a lesser extent level 2, apprenticeships tend to have very high wage returns. Studies tend to focus on marginal, rather than average,

returns to apprenticeships[4]. Level 3 apprenticeship holders have a wage return of between 13% (BIS, 2011) and 18% (McIntosh, 2007) compared to individuals who hold a level 2 qualification as their highest. The wage return for level 2 apprenticeship holders compared to individuals who hold level 1 or other level 2 qualifications, is between 8% (BIS, 2011) and 16% (McIntosh, 2007).[5] Studies tend to use this comparison group as it closely matches the prior qualifications of those acquiring level 2 apprenticeships.

- Unlike for GCSEs and A levels, apprenticeship wage returns vary considerably across gender, with wage returns being higher for men at both levels 2 and 3. This might reflect the lower-paying nature of the sectors or occupations that women who hold apprenticeships go on to enter, rather than lower returns to apprenticeships in themselves.

- Greenwood et al. (2007) find that employment return for individuals who gain five or more good GCSEs as their highest qualification (including the economically inactive) is very high at 16 percentage points[6], compared to individuals who hold no qualifications. The average employment return is of a similar magnitude for all individuals who hold five or more good GCSEs compared to those who don't hold these qualifications. They find that employment returns are generally higher when using a sample that includes inactive workers, rather than only using the economically active sample (the latter group giving GCSE employment returns of 3 percentage points for both marginal and average specifications).[7] This is generally true for all other qualifications examined.

- A levels improve employment prospects when held as someone's highest qualification. Greenwood et al. (2007) find that for economically active individuals who hold A levels as their highest qualification, marginal employment returns are around 3 percentage points compared to someone with no qualifications. For the full sample (including the inactive), marginal returns are around 10 percentage points. Estimates of the average employment returns to holding A levels are varied, with BIS (2011) estimating returns of around 3 percentage points compared to those who don't hold A levels, and Greenwood et al (2007) essentially reporting zero returns, regardless of whether the sample includes inactive individuals.

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[4] The average returns methodology is problematic for apprenticeships because of defining the comparison group as everyone who does not hold an apprenticeship. This will encompass a very broad group of people qualified to different levels. It contrasts with academic qualifications where individuals usually progress in a linear way from one qualification level to the next (which means that people who don't hold the academic qualification of interest are usually qualified to the level below).

[5] We exclude those who hold traditional trade apprenticeships which existed prior to the introduction of the modern form of apprenticeships in 1994. This is because they are no longer of policy relevance.

[6] A percentage point return is the arithmetic difference between two percentage values – e.g. a 3 percentage point increase on 50% is 53%. This is not the same as a percentage change (%), since a 3% uplift on 50% would equal 51.5%, not 53%.

[7] The distinction between economically active and inactive workers is taken from the International Labour Organisation (ILO). Economically active individuals are defined as those in the labour market who are employed or who are without a job but have actively sought work in the last 4 weeks and are available to start work in the next 2 weeks. Inactive workers are those who are not in the labour force, i.e. those who are unable to carry out work or who are not actively seeking work.

- The employment returns to apprenticeships tend to be sizeable. This is particularly the case at level 3, where marginal and average returns for the full sample are between 11 percentage points (Greenwood et al, 2007) and 16 percentage points (McIntosh, 2007) compared to those at level 2. However, given that apprenticeships are qualifications that are undertaken in the workplace, the large returns may not be causal impacts.

- Employment returns are generally higher for women than men for GCSEs and A levels, but fairly similar for level 2 and level 3 apprenticeships, when considering both active and inactive workers (i.e. the full sample). This likely reflects the fact that men generally work regardless of their qualification level, whereas women are more likely to seek and consequently gain employment if they become more educated.

High lifetime productivity returns:

- Apprenticeship holders make a substantial economic contribution over their working lifetimes in terms of higher output. Lifetime productivity returns are higher for level 3 apprenticeship holders than for level 2 apprenticeship holders.

- McIntosh (2007) estimates the lifetime productivity gain to society from individuals completing apprenticeships as their highest qualification, *net* of the costs of acquiring these. The net lifetime productivity returns are £105,000 for level 3 apprenticeships (compared to those at level 2) and £77,000 for level 2 apprenticeships (compared to those at level 1 or level 2). BIS (2011) find lower lifetime returns to apprenticeships at both levels but these are based on the private gains to individuals, rather than to society as a whole.

The Annex gives a more detailed overview of the estimates at each qualification level. These estimates are based on the studies referenced above, and are shown in tabulated format. There are inherent difficulties making direct comparisons across studies given the varying data periods, methodologies, and, in some cases, comparator groups.

Data

We use pooled quarterly Labour Force Survey (LFS)[8] data from Quarter 1 2006 to Quarter 1 2013 to give a good spread of data before, during and after the 2008 recession. The LFS is a large, nationally representative cross-sectional dataset that is widely used in estimating returns to education due to its rich data on qualifications and labour market outcomes. As the Office for National Statistics undertakes the survey on a quarterly basis, the data has the benefit of being very timely. However the key drawback of estimating returns using the LFS is that it lacks information on various background characteristics (e.g. early test scores) which would improve the accuracy of the returns estimates.

We only include wave 1 individuals to avoid double-counting.[9] The sample only includes those who live in England and covers individuals from age 18 up to the current retirement age of 64[10]. The sample is split by gender. For wage estimations, the sample is restricted to only covering those who work (i.e. full and part-time) and who report non-negative hourly earnings below £100 per hour. The data is unweighted.

Dependent variables

Wages

The analysis uses gross weekly wages in the respondent's main job, and, as a sensitivity test, hourly wages to estimate the qualification returns. To ensure comparability, we convert wages to first quarter 2013 prices using the Consumer Prices Index[11].

Employment

The main definition of employment is generated based on whether the individual was in employment, searching for a job (ILO unemployed) or inactive. The dependent variable takes a value of 1 if someone is in employment and 0 otherwise.

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[8] This is a quarterly sample survey of individuals in over 60,000 households, made up of five 'waves' each of around 12,000 households. It collects information about the personal circumstances, including age, marital status, ethnic group, qualification and study or training, as well as the work circumstances of every adult living in these households. For more information, refer to Jones & Smith (2001).

[9] Individuals are interviewed each quarter for 5 quarters. Individuals are asked about wages twice, in wave 1 and again in wave 5. For Q1 2006 only, we can include both wave 1 and wave 5 individuals as there is no risk of double-counting.

[10] Lifetime productivity estimates are based on age 18-67 as, due to increases in the participation age – the minimum age individuals can leave education – and the state-pension age, this is the expected working life for school leavers from 2015 onwards.

[11] Based on CPI figures from the ONS available here: http://www.ons.gov.uk/ons/datasets-and-tables/data-selector.html?cdid=D7BT&dataset=mm23&table-id=1.1

Qualification variables

When creating variables the highest qualification determinant is based on a number of questions covering the qualifications the person holds. Qualifications are grouped by levels based on the Key Skills Qualification levels.

GCSE bundles

GCSE bundles are created based on a range of variables. The number of GCSEs is based on a question on whether or not individuals have GCSEs above grade C, and subsequent questions on the number of these. If a person has five or more GCSE passes then we use their response in a further question to see if these qualifications include English and/or maths.

2+ A levels

We code individuals as having 2 or more A levels based on responses to questions if they have more than one A level.

Level 2 and level 3 apprenticeships

Apprenticeship levels are created based on answers to questions on whether the individual has completed a Modern apprenticeship[12] since the year 2000 and what level the apprenticeship was.

Table 1 below shows the sample sizes on which our regressions are based. The sample is fairly even split between men and women for GCSEs; however the cohort studying apprenticeships is predominantly male. The more GCSEs an individual achieves the more likely they are to progress to higher qualifications: approximately half of the individuals in our sample who gained 1-2 good GCSEs progress further in education, whereas almost 90% of those achieving eight or more good GCSEs continue their education after qualification age.

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[12] Modern apprenticeships are a fairly recent qualification that began in 1994; the analysis in this report does not look at any other type of apprenticeships. For the observations from 2012 onwards , the variable only includes those who started their apprenticeships in the year 2000 or after.

Table 1: Descriptive statistics – sample size

Qualification	Men		Women	
	As highest	Total	As highest	Total
1-2 good GCSEs	2,438	5,143	2,873	6,339
3-4 good GCSEs	2,793	6,893	3,571	8,424
5-7 good GCSEs	3,625	12,843	4,762	15,114
5-7 good GCSEs including both English and maths	1,704	6,007	1,853	6,336
8+ good GCSEs	1,915	17,568	2,668	25,782
5+ good GCSEs including both English and maths	2,822	16,941	3,248	17,159
2+ A levels[13]	2,934	12,224	3,195	15,008
Level 2 apprenticeship	2,029	N/A	437	N/A
Level 3 apprenticeship[14]	396	N/A	87	N/A

Control variables

Control variables are variables that are used to improve the accuracy of the estimates of the relationship between the dependent variable and the variable of interest.

Table 2 gives a list of the control variables used in each regression. When estimating average returns, we also control for someone's highest qualification held. This is to isolate the independent impact of the qualification of interest (for example, A levels) on wages or employment, as distinct from any other higher qualification (for example, a degree).

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[13] Individuals are only included in this count if they also have five or more good GCSEs and are not currently in education. Individuals who do not meet these criteria are excluded from the regression model to avoid bias in the results.

[14] Individuals are only included in this count if they also have a level 2 qualification. Individuals who do not meet this criteria are excluded from the regression model to avoid bias in the results.

Table 2: List of control variables and basis

Control variable	Description
Regional dummies	Dummy variables[15] for each Government Office Region
Ethnicity dummies	Dummy variables for each main ethnic group
Married	Whether the individual is married, cohabiting, in a civil partnership or single (1=married/cohabiting/civil partnership)
Number of children in age groups	The number of children in each of the following age groups, 0-to-2, 3-to-4, 5-to-9, 10-to-15, 16-to-19
Year of observation	The calendar year that the observation is from

For the interested reader a more detailed discussion on the variables in the LFS can be found in the LFS User Guide: http://www.ons.gov.uk/ons/guide-method/method-quality/specific/labour-market/labour-market-statistics/index.html.

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[15] A dummy variable is a variable that only takes the values 1 or 0. For example, the dummy variable London takes the value 1 if the individual is from London and 0 if not.

Methodology

Our focus is on estimating the economic value of the key intermediate qualifications that young people achieve: GCSEs, A levels and apprenticeships. For GCSEs, we consider more granular qualification bundles than have been previously estimated in the literature. In cases where individuals cross the five good GCSE threshold, our estimates are based on individuals whose GCSEs passes include both English and maths, given that this is the current policy focus.

We estimate the economic value of these qualifications in two steps.

In the first step we estimate the wage returns and employment increases associated with gaining qualifications. This is done by comparing the wage and employment outcomes of individuals who hold the qualification of interest to similar individuals qualified to the level below. (We distinguish between the marginal return – for individuals who hold the qualification as their *highest* – and the average return – which includes *all* individuals who hold the qualification).

In the second step we use these estimated wage and employment return figures to calculate the economic benefit to society generated by individuals achieving specific qualifications, in the form of their higher lifetime productivity. We do this by estimating the productivity at each age for those in the less qualified comparison group. We then uprate this "base" lifetime productivity profile by the estimated wage and employment returns to generate the lifetime productivity of those in the more qualified group. The gap between the two profiles is our best estimate of the productivity gain to society from achieving the qualification of interest.

In estimating the lifetime productivity gains from acquiring qualifications, there are several methodological issues which we have considered. These are discussed in more detail in this section but are summarised below:

- *Choice of comparison group:* in contrast to some previous studies, our comparison group is those who hold qualifications at the level below the qualification of interest, rather than those with no qualifications at all. This is the more policy relevant comparison group.

- *How to estimate the 'base' profiles for individuals without the qualification of interest:* our counterfactuals are based on simple regression models which allow us to estimate average wage and employment probabilities at each age during that individual's working lifetime. This includes "out of sample" predictions at older ages than we have in our dataset, given our assumption that young people will be retiring later than the current workforce (aged 67 as opposed to aged 65).

- *Whether returns to qualifications vary over the lifecycle:* we allow our estimated wage returns to vary over the lifecycle by interacting the qualification variable with age and age squared. As individuals acquire experience and develop on-the-job skills the productivity gain from qualifications may change over their lifetime. This relationship is observed in the data.

- *Whether to estimate employment returns for everyone or only the economically active:* we estimate employment returns for everyone, including the inactive. This is because qualifications could affect someone's decision whether to look for work at all. In the annex we consider how using only those active in the labour force affects our results.

- *How to account for hours worked:* given that qualifications may affect the number of hours that someone works, we use weekly pay as the dependent variable for our headline figures. We also consider how using hourly wages affects our results.

- *Social versus private benefits of education*: our interest is in the benefit to society, rather than to the individual, from acquiring qualifications. To estimate economic output, we apply 'non-wage labour costs' of 30% to the estimated wage impacts.

- *Real earnings growth:* we assume that for a given qualification level, people's real wages do not rise over time. This could be considered conservative and is in contrast to other studies which tend to assume positive real earnings growth of around 2% per year. We also consider whether our historic returns estimates are constant over the 2006-2013 data period used in our analysis to check the stability of our estimates over time.

- *Ability Bias – how much of the difference in wages is due to inherent productivity differences between individuals and how much is due to their education:* if more able and therefore higher earning, people acquire more qualifications, a key concern is that our LFS estimates could be upwardly biased. To inform sensitivity tests around the possible scale of ability bias, the Institute for Fiscal Studies (IFS) have separately estimated the returns to qualifications using the British Cohort Study which contains childhood ability measures.

We do not estimate the costs to the individual or exchequer of acquiring the qualifications. Nor do we examine the wider benefits, such as through lower crime rates and better health outcomes, which education can provide. This report does not split the benefits from higher productivity between the individual, through higher earnings, and the exchequer, through higher taxes and lower benefits. The section below discusses the regression techniques employed, how the base case is profiled and how the lifetime productivity gains are calculated.

Average and marginal returns

For all the qualifications examined in this report – with a few exceptions – there are two estimates of the returns to the qualifications, the marginal and the average return.

Marginal return

The 'marginal return' is the benefit to an individual from holding the qualification of interest as their highest qualification. For example, the 'marginal return' to 3-4 good GCSEs versus 1-2 good GCSEs is the benefit from having 1-2 GCSEs at grade C and above to having 3-4 GCSEs at grade C and above and not progressing further in education or training.

To estimate marginal returns, we compare the benefit of acquiring qualifications relative to the next lowest qualification group. This is the most policy relevant comparison group but is different to Greenwood et al (2007) and BIS (2011) who estimate the benefit of acquiring qualifications relative to those who hold no qualifications.

Average return

The 'average return' is the benefit to an individual from holding a qualification, whether or not it is their highest qualification. For example, the 'average return' to 3-4 good GCSEs versus 1-2 good GCSEs is the benefit from having 3-4 GCSEs at grade C and above over 1-2 GCSEs at grade C and above, while controlling for the higher qualifications that certain individuals in either group may go on to get. In this example the sample of these individuals is likely to be small, since most people who acquire only 3-4 or 1-2 good GCSEs at GCSE level are unlikely to continue any further in education. We control for higher qualifications by adding additional variables in the wage and employment regression equations, which, to our knowledge, is the best method for isolating the independent impact of 3-4 good GCSEs on wages or employment.

The methods used in controlling for higher educational qualifications and the comparison groups used (comparing *all* those who hold the qualification to all those who don't) follow the methodologies of other studies that have estimated average returns to educational qualifications.

Regression methodology

The first step we undertake to estimate the lifetime productivity gains to acquiring qualifications is to estimate the wage and employment returns using regression methodology. Here, we outline the separate regression techniques used to estimate returns.

Wage regressions

We are interested in estimating how much more an individual is likely to earn, on average, if they acquire a given qualification. To do this we estimate the wage return using the standard Mincer wage specification[16]. This models the natural logarithm of wages as a function of education, experience (here proxied by age) and a range of other observable characteristics which could affect wages. The regressions used in this report differ from the more common specifications as the returns to qualifications are allowed to vary quadratically with age. This is to reflect the assumption that returns to qualifications may vary as an individual builds on-the-job skills through workplace experience. This is modelled by estimating separate coefficients in the wage regression for the qualification, the qualification multiplied by age and the qualification multiplied by age squared.

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[16] Based on Mincer (1958) "Investment in Human Capital and Personal Income Distribution" it is the standard equation used to estimate earnings models. The exact specification in this paper is set out below.

This allows the returns to vary with age, within a quadratic regression (a relationship that follows a "u" or "n" shape with age), instead of forcing a constant wage uplift on the model. This is important if the benefit of a qualification is believed to vary over an individual's lifecycle[17]. In our analysis, estimated returns to the more academic qualifications, GCSEs and A levels, start low and increase, peaking around age 35, before falling away towards the end of the individual's working life. For vocational qualifications – level 2 and level 3 apprenticeships – wage returns are highest in the first few years and then trail off as the individual gets older.

A typical "marginal" regression is set out below:

$$\ln(Y_i) = \alpha + \boldsymbol{\beta} \begin{pmatrix} 1 \\ age_i \\ age_i^2 \end{pmatrix} q_i + \boldsymbol{\gamma x_i} + \varepsilon_i$$

Where: Y_i = wage for individual i

$\boldsymbol{\beta}$ = vector of qualification coefficients

age_i = age of individual i

q_i = qualification of interest

$\boldsymbol{x_i}$ = vector of control variables of individual i – these are covered in the data section

ε_i = error term

The regression estimation model used to analyse wage returns was a heteroscedastic consistent Ordinary Least Squares (OLS) estimator.

Employment regressions

Employment is a binary state: an individual is either employed or is not. Therefore the employment variable is a dummy dependent variable, and can only take the value 1 or 0. As employment is a binary variable, a probit model is used to estimate the employment returns to qualifications.

A typical "marginal" regression is set out below:

$$E_i = \alpha + \boldsymbol{\beta} q_i + \boldsymbol{\gamma x_i} + \varepsilon_i$$

Where: E_i = employment status for individual i (1=employed)

$\boldsymbol{\beta}$ = qualification coefficient

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[17] This is observed in the BIS (2011) paper.

q_i = qualification of interest

$\mathbf{x_i}$ = vector of control variables of individual i

ε_i = error term

Employment returns are the increased likelihood of an individual who has that qualification holding a job. For example an employment return of 3 percentage points means that an individual holding the qualification of interest would be three percentage points more likely to be employed than an identical individual who did not have the qualification. This equates to an extra three out of one hundred individuals with that qualification being in employment.

Calculating lifetime productivity gains

Once we've calculated the wage and employment returns associated with gaining a particular qualification, relative to a lower level qualification, we are able to use these estimates to calculate the productivity gain of the higher qualification. Headline lifetime productivity returns are the difference between the productivity of an individual with the qualification of interest and that of someone without the qualification.

The wage and employment profiles for individuals without the qualification of interest, known as the "base case", are created using the techniques discussed in the next section. For individuals with the qualification of interest, these base cases are adjusted by the returns estimated in the wage and employment regressions to produce estimates of their lifetime productivity. The difference between the productivity profiles of individuals with and without the qualification provide the estimate of the productivity return.

Estimating wages and employment probability in the base case

The base cases are estimated by generating the wage and employment probabilities at each age for the group of individuals who hold the qualification in the base case. We base these on simple wage and employment regressions that have no control variables except for age and age squared. These regression coefficients are then used to generate the average wage and employment probability at each age. We use the regression coefficients to predict wages and employment outcomes for 65-to-67 year olds, who are not included in our sample. In the period we have data for, the maximum retirement age was 65. However, for today's school leavers the current retirement age is 67 so we use this age as the upper bound in our productivity profiles. We do not use the observed average wages and employment probabilities as these may not follow a smooth profile due to outliers at certain ages.

Using wage and employment probabilities to estimate lifetime productivity in the base case

We adjust wages to an annualised basis by multiplying the weekly figure by 52 to derive an annual figure. These are multiplied by the employment probabilities to account for the likelihood of someone being in work at each age.

We then transform these 'expected' annual earnings into employee productivity by applying a 30%[18] uplift to reflect non-wage labour costs (NWLC) such as National Insurance and pensions contributions, fixed administration costs and costs accounting for absence owing to illness. Increasing wages by the 30% figure therefore captures the full cost to firms of hiring these workers. It is assumed that the productivity of an individual must be at least as much as it costs the firm to employ them; otherwise the firm would not make any extra profit from the individual and would have no incentive to hire them.

The next stage is to discount the economic output at each age to derive a present value of the lifetime productivity from holding the base case qualification. These are discounted with respect to age 18 and by 3.5% for the first 30 years and 3% after that, in accordance with HMT 'The Green Book' guidance.

Estimating the lifetime productivity gain to achieving the higher qualification

The lifetime productivity gain from achieving the higher qualification is estimated in a similar way to the base case, with one difference. In the higher qualification productivity profile, wages and employment probabilities from the base case are uprated using the point returns at each age (as estimated by the OLS and probit regressions discussed above). These returns estimates are used even in cases when they are negative or statistically insignificant.

Subtracting estimated lifetime productivity in the base case from the estimated lifetime productivity arising from the higher qualification gives the *estimated lifetime productivity gain* to achieving the qualification. This gives our best estimate of the amount the economy gains from an individual achieving a qualification. To compare this approach to how other studies calculate the lifetime productivity return, please refer to the Annex.

Key assumptions

The estimated lifetime productivity gains are based on some key assumptions.

Firstly, our estimates do not include real earnings growth. Economic theory suggests that technological improvements should mean that workers get more productive and therefore earnings would increase. Real earnings growth captures this increased productivity over time. If individuals get more productive over time, the productivity gains to qualifications will increase, but this would not be reflected in our estimates, causing them to be too low. As there is no agreed figure for real earnings growth for individuals with a given level of education, we use the conservative assumption of 0% growth.

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[18] Measuring Administrative Costs: UK Standard Cost Model Manual, 2005, Better Regulation Executive", Cabinet Office, www.cabinet-office.x.gsi.gov.uk.

Secondly, our estimates assume individuals' productivity is just equal to the full cost of employing them but, in reality, it should be higher. If the productivity of an individual is not greater than their cost, there would not be an incentive for a firm to employ that individual. A study by Dearden et al (2005)[19] finds that workers only gain half the firms' productivity returns to training in the form of extra wages. If this split was used, productivity increases would be over 50% higher than estimated here. However, given that the type of training explored in Dearden et al (2005) is not completely analogous to formal education we employ the conservative estimate of no productivity gain to individuals (in excess of their wage gain). It is also possible that more educated individuals raise the productivity of those with whom they work. This would give a further spill-over effect that is not captured in our estimates.

Thirdly, our estimates assume that all of the wage return to the qualification reflects the extra human capital – the improved knowledge, skills and ideas – of the person achieving the qualification. However ability bias could cause returns estimates to overestimate the productivity benefits of qualifications. Ability bias occurs where more able individuals both chose more education and at all education levels earn more than less able individuals. Comparing individuals with different levels of education therefore overestimates the return from the qualification as some of the wage difference occurs due to the different levels of inherent ability in the groups. However, we do not include ability bias in our central estimates of lifetime productivity returns due to the wide range of estimated ability bias, and the conservative assumptions outlined in the preceding two paragraphs. Work produced for this report by the Institute for Fiscal Studies informs the Sensitivity analysis section.

Fourthly, our analysis assumes that 100% of the estimated employment return is the direct, causal impact of acquiring the qualification on someone's chances of being in work. However, for some people, the qualifications could have been achieved after the person was already in employment – this is a particular issue for apprenticeships, given they are undertaken in the workplace.

We consider the impact of varying these four key assumptions in our Sensitivity analysis section.

Other assumptions

Wage period: weekly or hourly

The headline figures in this report use weekly pay as the dependent variable, rather than hourly wages. We use weekly figures as they capture the number of hours that someone works (as well as earnings per hour) which is relevant to us when trying to estimate the lifetime output of workers. This is preferable to using hourly wages and then simply assuming a fixed number of working hours per week (as the number of hours worked is at

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[19] Entitled 'The Impact of Training on Productivity and Wages: Evidence from British Panel Data'. http://www.ifs.org.uk/wps/wp0516.pdf

least partly chosen by individuals which will be determined by multiple factors, including the wages themselves). We consider the impact of using hourly earnings, as part of our sensitivity analysis.

Employment probabilities

The headline figures in this report use employment returns based on the probability of being employed versus all other economic states, including being out of the labour market. This definition is used because qualifications could, through their impact on pay and employment, affect the return to an individual from entering the labour market and therefore this effect is captured in our estimates.

An alternative way to examine employment effects is to limit the sample to just the economically active population – those employed and those seeking employment. Using this definition would, generally, reduce the returns to qualifications as more qualified individuals should be more likely to search for employment. We consider the impact of using a sample restricted to economically active individuals in the Annex.

Different returns over time

The sample used in this report covers Quarter 1 2006 to Quarter 1 2013. We assume the returns to qualifications are constant over the time period but test this assumption, as part of our sensitivity analysis.

Our estimates are 'snapshot estimates' in the sense that they are based on a cross-section of working-age individuals, some of whom will have acquired qualifications recently and others, many years previously. We assume that this will be a reasonable estimate of the lifetime productivity of today's young people. This assumption will hold only in the absence of general equilibrium effects - in other words, assuming there are no large shifts in the demand for, or supply, of qualifications.

Are the returns to qualifications quadratic?

This paper estimates a return to qualifications that is quadratic with age, rather than constant over the lifecycle. In most cases returns start low, peak in middle age and fall off towards the end of an individual's working life, or vice versa. We examine a subset of qualifications in our sensitivity analysis to analyse if this assumption is appropriate.

The one exception is women with level 3 apprenticeships, where the sample size is not large enough to estimate a quadratic specification[20].Therefore, for women only, we estimate a constant return regression, where the qualification increases wages by the same percentage at every age.

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[20] There were only 52 females in employment with level 3 apprenticeships who had no A levels, and had achieved level 2.

Issues

A level estimates

When analysing the return to those who hold A levels as their highest qualification, the regression outputs initially showed very low or negative estimates of the returns to A levels. We examined these estimates and found the low returns were due to the low wages and labour market participation of the large numbers of young A level holders still in full time education. As these individuals are in the process of progressing to higher qualifications, they are not representative of the group the report is interested in, and we therefore exclude them from the estimates[21].

Five or more GCSE estimates

The base case for the estimates of the return to having five or more good GCSEs is those who have fewer than five good GCSEs or no GCSEs. However, a significant number in the sample of individuals who have no GCSEs have progressed on to further education, including a quarter to degree level. These progress levels are significantly higher than those with 1-4 good GCSEs, which indicate that some of these individuals may have not had their lower-level qualifications, included in the survey responses. This could be because they did not feel that the qualification was relevant or this might be down to proxy respondents being less aware of lower level qualifications held by the person they are responding on behalf of. Furthermore, while it may once have been possible to progress to higher qualifications without any GCSEs in previous decades, this is no longer likely to be the case for today's school leavers.

For these reasons we have limited the comparison group in the 'average returns' to those with 1-4 good GCSEs, who may or may not have higher than GCSE qualifications, and those with no qualifications. Those reporting no GCSEs but say they hold higher level qualifications have been excluded.

1-2 GCSE estimates

To correct for possible reporting errors and to ensure a more policy relevant comparison group, we have limited the comparison group in the 'average returns' to those with 1-4 good GCSEs, who can have higher qualifications, and those with no qualifications. We exclude those reporting no GCSEs but say they hold higher level qualifications.

Average return to apprenticeships

This paper has not estimated the average return to apprenticeships. There are significant differences in the education and career paths between those who do apprenticeships and those who follow a more academic route. For these reasons, estimating the average return to apprenticeships is likely to give unreasonable estimates of the benefits of those

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[21] Hence, we only included observations based on CURED and CURED8 variables in the LFS.

qualifications and we do not model these in this study. Other studies of the economic value of apprenticeships similarly do not estimate the average return to apprenticeships.

Results

Main findings

Sizeable lifetime productivity gains:

- There are sizeable lifetime productivity gains to achieving GCSEs, A levels and apprenticeships, compared to similar individuals qualified to the level below. The lifetime gains tend to be higher for individuals who hold the qualification as their highest ('marginal returns') than for all individuals who hold the qualification ('average returns'). They also tend to be higher for men than women.

- Even achieving very low levels of qualification – just one or two GCSE passes compared to no qualifications – is associated with large economic gains. Modest incremental improvements in GCSE attainment also have sizeable lifetime returns, across the spectrum of GCSE achievement.

- Individuals who achieve five or more good GCSEs including English and maths as their highest qualification, have estimated lifetime productivity returns in excess of £100,000, compared to those with below level 2 or no qualifications. Average lifetime productivity gains – which take account of everyone who holds five or more good GCSEs including English and maths – are around £63,000 for men and £54,000 for women. Compared to those with no qualifications at all, the marginal lifetime productivity returns to five or more good GCSEs including English and maths are around £283,000 for men and £232,000 for women.

- Individuals who just cross the five good GCSE threshold have considerable lifetime productivity returns compared to those who don't. Men holding 5-7 good GCSEs including English and maths as their highest qualification, have a lifetime productivity gain worth around £73,000 relative to those with only 3-4 good GCSEs; for women, the figure is £55,000. The average lifetime productivity gain to 5-7 good GCSEs including English and maths is also sizeable at around £60,000 for both men and women.

- Individuals who gain two or more A levels as their highest qualification, have a lifetime productivity gain relative to those with 5-7 good GCSEs of around £90,000 for men and £76,000 for women. The average lifetime productivity gain to everyone who holds A levels is around two-thirds of this amount: £58,000 for men and £43,000 for women. Compared to people with no qualifications at all, the marginal lifetime productivity returns to two or more A levels are substantially higher at around £441,000 for men and £354,000 for women. These estimates have been produced for completeness only. Those with no qualifications will have very different characteristics to A level holders which means they are unlikely to progress directly to this level, without having first achieved GCSEs.

- Marginal lifetime productivity returns are high for acquiring apprenticeships, particularly for men. Men with level 2 apprenticeships as their highest qualification have a lifetime productivity gain of around £139,000 compared to those qualified to level 1 or level 2; the premium for women with level 2 apprenticeships is around £67,000. Men holding level 3 apprenticeships have an even higher lifetime productivity gain of around £176,000, compared to those with level 2 qualifications; for women, the figure is around £78,000.

Strong wage and employment returns:

- There are generally strong wage and employment returns to achieving GCSEs, A levels and apprenticeships, compared to similar individuals qualified to the level below. Marginal employment returns tend to be higher than average employment returns; they are also higher for women than men. Conversely, wage returns are much higher for men than women when acquiring apprenticeships, although this relationship is less clear for those who acquire academic qualifications.

- Individuals who achieve five or more good GCSEs including English and maths as their highest qualification, earn 3-13% more than similar individuals qualified to below level 2. Employment returns are also sizeable when comparing the same two groups of individuals, with marginal returns of 7 percentage points for men and 14 percentage points for women.

- Individuals who gain two or more A levels as their highest qualification have high wage returns of around 15% relative to those who gain 5-7 good GCSEs and progress no further in education. However, gaining A levels doesn't appear to raise the likelihood of employment, with marginal employment returns insignificant for men and low (3 percentage points) for women.

- Marginal wage returns to acquiring apprenticeships are very high for men, with returns of 15% and 19% at levels 2 and 3 respectively. We find that wage returns are much lower for women (between 2-5% for levels 2 and 3). This disparity could partly be due to the different sectors and occupations that men and women go into following an apprenticeship. Employment returns are sizeable and significant for both men and women. However, given that apprenticeships are work-based qualifications, this may not be entirely a causal impact.

Figure 1: Estimated lifetime productivity returns to achieving GCSEs at A*-C as highest qualification
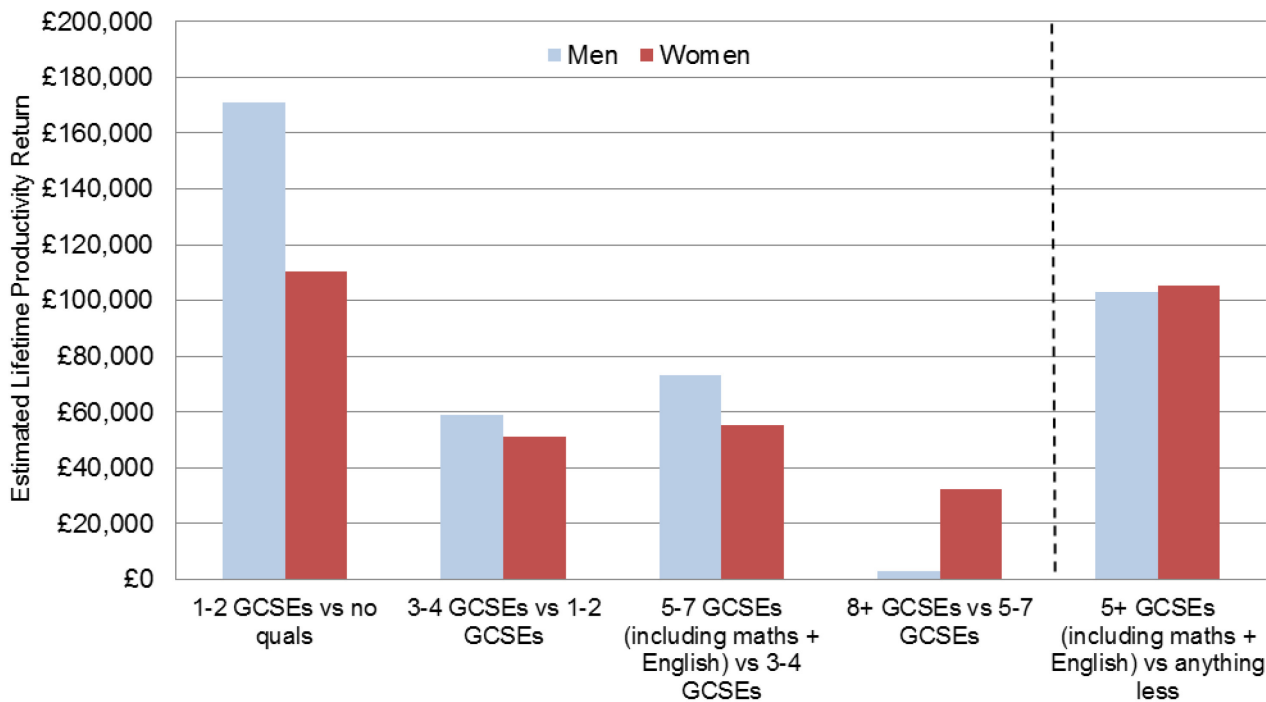
Figure 2: Estimated lifetime productivity returns to achieving GCSEs at A*-C, A levels and apprenticeships as highest qualification
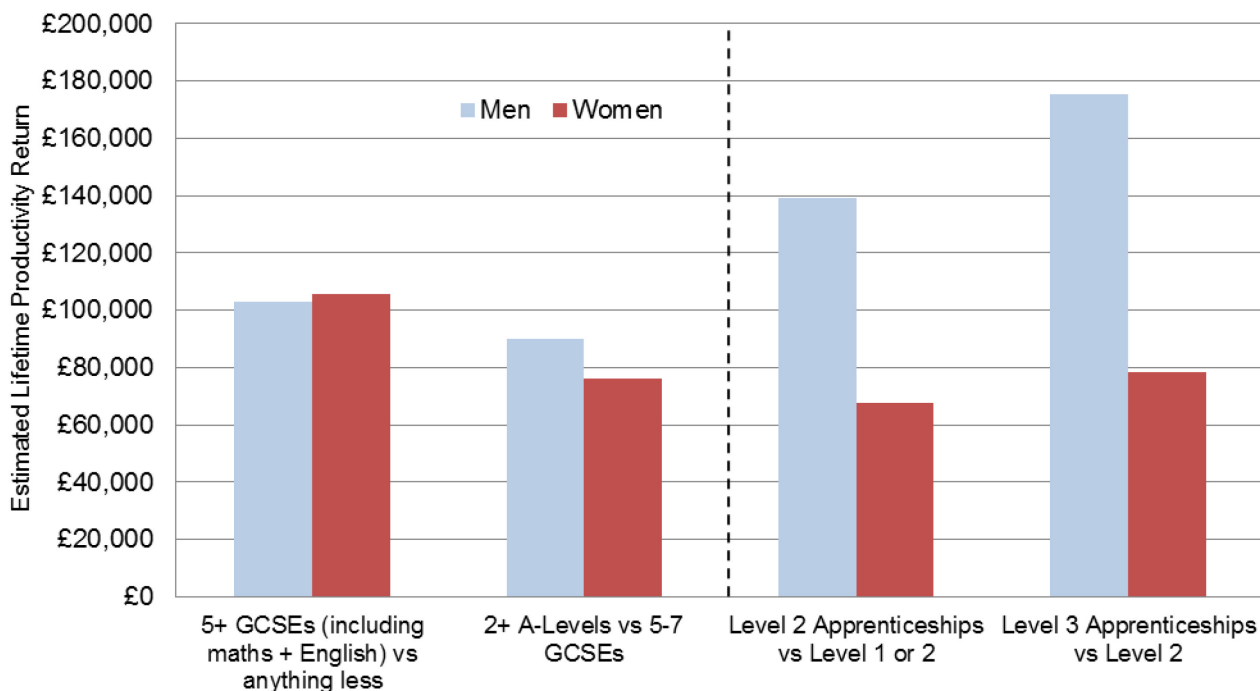
Consistency with wider literature:

Many of our findings are consistent with those reported in the wider literature. We find that: marginal wage returns are higher than average wage returns in nearly all cases; women tend to have higher employment returns than men (at least for academic qualifications); and, that there are very high lifetime productivity returns to level 2 and level 3 apprenticeships. Our

estimates confirm the general finding from the literature that GCSEs, A levels and apprenticeships are highly valued in the labour market.

However, our wage return estimates are not directly comparable to those found in other studies. This is because we assume a quadratic function, which allows wage returns to vary with age, whereas most other studies assume constant wage returns over a lifetime. We do produce a single estimate of the wage return averaged over the lifecycle given that this could be of policy interest, but it is important to recognise that this is not calculated in the same way as wage returns estimates in other studies.[22]

In the following section we outline the results for each qualification in more detail, picking out the key findings and explaining anomalies where appropriate. Comparisons to estimates in the literature are available for certain qualifications only.

GCSEs

In this section we discuss our headline GCSE figures (five or more good GCSEs including English and maths compared with anything less) in detail, and give the results to our other GCSE bundles, with commentary on some of the more unusual results.

Five or more good GCSEs including English and maths compared with anything less

Table 3 shows that there are considerable lifetime productivity benefits to gaining five or more good GCSEs including English and maths, compared to those with anything less. The marginal returns are over £100,000 for both men and women, while the average returns are closer to £60,000.

For men who hold the qualification as their highest (marginal) the lifetime productivity return is £103,000. This is based on a 7% employment return and a wage return of 3% averaged over the lifecycle. The wage return is allowed to vary over the lifecycle by combining the coefficients on the qualification, qualification multiplied by age and by age squared, as set out in the 'Wage coefficient by age' column of Table 3. (For information on how to estimate the return at each age refer to footnote 25). These wage coefficients combine to give an estimated uplift of 3% over the lifecycle. The F-statistic of 56.45 indicates that the wage returns are jointly significant.

Men earn on average 3% more if they hold five or more good GCSEs including English and maths as their highest qualification, and 12% more for all those who hold the qualification.[23] For women the equivalent figures are 13% and 20% respectively. There are large

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[22] This percentage estimate represents how much more an individual could expect to earn (not-discounted), over their lifetime if they were employed at each age between 18 and 67.

[23] These estimates refer to constant wage returns in line with other studies. For a more detailed breakdown of the wage returns at each age please refer to the tables in this section.

employment gains to holding the qualification as the highest, 9 percentage points for men and 15 percentage points for women, compared to not reaching this threshold. The estimates are statistically insignificant for all those who hold the qualification.

Compared to the estimates in this report, BIS (2011) report higher average wage returns to men who acquire five or more good GCSEs, but similar returns to women, at 23% and 25% respectively[24]. In contrast, Greenwood et al (2007) find lower average wage returns to both men (9%) and women (11%). The estimated returns will be slightly different to this paper as we allow returns to vary quadratically with age and focus on a subsample of those with five or more good GCSEs – those who also hold English and maths.

BIS (2011) find that the returns vary with age (average specification) for women, but, unlike our study, find that for men the wage returns are constant across age groups. Our employment returns estimates are broadly similar to those in the literature, although other studies estimate statistically significant returns in the average specification, whereas we do not.

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[24] Note that the comparator group used by Greenwood et al (2007) and BIS (2011) are those with no qualifications, rather than those who hold below level 2 qualifications as used in our study. We would therefore expect the returns estimates to be slightly higher in other studies, since the relative difference between the two qualification groups is higher.

**Table 3: Returns to five or more good GCSEs including English and maths relative to those with anything less**

		Estimated Lifetime Productivity Returns	Constant Wage Returns	Wage Coefficients By Age[25]			Employment Returns
				Qual	Qual*Age	Qual*Age^2	
Men	Marginal	£102,941	3%	-1.4644*** (0.2024) F(3, 30701)	0.0919*** (0.0126) 56.45***	-0.0012*** (0.0001)	0.0703*** (0.0050)
	Average	£62,930	12%	-1.8927*** (0.0981) F(3, 31953)	0.1067*** (0.0058) 238.75***	-0.0013*** (0.0001)	-0.0109 (0.0076)
Women	Marginal	£105,485	13%	-0.9556*** (0.1606) F(3, 36478)	0.0605*** (0.0094) 46.39***	-0.0008*** (0.0001)	0.1358*** (0.0081)
	Average	£54,486	20%	-1.9763*** (0.0985) F(3, 34587)	0.1137*** (0.0057) 273.48***	-0.0014*** 0.0001	0.0148* (0.0075)

*, **, *** indicate statistical significance at 10%, 5%, 1% respectively. Note: Grey cell denotes lack of statistical significance. Figures in parentheses are standard errors.

Figure 3 overleaf shows how the returns to five or more good GCSEs including English and maths (as an individual's highest qualification) build up over an individual's working life. The red line shows the modelled discounted productivity of an individual with fewer than five good GCSEs, discounted to age 18. The blue line is the modelled discounted productivity of those with five or more good GCSEs. The productivity of those with five or more good GCSEs is the same at age 18, as those with fewer than five good GCSEs, but increases quicker, until it peaks at age 36 and then a combination of the discounting, a falling wage premium and fewer hours worked reduces the return before turning it negative.

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[25] To estimate the return to a qualification at a given age we add the 'qual' coefficient to the 'qual*age' coefficient multiplied by the individual's age, and the qual*age$^{2'}$ coefficient multiplied by the individual's age squared. For example, the wage return to men aged 40 who hold five or more good GCSEs including English and maths as their highest qualification is: $-1.4644 + 0.1067 * 40.0.0012 * 40^2 = 0.25,$ which corresponds to a (anti-logged) 28% increase.

Figure 3: Marginal returns by age to five or more good GCSEs including English and maths - male
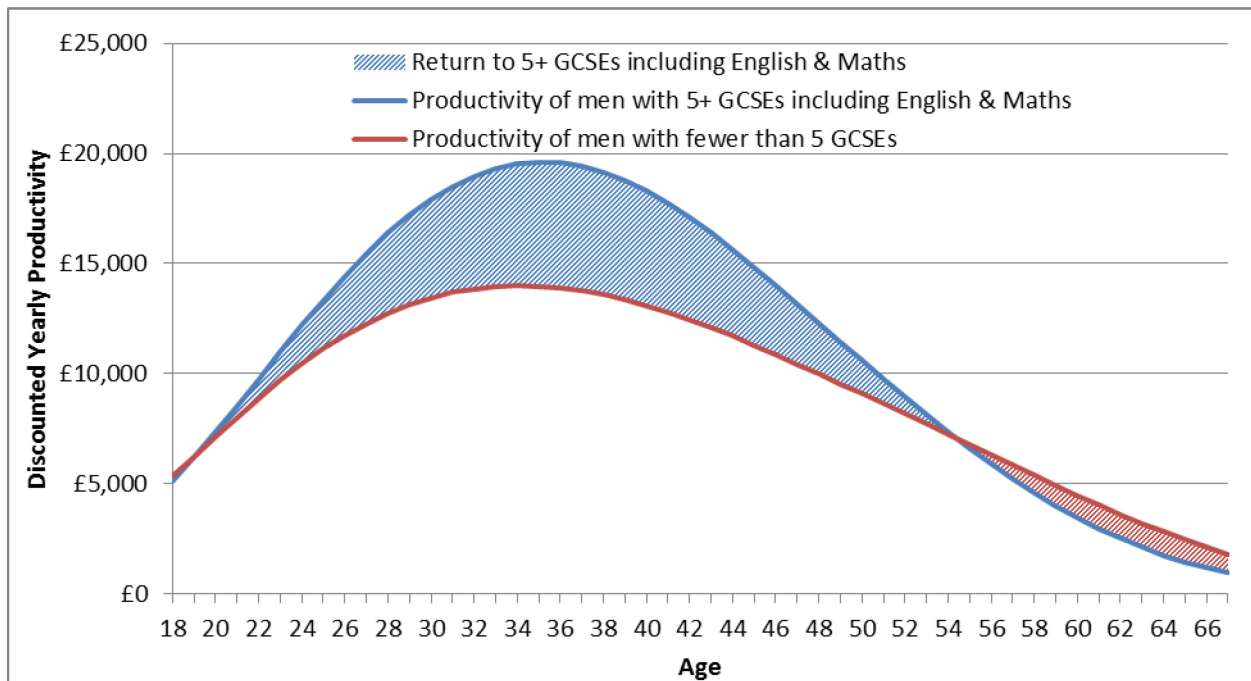
Other GCSE bundles

Tables 4 to 8 give the returns to more refined GCSE bundles. Here we comment on some of the more unusual estimates.

Table 4 shows that there are high wage, and particularly employment, returns to 1-2 good GCSEs. These combine to produce very large lifetime productivity gains to 1-2 GCSEs compared to no qualifications, particularly for men. However there may well be important unobserved differences between those with even low level qualifications and those with none at all. Therefore it is possible that part of this very high return may be due to signalling, rather than entirely due to the skills imparted by the qualification. Employers may believe that certain qualities they value, such as effort or commitment, are more likely to be present in individuals who achieved low level GCSEs relative to those who did not. They may therefore be using the qualification partly as a signal that the employee has these qualities.

Men who acquire eight or more good GCSEs as their highest qualification compared to those who acquire 5-7 good GCSEs have lifetime productivity returns of just £3,000. This could be explained by the unusual sample. Only around 10% of men or women who achieve eight or more good GCSEs do not go on to get higher qualifications. Therefore, this group is likely to be different in some way, which suppresses the marginal returns, especially for men.

The average lifetime productivity return for men who acquire eight or more good GCSEs – which includes anyone who holds these qualifications – is significantly higher at £92,000. This may be driven by unobserved differences when comparing this group to those with 5-7 good GCSEs. For example, it is plausible that those with eight or more good GCSEs are more likely to go to higher quality universities or do degrees in subjects associated with higher paying jobs, than those with 5-7 good GCSEs.

Table 4: Returns to achieving 1-2 good GCSEs relative to those with no qualifications

		Estimated Lifetime Productivity Returns	Constant Wage Returns	Wage Coefficients By Age			Employment Returns
				Qual	Qual*Age	Qual*Age^2	
Men	Marginal	£170,984	10%	-1.0006***	0.0657***	-0.0009***	0.1524***
				(0.2146)	(0.0129)	(0.0002)	(0.0103)
				F(3, 7510)	35.64***		
Women	Marginal	£110,395	21%	-0.6579***	0.0392***	-0.0004**	0.1940***
				(0.2285)	(0.0126)	(0.0002)	(0.0108)
				F(3, 7971)	27.14***		

*, **, *** indicate statistical significance at 10%, 5%, 1% respectively. Figures in parentheses are standard errors.

Table 5: Returns to achieving 3-4 good GCSEs relative to those with 1-2 good GCSEs

		Estimated Lifetime Productivity Returns	Constant Wage Returns	Wage Coefficients By Age			Employment Returns
				Qual	Qual*Age	Qual*Age^2	
Men	Marginal	£59,043	5%	-0.2768	0.0182	-0.0002	0.0411***
				(0.2706)	(0.0165)	(0.0002)	(0.0115)
				F(3, 2379)	2.64**		
	Average	£39,047	3%	-0.0916	0.0071	-0.0001	0.0231***
				(0.1696)	(0.0101)	(0.0002)	(0.0069)
				F(3, 6084)	2.77**		
Women	Marginal	£51,055	4%	-0.14473	0.0139	-0.0002	0.0877***
				(0.2690)	(0.0153)	(0.0002)	(0.0129)
				F(3, 2649)	3.05**		
	Average	£28,432	-2%	-0.3029*	0.0219**	-0.0003**	0.0556***
				(0.1708)	(0.0098)	(0.0001)	(0.0081)
				F(3, 7095)	4.91***		

*, **, *** indicate statistical significance at 10%, 5%, 1% respectively. Figures in parentheses are standard errors.

Table 6: Returns to achieving 5-7 good GCSEs including English and maths relative to those with 3-4 good GCSEs

		Estimated Lifetime Productivity Returns	Constant Wage Returns	Wage Coefficients By Age			Employment Returns
				Qual	Qual*Age	Qual*Age^2	
Men	Marginal	£72,999	7%	-0.4206 (0.3041) F(3, 2115)	0.0239 (0.0185) 3.14**	-0.0003 (0.0003)	0.0462*** (0.0135)
	Average	£60,611	8%	-0.7631*** (0.1760) F(3, 6931)	0.0415*** (0.0103) 19.21**	-0.0005*** (0.0001)	0.0159* (0.0084)
Women	Marginal	£55,455	10%	-0.7891*** (0.2951) F(3, 2539)	0.0477*** (0.0167) 8.25***	-0.0006** (0.0002)	0.0525*** (0.0158)
	Average	£59,019	18%	-0.6406*** (0.1759) F(3, 7931)	0.0379*** (0.0101) 32.11***	-0.0004*** (0.0001)	0.0149*** (0.0097)

*, **, *** indicate statistical significance at 10%, 5%, 1% respectively. Figures in parentheses are standard errors.

Table 7: Returns to eight or more good GCSEs relative to those with 5-7 good GCSEs

		Estimated Lifetime Productivity Returns	Constant Wage Returns	Wage Coefficients By Age			Employment Returns
				Qual	Qual*Age	Qual*Age^2	
Men	Marginal	£2,909	-5%	-0.6439** (0.2748) F(3, 2470)	0.0423** (0.0174) 2.79**	-0.0006 (0.0003)	-0.0030 (0.0114)
	Average	£91,686	14%	-1.0054*** (0.1278) F(3, 16909)	0.0575*** (0.0078) 88.63***	-0.0007 (0.0001)	-0.0170*** (0.0043)
Women	Marginal	£32,592	5%	-0.7445*** (0.2419) F(3, 3385)	0.0468*** (0.0146) 6.30***	-0.0006*** (0.0002)	0.0032 (0.0060)
	Average	£36,147	7%	-1.4415*** (0.1153) F(3, 22023)	0.0866*** (0.0070) 113.49***	-0.0011*** (0.0001)	-0.0182*** (0.0046)

*, **, *** indicate statistical significance at 10%, 5%, 1% respectively. Note: Grey cell denotes lack of statistical significance. Figures in parentheses are standard errors.

Table 8: Returns to five or more good GCSEs including English and maths relative to those with 1-4 good GCSEs

		Estimated Lifetime Productivity Returns	Constant Wage Returns	Wage Coefficients By Age			Employment Returns
				Qual	Qual*Age	Qual*Age^2	
Men	Marginal	£105,474	9%	-0.8732** (0. 2359) F(3, 3747)	0.0515** (0.0145) 14.91***	-0.0006 (0.0002)	0.0634*** (0.0105)
	Average	£111,883	15%	-1.2477*** (0.1218) F(3, 15867)	0.0707*** (0.0072) 112.80***	-0.0008*** (0.0001)	0.0149** (0.0065)
Women	Marginal	£99,931	13%	-1.0373*** (0.2116) F(3, 4300)	0.0667*** (0.0123) 25.45***	-0.0008*** (0.0002)	0.1191*** (0.0126)
	Average	£72,329	16%	-1.6338*** (0.1187) F(3, 19222)	0.1003*** (0.0069) 173.87***	-0.0013*** (0.0001)	0.0178** (0.0072)

*, **, *** indicate statistical significance at 10%, 5%, 1% respectively. Note: Grey cell denotes lack of statistical significance. Figures in parentheses are standard errors.

A levels

Two or more A levels compared with 5-7 good GCSEs

There is a large lifetime productivity benefit from completing two or more A levels compared to holding 5-7 good GCSEs. The marginal lifetime productivity gain is around £90,000 for men and £76,000 for women, with the average gains at almost two-thirds of this amount: £58,000 for men and £43,000 for women. The lifetime returns are mostly due to higher wages from holding A levels, rather than improved employability (as shown in Table 9).

Individuals who gain two or more A levels earn 11-16% more over their lifetime, than those who gain 5-7 good GCSEs (depending on whether the returns are marginal or average). Employment returns are small or insignificant. The profiles of returns over the lifecycle are fairly similar across gender, although men who acquire two or more A levels as their highest qualification have negative wage returns in the first few years, whilst the returns profile for women is considerably more humped (Figure 7 & Figure 8 in the Annex).

The average wage returns estimates in this paper are similar to Greenwood et al (2007). BIS (2011), uses a slightly different qualification measure – one or more A levels – from that used in this paper, and allows returns to vary by age in 5-year age ranges. As in this paper, returns for women increase until 35-40 after which they begin to decline. Wage returns for

men are flatter than for women, which is comparable to the findings here, but unlike this paper, returns increase again after 55.

Greenwood et al (2007) find very small (0.4 percentage point), but statistically significant, employment returns to A levels in the average specification, whereas equivalent returns estimated here are not statistically significant. Using the different qualification and employment measure, BIS (2011) finds insignificant full-time employment returns to men, but quite large (5.1 percentage point) returns for women.

Table 9: Returns to two or more A levels relative to those with 5-7 good GCSEs

		Estimated Lifetime Productivity Returns	Constant Wage Returns	Wage Coefficients By Age			Employment Returns
				Qual	Qual*Age	Qual*Age^2	
Men	Marginal	£90,020	15%	-0.7237*** (0.2061) F(3, 6629)	0.0434*** (0.0131) 20.24***	-0.0005** (0.0002)	-0.0078 (0.0070)
	Average	£57,973	11%	-0.6714*** (0.1591) F(3, 14585)	0.0346*** (0.0096) 27.57***	-0.0004** (0.0001)	-0.0084 (0.0059)
Women	Marginal	£76,099	16%	-0.8498*** (0.1980) F(3, 8323)	0.0560*** (0.0124) 30.27***	-0.0007*** (0.0002)	0.0265*** (0.0084)
	Average	£42,982	11%	-1.0026*** (0.1381) F(3, 18588)	0.0576*** (0.0082) 49.92***	-0.0007*** (0.0001)	-0.0061 (0.0070)

*, **, *** indicate statistical significance at 10%, 5%, 1% respectively. Note: Grey cell denotes lack of statistical significance. Figures in parentheses are standard errors.

Apprenticeships

Level 2 apprenticeships compared with some lower or equivalent qualifications

There is a large lifetime productivity benefit from completing level 2 apprenticeships compared to holding at least some lower or equivalent level 2 qualifications. The lifetime productivity gains are particularly large for men, at close to £140,000, but are also sizeable for women (£67,000).

In contrast to other qualifications, the wage return to men with level 2 apprenticeships starts highly at around 40%, but decreases thereafter. This marginal wage return is 15% over the lifetime compared to men holding at least some lower or equivalent level 2 qualifications.

The marginal wage return profile to women is a similar shape to men (Figure 8 in the Annex). It starts lower (around 20%) and turns negative at 37, but this is offset by the large employment effects. This corresponds to a small but significant wage return of 2% over the lifetime.

Employment returns are sizeable and significant for both men and women. However, given that apprenticeships are work-based qualifications, the observed relationship may be partly an association between holding an apprenticeship and being in work, and not entirely a causal impact.

The wage returns in this paper are fairly similar to those in McIntosh (2007): 20% for men and 4% for women. As the wage returns to apprenticeships are largest in the first few years of work, and most people with apprenticeships are of younger ages, a quadratic return is likely to estimate lower returns over the lifecycle than a constant return. This may explain some of the differences in the estimated wages between this paper and the BIS (2011) and McIntosh (2007) papers. McIntosh (2007) estimates employment returns for men that are similar to this paper but considerably higher returns for women. BIS (2011) estimate higher returns for both men and women.

Table 10: Returns to level 2 apprenticeships relative to those with some lower or equivalent qualifications

		Estimated Lifetime Productivity Returns	Constant Wage Returns	Wage Coefficients By Age			Employment Returns
				Qual	Qual*Age	Qual*Age^2	
Men	Marginal	£138,999	15%	0.6436*** (0.1645) F(3, 38284)	-0.0205** (0.0092) 55.61***	0.0002 (0.0001)	0.0502*** (0.0073)
Women	Marginal	£67,444	2%	0.5636 (0.3699) F(3, 39672)	-0.0248 (0.0229) 4.20***	0.0003 (0.0003)	0.1256*** (0.0198)

*, **, *** indicate statistical significance at 10%, 5%, 1% respectively. Figures in parentheses are standard errors.

Return to level 3 apprenticeships compared with level 2 qualifications

There is a large lifetime productivity gain from level 3 apprenticeships for males of around £175,000 compared to those with level 2 qualifications. The lifetime profile of the wage return to men is similar in shape to those with level 2 apprenticeships, starting high but decreasing thereafter. However the level 3 apprenticeship wage returns pick-up again from age 55

onwards[26]. This corresponds to a wage return of around 19% over the lifetime. There is also a statistically significant employment return to level 3 apprenticeships of 8.5 percentage points, although again this should be considered an association rather than a causal impact.

McIntosh (2007) and BIS (2011) estimate a level 3 apprenticeship wage return to men of 22% and 18% respectively, close to the return estimated in this paper. Their respective employment returns are both higher than estimated in this paper.

The sample size of women with level 3 apprenticeships is too small to estimate the wage returns using a quadratic relationship (see methodology section). Instead we estimate a constant wage return to this qualification. This gives an estimated 5% uplift each year; however this estimate is not statistically significant. BIS (2011) similarly estimate a low, insignificant return to women with level 3 apprenticeships, whereas McIntosh (2007) estimates a (statistically significant) 14% return.

The 11.6 percentage point employment return to level 3 apprenticeships for women is fairly close to the McIntosh (2007) estimate of 16.2 percentage points. The BIS (2007) estimate is not statistically significant.

Table 11: Returns to level 3 apprenticeships relative to those with level 2 academic or vocational qualifications

		Estimated Lifetime Productivity Returns	Constant Wage Returns	Wage Coefficients By Age			Employment Returns
				Qual	Qual*Age	Qual*Age^2	
Men	Marginal	£175,500	19%	2.0880*** (0.3668) F(3, 6021)	-0.1054*** (0.0218) 36.63***	0.0013*** (0.0003)	0.0847*** (0.0138)
Women	Marginal	£78,477	5%	0.0528 (0.0782)			0.1162** (0.0375)

*, **, *** indicate statistical significance at 10%, 5%, 1% respectively. Figures in parentheses are standard errors. Blank grey cells denote unrecorded information. This is because the sample size of women with level 3 apprenticeships is too small to estimate the wage returns using a quadratic relationship.

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[26] Wage returns from age 50 onwards are based on only a few individuals and therefore should be treated with caution.

Sensitivity analysis

Are the returns to qualifications quadratic?

Previous studies (BIS, 2011) have shown that the returns to qualifications are not linear. This fits in with the theory that some skills are complements. As individuals build up job based skills, their education becomes more useful and therefore the productivity benefit from higher qualifications increases. As individuals move towards the end of their working life these education based skills become less relevant and the productivity difference falls. To model this hypothetical relationship we used a quadratic relationship between returns and age.

We examine a subset of qualifications to check if a quadratic specification is appropriate. The qualification returns in this subset are: marginal returns to 3-4 good GCSEs vs 1-2 good GCSEs; marginal returns to 5-7 good GCSEs including English and maths vs 3-4 good GCSEs; marginal returns to 2 or more A levels vs 5-7 good GCSEs; and marginal returns to level 3 apprenticeships vs any level 2 qualification (males only). These qualifications are chosen to give a wide range of possible levels.

For this sensitivity check, we allow the qualification returns to vary at each age (using dummy variables) and we compare the coefficients of these variables to the estimated return using the quadratic specification. For all the returns estimated it appears that the quadratic specification follows the dummy variables quite closely, with the relationship occasionally breaking down towards the end of an individual's life (for apprenticeships the breakdowns occur earlier in life than for the academic qualifications).

Figure 4 below shows the relationship between returns and age for men achieving two or more A levels, compared to those with 5-7 good GCSEs. The red line, representing the estimated quadratic returns appears to be a good estimate of the estimated returns at each individual age (represented by the blue diamonds). However, the smaller sample sizes above age 55 result in the individual age estimates becoming more variable. From this we can conclude that the quadratic specification is a sensible one to use to model the returns to 2 or more A levels.

Figure 4: Chart showing the marginal returns to 2 or more A levels vs 5-7 good GCSEs at each age and the modelled quadratic relationship
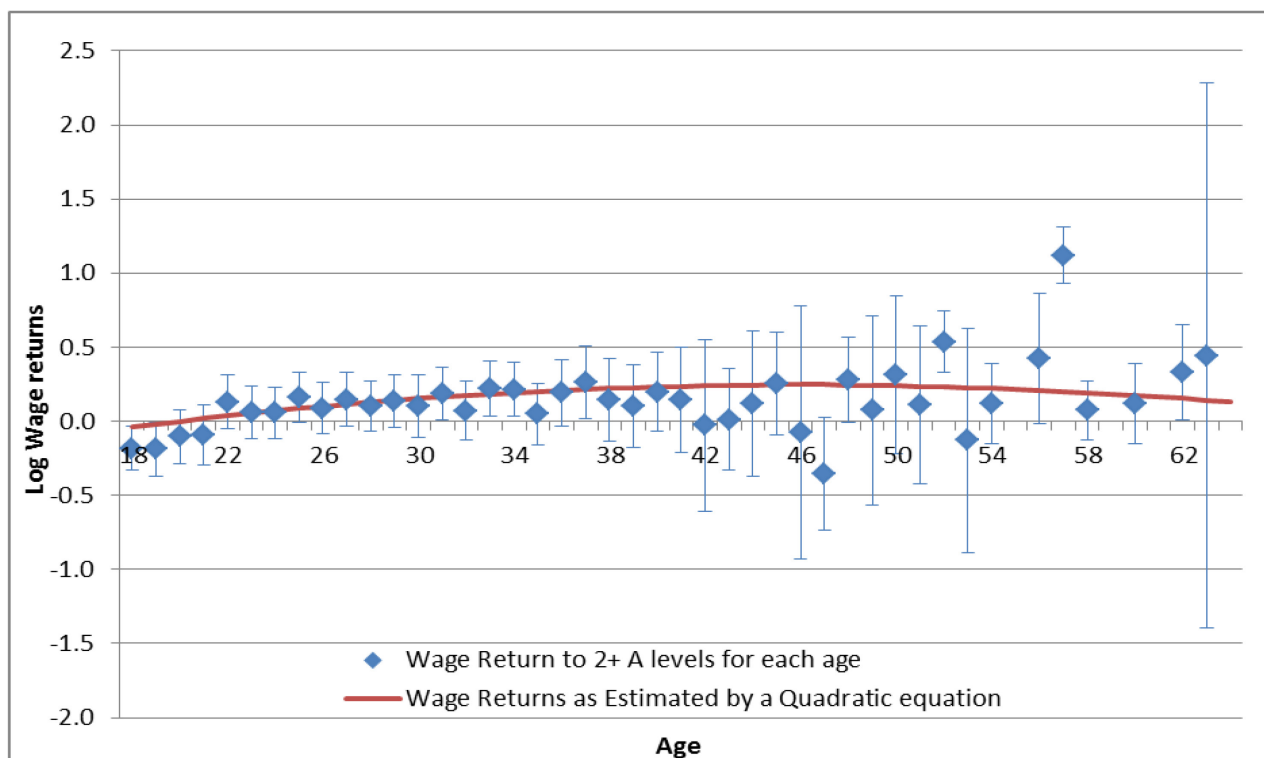
Wage period: weekly or hourly

The headline figures in this report use weekly pay as the dependent variable, rather than hourly wages. However, we also try hourly figures in the Annex as a sensitivity check. We find that the productivity returns estimated on hourly wages[27] do not differ systematically from the estimates based on weekly pay.

Different returns over time

The headline figures assume the returns to qualifications are constant over the time period Quarter 1 2006 to Quarter 1 2013. To determine if this is the case, we estimate a subset[28] of the returns with dummy variables for the calendar year the observation came from. This allows returns to differ depending on the year of the sample. Therefore we can examine the confidents of these dummy variables to test if the returns differ statistically each year. These regressions indicate that only a very few years have statistically significantly different returns (at 5%) and that there is no general pattern in the differing point estimates.

Productivity increases over wage

Our central estimates assume individuals' productivity is just equal to the full cost of employing them. We assume that the full-costs of employing someone is an extra 30% over

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[27] Based on assumed 40 hour working weeks.

[28] 5-7 good GCSEs including English and maths, 2 or more A levels and level 2 apprenticeships – the thresholds of most interest.

and above their labour costs. We consider the impact of varying this 'non-wage labour wage cost' assumption, in our upper and lower estimates of lifetime productivity below. The lower bound of 17% comes from an Office for National Statistics figure that uses a narrower definition of non-wage labour costs. The upper bound of 100% productivity increase over wages is based on a paper by Dearden et al (2005) who find that only half of the benefit of training accrues to the individual through higher wages.

Ability bias

Analysis produced by the Institute for Fiscal Studies (IFS) for this report using the British Cohort Study (BCS) looked at the potential effects of ability bias in our central LFS estimates. The BCS is a study of individuals born in one week in 1970 with follow up interviews in 1975, 1980, 1986, 1996, 1999/2000, 2004/5, 2008 and 2012. The dataset contains a richer set of variables than the LFS which allows for an estimation of the ability bias in the LFS.

The IFS analysis looks at how the returns to qualifications change when including additional variables[29] that control for ability. The analysis only covers those of age 30, 35 and 39 and only looks at the returns to O levels and A levels. The scale of ability bias is modelled by estimating returns first without the controls for ability and then again with the controls. The difference between the two returns coefficients is the degree of ability bias in the estimates. Ability bias was estimated separately for males and females and in both the marginal and average specifications. The data suggest that ability bias is around 40% for males and 25% for females in the marginal specification. For average returns, it is around 35% for males and 20% for females.

However, the estimated bias varies across the estimates and across the age range. There are issues with the BCS: most individuals will have sat O levels and not GCSEs, which may have different returns and ability bias; there is non-random attrition (dropping out of the survey) and problems with non-completion of surveys, which could impact on the estimates of returns and ability bias. For these reasons, we have not downgraded our central estimates by this estimated bias, but it informs the lower estimates of lifetime productivity, below.

Real earnings growth

Our central estimates do not include real earnings growth. However if there are technological improvements which cause workers to become more productive over time, the returns to qualifications will increase. The impact of assuming positive real earnings growth is considered further below, in our upper estimates of lifetime productivity. The central and lower estimate of 0% real earnings growth is based on a conservative assumption due to the absence of a robust figure. The upper bound figure of 2.2% is based on the Office for Budget

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[29] Variables are birth weight, parental education (leaving age), cognitive ability at 5, cognitive ability at 10, and childhood deprivation (quarters).

Responsibility estimate for economy wide real earnings growth, which would include general upskilling in the population.

The causal effect of qualifications on employment

Our central estimates assume 100% of the estimated employment return is the direct, causal impact of acquiring the qualification on someone's chances of being in work. However we vary this assumption for apprenticeships in our lower estimates of lifetime productivity below, given that apprenticeships are work-based qualifications and then there may be a causal link from being in work to obtaining an apprenticeship. The 50% lower bound figure is based on figures from BIS (2011).

Upper and lower estimates of lifetime productivity returns

To understand how the assumptions discussed in the previous section affect the lifetime productivity estimates, we have produced upper and lower estimates by varying what we see as the four key assumptions in our models. The different assumptions used to produce the estimates are given in Table 12 below.

Table 12: Assumptions for central, low and high estimates

Assumption	Central Estimate	Lower Estimate	Upper Estimate
Productivity increases over wage returns	30% - Covers non-wage labour cost based on BERR	17% - ONS[30]	100% Based on spill over benefits to firms – Dearden et al (2005)
Ability bias effects	0%	40% (males marginal); 25% (females marginal); 35% (males average) and 20% (females average) - Based on IFS	0%
Real Earnings Growth	0%	0%	2.2%[31]
Causal effect of employment returns for apprenticeships	100%	50% - BIS (2011)	100%

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[30] As taken from the "Share of Total Labour Costs, 2009Q1-2013Q1".http://www.ons.gov.uk/ons/about-ons/business-transparency/freedom-of-information/what-can-i-request/published-ad-hoc-data/labour/september-2013/share-of-total-labour-costs--2009q1-2013q1.xls

[31] Office for Budget Responsibility, 'Fiscal Sustainability Report' (2014), paragraph 25. http://cdn.budgetresponsibility.org.uk/41298-OBR-accessible.pdf

The results of our sensitivity analysis are outlined in Tables 13 & 14 for men and Tables 15 & 16 for women.

In Table 13 we can see that taking the lower bound assumptions, discussed in Table 12, reduce the estimated marginal lifetime productivity return to 5-7 good GCSEs vs 3-4 good GCSEs from £73,000 to £51,000. Taking the upper bound assumptions results in returns of £186,000.

Table 13: Central, low and high estimates of lifetime productivity returns – men GCSEs

	Marginal			Average		
	Central	Low	High	Central	Low	High
1-2 good GCSEs	£170,984	£125,029	£403,147			
3-4 good GCSEs	£59,043	£42,053	£141,726	£39,047	£28,313	£94,045
5-7 good GCSEs*	£72,999	£50,989	£186,321	£60,611	£38,598	£164,347
8+ good GCSEs	£2,909	-£120	-£24,518[32]	£91,686	£46,620	£241,524
5+ good GCSEs* (vs anything less)	£102,941	£70,777	£222,054	£62,930	£31,385	£163,004
5+ good GCSE* (vs 1-4 good GCSEs)	£105,474	£72,065	£260,259	£111,883	£66,371	£293,398

* Including English and maths

Table 14: Central, low and high estimates of lifetime productivity returns – men other qualifications

	Marginal			Average		
	Central	Low	High	Central	Low	High
A levels	£90,486	£44,335	£235,208	£57,973	£30,395	£173,522
Level 2 App	£138,999	£67,937	£313,668			
Level 3 App	£175,000	£80,550	£423,128			

The equivalent figures for women are given in Table 15 and Table 16 overleaf.

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[32] Due to the unusual returns occurring to the small sample of men who gain 8 or more GCSEs and then do not progress, the assumptions that result in larger positive returns in all other cases result in large negative returns.

Table 15: Central, low and high estimates of lifetime productivity returns – women GCSEs

	Marginal			Average		
	Central	Low	High	Central	Low	High
1-2 good GCSEs	£110,395	£89,542	£280,995			
3-4 good GCSEs	£51,055	£42,436	£118,221	£28,432	£24,915	£55,970
5-7 good GCSEs*	£55,445	£42,080	£136,850	£59,019	£42,979	£158,275
8+ good GCSEs	£32,592	£23,493	£71,799	£36,147	£24,639	£80,514
5+ good GCSEs* (vs anything less)	£105,485	£83,418	£254,336	£54,486	£38,772	£139,719
5+ good GCSEs* (vs 1-to-4 good GCSEs)	£99,931	£77,752	£237,081	£72,329	£51,685	£170,917

* Including English and maths

Table 16: Central, low and high estimates of lifetime productivity returns – women other qualifications

	Marginal			Average		
	Central	Low	High	Central	Low	High
A levels	£76,099	£53,063	£180,438	£42,982	£29,492	£113,908
Level 2 App	£67,444	£31,685	£148,700			
Level 3 App	£78,477	£39,206	£186,405			

There is a wide spread of estimates depending on the assumptions made in the model. This shows how important these assumptions are in estimating lifetime productivity returns. However, even taking the most conservative assumptions, the estimates show that there are large lifetime benefits to qualifications.

While the impact that each assumption has on the central estimate depends on the other assumptions made elsewhere in the model, typically the real wage growth assumption has the largest effect on the size of the lifetime productivity estimates.

Conclusion

This report provides a detailed analysis of the current economic value of key intermediate qualifications in England. We review the recent UK studies which have estimated the returns to GCSEs, A levels and apprenticeships. We then produce new estimates of the wage and employment returns to these qualifications, and use these to estimate the associated lifetime productivity gains to society.

Our analysis adds to the extensive returns evidence base in a number of ways. First, we use more recent Labour Force Survey data (2006-2013) spanning a period before, during and after the 2008 recession. Secondly, we produce more granular estimates of the economic benefits of GCSEs than has previously been available. Thirdly, we take a fresh and in-depth approach to a range of methodological issues involved in estimating the lifetime benefit of qualifications. In doing so, we have produced up-to-date and methodologically defensible estimates of the value of intermediate qualifications.

Key Findings

Intermediate qualifications have a strong labour market value in England. Achieving GCSEs, A levels and apprenticeships improve earnings, employability and lifetime productivity. Even achieving at very low levels – just one or two GCSE passes compared to none – is associated with large economic gains. Modest incremental improvements in GCSE attainment can also have sizeable lifetime returns, across the spectrum of GCSE achievement.

Our analysis shows that apprenticeships can have particularly high lifetime productivity returns for men. We also find that employment returns are higher for women than men at all qualification levels examined. Both of these findings broadly agree with the findings elsewhere in the wider literature.

The key lifetime productivity estimates are:

- Individuals achieving five or more good GCSEs (including English and maths) as their highest qualification have a lifetime productivity gain worth around £100,000 compared to those with below level 2 or no qualifications. Restricting the comparison group to just those with no qualifications boosts the returns to £283,000 for men and £232,000 for women.

- Individuals who just cross the five good GCSE threshold have considerably higher lifetime productivity than those who don't cross the threshold. Men holding 5-7 good GCSEs (including English and maths) as their highest qualification have lifetime productivity worth around £73,000 more than those with only 3-4 good GCSEs; for women, the gain is £55,000.

- Men with two or more A levels as their highest qualification have a lifetime productivity gain of around £90,000 compared to those with 5-7 good GCSEs; for women the figure is around £76,000.

- Men with level 2 apprenticeships as their highest qualification have a lifetime productivity gain of around £139,000 compared to those qualified to level 1 or 2, while the premium for women is around £67,000. This figure is even higher for those who acquire level 3 apprenticeships as their highest qualification, with lifetime returns for men of around £176,000, compared to those who have level 2 qualifications, and around £78,000 for women.

Sensitivity Analysis

Our lifetime returns estimates are quite sensitive to the assumptions that we make about key, uncertain parameters. In most cases taking the lower bound reduces the productivity benefit by between a fifth and a third. The upper bound generally increases the returns to around two to two-and-a-half times the central estimate. Yet even using conservative assumptions for all of these do not alter the conclusion: the labour market places a sizeable premium on GCSEs, A levels and apprenticeships.

Policy Implications

Our analysis raises some key policy issues. First, the 1% of pupils who leave school at age 16 without any qualifications do so at a large economic cost to themselves and to society in lost output. Secondly, there is a strong economic imperative that all children fulfil their educational potential, as even modest GCSE improvements – at all levels – deliver large returns. Thirdly, the very high returns observed for men who acquire apprenticeships, demonstrates that high-quality vocational qualifications offer significant economic returns. Academic provision should not be considered the default option for all young people.

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Annex

Data and methodology of key recent UK studies

This section outlines the data and methodology used by three key UK studies that estimate the economic benefits to gaining academic and/or vocational qualifications at levels 2 and 3.

The first study examined is by Greenwood et al. (2007), who estimate the wage and employment returns for the full range of academic and vocational qualifications at levels 2 and 3. These qualifications are held by the English workforce aged 16-65 and are taken from Labour Force Survey (LFS) data between 1997 and 2006. The sample includes full and part-time workers. They use an Ordinary Least Squares (OLS) methodology[33] to compare the (log) gross real hourly wages of those with and without the qualification of interest, stripping out the effects of other observed characteristics - such as gender, age, and other qualifications held - that would otherwise impact on wage outcomes[34]. They estimate the return to everyone who holds the qualification of interest (known as the 'average return'), and to the subset of individuals who hold it as their highest qualification (the 'marginal return').

Greenwood et al. (2007) use a probit model[35] to estimate employment returns in a similar way to estimating the wage returns, where the dependent variable is defined as someone being in employment or not. They estimate average and marginal employment returns for two samples: (1) economically active individuals (in accordance with International Labour Organisation's definition of economic activity) and (2) the full sample of economically active and inactive individuals.[36]

The second study examined is by McIntosh (2007), who estimates the wage and employment returns to gaining vocational qualifications such as National Vocational Qualifications (NVQs) and apprenticeships. He uses pooled LFS data between 1997 and 2006 for a full-time English workforce not in education. Only marginal returns are examined, e.g. individuals who hold apprenticeships as their highest qualification. Individuals who hold higher-ranked qualifications such as A levels, degrees or other higher education qualifications are therefore excluded from the analysis. McIntosh uses OLS methodology

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[33] A statistical technique that is used to minimise the sum of squares between the observed data values and the predicted data values (i.e. it calculates a line of best fit).

[34] The full list of controls are: gender, age, age-squared, ethnicity, region, year dummies, other qualifications held, whether the person works part-time, and a proxy respondent dummy variable.

[35] A technique used to estimate binary outcomes, e.g. whether someone is in employment or not. In this example it would take a value of 1 if someone is in employment and 0 otherwise.

[36] ILO defines economically active individuals as those in the labour market who are either employed or are: without a job, want one, have actively sought work in the last 4 weeks and are available to start work in the next 2 weeks; or are out of work, but have found a job and are waiting to start it in the next 2 weeks. Inactive workers are those who are not in the labour force, i.e. those who are unable to carry out work or who are not actively seeking work.

with very similar controls to Greenwood et al (2007)[37]. However, he uses (log) real gross weekly, rather than hourly, earnings as the dependent variable in the wage regression.

Finally, the most recent study we examine is the BIS Research Paper No. 53 (2011). Although the focus is on vocational qualifications, they do consider the economic value of acquiring GCSEs and A levels. They use pooled LFS data over a longer period from 1996 to 2009 for UK men aged 16 to 64 and women aged 16 to 59. Consistent with McIntosh (2007), the sample is full-time workers only. OLS is used to estimate the wage returns, with (log) real hourly earnings as the dependent variable in the wage regression, while a probit model is used to estimate the employment returns. BIS (2011) use additional controls to Greenwood et al (2007).[38]

Calculating lifetime productivity returns in the literature

This section outlines how other studies calculate lifetime productivity returns.

McIntosh (2007) calculates the lifetime productivity returns (or, as he defines it, the social benefits) to acquiring apprenticeships by looking at the future stream of earnings for individuals who hold the qualification of interest, and for those who do not. He compares the two earnings streams and argues that the difference between the two indicates how much more output an individual can produce as a result of their training.

To calculate the earnings profile for individuals who do not hold the qualification of interest (the comparison group), McIntosh predicts the wage from a regression of weekly earnings against age and age-squared, among other controls in the wage equation, with the age coefficients being used to estimate the earnings at each point in the life cycle. These estimated annual earnings at each age are then corrected for the probability that someone of that age is in employment and receiving this wage. This figure (i.e. annual wage corrected for employment probability) is then increased to include non-wage labour costs (NWLC)[39] (assumed to be 25% of the annual wage), and to allow for real earnings growth over the lifetime (assumed to be 2% per year)[40]. Finally, this adjusted annual earnings figure at each age is discounted to obtain the present value of these qualifications[41].

For those who hold the qualification of interest, predicted annual earnings are calculated by taking the average earnings of individuals in the comparison group at each age, increasing them by the appropriate wage return estimates, and then correcting for the likelihood of being in work by multiplying this wage by the comparison group's employment probability

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[37] The only differences are that McIntosh (2007) includes controls for workplace size and public or private sector, and excludes controls for whether a person works part-time, and a proxy respondent.

[38] They are: marital status, the number of dependent children, seasonal dummies, and for the wage regression, controls for temporary or permanent employment, public or private sector, and workplace size.

[39] The argument here is that adjusting wages to account for the full cost to the firm is a stronger proxy for output, since firms would only hire someone if they produce output to the level that they cost.

[40] Real earnings growth accounts for increased productivity over time due to improved technology etc.

[41] The discount rate is assumed to be 3.5% for the first 30 years of the working life, and then 3% thereafter in accordance with HMT 'Green Book' guidance.

plus half of the estimated extra probability of being in work if the particular qualification is held[42]. Like before, these estimated wages are corrected for NWLC (25%) and annual real earnings growth (2% per year), and discounted, to produce an age-earnings profile of future earnings. The difference between this value and the value calculated for the comparison group gives the output gain (which McIntosh argues is a social benefit) to acquiring the qualification.

McIntosh also considers the cost of delivering the qualification; so that the lifetime benefits of apprenticeships can be weighed against the costs (i.e. he calculates the net present value – NPV[43]). We do not discuss his method for calculating costs any further since this study only focuses on the economic benefit of becoming more educated.

BIS (2011) also study the lifetime benefits of educational attainment. This work focuses only on lifetime wage benefits to the individual from acquiring apprenticeships, rather than the benefits to society from any higher output produced. They do not consider the costs of delivering the qualification or the employment benefits of acquiring an apprenticeship[44]. They adopt a very similar approach to measuring lifetime earnings as the McIntosh study, inflating the earnings of the counterfactual group using the earnings premium and the employment probability of the base case. As above, real earnings growth is assumed to be 2%. The only differences seem to be that the benefits are estimated for the individual (not society) and therefore net of tax; and that earnings are not uplifted to account for NWLC.

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[42] Unlike our study, which attributes the full 100% employment benefit to the qualification, McIntosh (2007) argues that "only half of the apparent gain in employment likelihood associated with each of the qualifications of interest is attributed to that qualification because not all of the estimated effect in the employment equations can be interpreted as a causal effect of that qualification on employment; 50% is simply an assumption as to how much of the employment effect is causal, though robustness checks are carried out in the appendix where different proportions are assumed (2007:33)."

[43] Net Present Value (NPV) is a formula used in investment appraisal to weigh up the benefits and costs of a particular project, by discounting the future stream of benefits and costs into their present value.

[44] They assume that apprentices would be employed even in the absence of undertaking the apprenticeship qualification.

Results of the key recent UK studies

Table 17: Wage & employment returns estimates for five or more good GCSEs

		Constant Wage Returns (%)		Employment Returns (ppt.)			
		Marginal	Average	Marginal - Full sample	Marginal - Economically active	Average – Full sample	Average – Economically active
Greenwood et al (2007)	Men	25.7***	11.3***	11.1***	3.1***	9.6***	3.1***
	Women	23.6***	9.4***	20.6***	2.7***	19.6***	2.9***
	Both	25.2***	10.6***	15.9***	2.9***	14.8***	3.0***
BIS (2011)[a]	Men	14.0***	25.5***	-	-	11.2***	-
	Women	13.1***	22.5***	-	-	17.6***	-
	Both	15.0***	24.6***	-	-	14.3***	-

*** significant at 1% level. ** significant at 5% level. * significant at 10% level.

Numbers above represent the percentage returns on wages, or percentage point (ppt.) returns on employment probability. Comparison groups are identical across studies, with 'marginal returns' comparing those who hold 5 good GCSEs as their highest qualification to those with no qualifications, and 'average returns comparing anyone who holds 5 good GCSEs to all those who do not hold this qualification. Where coefficient values are reported in the literature, they are converted using the following formula: 100*[exp(b)-1] where 'b' is the regression coefficient. We have done this for consistency and comparison reasons.

[a] Employment returns estimates are taken from their annex, which estimates the increased likelihood of being in full-time or part-time employment, as opposed to only being in full-time employment. These estimates should be more comparable to ours, given that our sample includes both full and part-time workers.

Table 18: Wage & employment Returns estimates for A levels

		Constant Wage Returns (%)		Employment Returns (ppt.)			
		Marginal	Average	Marginal - Full sample	Marginal - Economically active	Average – Full sample	Average – Economically active
Greenwood et al (2007)[a]	Men	45.4***	13.9***	5.7***	2.8***	-3.2***	0.5***
	Women	41.6***	13.8***	14.5***	2.4***	-2.1***	0.3**
	Both	43.8***	14.2***	10.0***	2.6***	-2.7***	0.4***
BIS (2011)†	Men	-	9.5***	-	-	1.7***	-
	Women	-	9.4***	-	-	4.0***	-
	Both	-	9.4***	-	-	2.9***	-

*** significant at 1% level. ** significant at 5% level. * significant at 10% level.

[a] 'Marginal' returns compares those who hold 2 or more A levels as their highest qualification with those who hold no qualifications.
† Unlike Greenwood et al (2007), 'average' wage returns compares anyone who holds 1 or more A levels, rather than 2 or more A levels, to all those who do not hold this qualification.

Numbers above represent the percentage returns on wages, or percentage point (ppt.) returns on employment probability. Where coefficient values are reported in the literature, they are converted using the following formula: 100*[exp(b)-1] where 'b' is the regression coefficient. We have done this for consistency and comparison reasons.

Table 19: Wage & employment returns estimates for level 2 and level 3 apprenticeships

		Constant Wage Returns (%)		Employment Returns (ppt.)			
		Marginal	Average	Marginal - Full sample	Marginal - Economically active	Average – Full sample	Average – Economically active
Level 3: McIntosh (2007)	Men	22.4***	-	10.1***	-	-	-
	Women	14.2**	-	16.2***	-	-	-
	Both	17.7***	-	15.7***	-	-	-
Level 3: Greenwood et al (2007)	Men	-	8.9***	-	-	8.9***	2.3***
	Women	-	-3.2*	-	-	10.8***	1.6***
	Both	-	4.7***	-	-	10.8***	2.1***
Level 3: BIS (2011)	Men	18.4***	-	13.6***	-	-	-
	Women	1.6	-	2.9	-	-	-
	Both	13.3***	-	13.8***	-	-	-
Level 2: McIntosh (2007)	Men	19.8***	-	4.6*	-	-	-
	Women	3.9	-	6.4	-	-	-
	Both	15.6***	-	7.4**	-	-	-
Level 2: Greenwood et al (2007)	Men	24.9***	13.8***	-	1.4	-	2.5***
	Women	-10.86	3.1	-	2.0	-	2.8***
	Both	9.64*	9.2***	-	1.6	-	2.6***
Level 2: BIS (2011)	Men	8.8***	-	7.8***	-	-	-
	Women	0	-	8.6***	-	-	-
	Both	7.9***	-	9.5***	-	-	-

*** significant at 1% level. ** significant at 5% level. * significant at 10% level.

Numbers above represent the percentage returns on wages, or percentage point (ppt.) returns on employment probability. Comparison groups using the marginal specification are different across the studies. McIntosh (2007) compares those who hold level 2 apprenticeships as their highest qualification to those with a level 1 or level 2 qualification as their highest, whereas BIS (2011) only compare to those with a level 1 qualification as their highest. Average specification is the same across all studies, by comparing those with the qualification of interest to all those who don't hold the qualification, controlling for all other qualifications held. Where coefficient values are reported in the literature, they are converted using the following formula: 100*[exp(b)-1] where 'b' is the regression coefficient.

Table 20: Lifetime returns for apprenticeships

	Estimated Average Lifetime Productivity Returns
Level 3: McIntosh (2007)	£105,000 (NPV)
Level 3: BIS (2011)	£77,000 - £117,000[a]
Level 2: McIntosh (2007)	£73,000 (NPV)
Level 2: BIS (2011)	£48,000 - £74,000[a]

[a] The range reflects whether the full employment benefit is attributed to the qualification (upper estimate), or whether it should take the value 50% (lower estimate).The lower estimate follows the approach of McIntosh (2007) who argues that some of the employment benefit of getting qualified cannot be considered causal. For consistency between studies we report the lower estimate; note however that these figures are not directly comparable since McIntosh (2007) calculates the social benefits *net* of costs, whilst BIS (2011) focuses on private gains only.

Figures

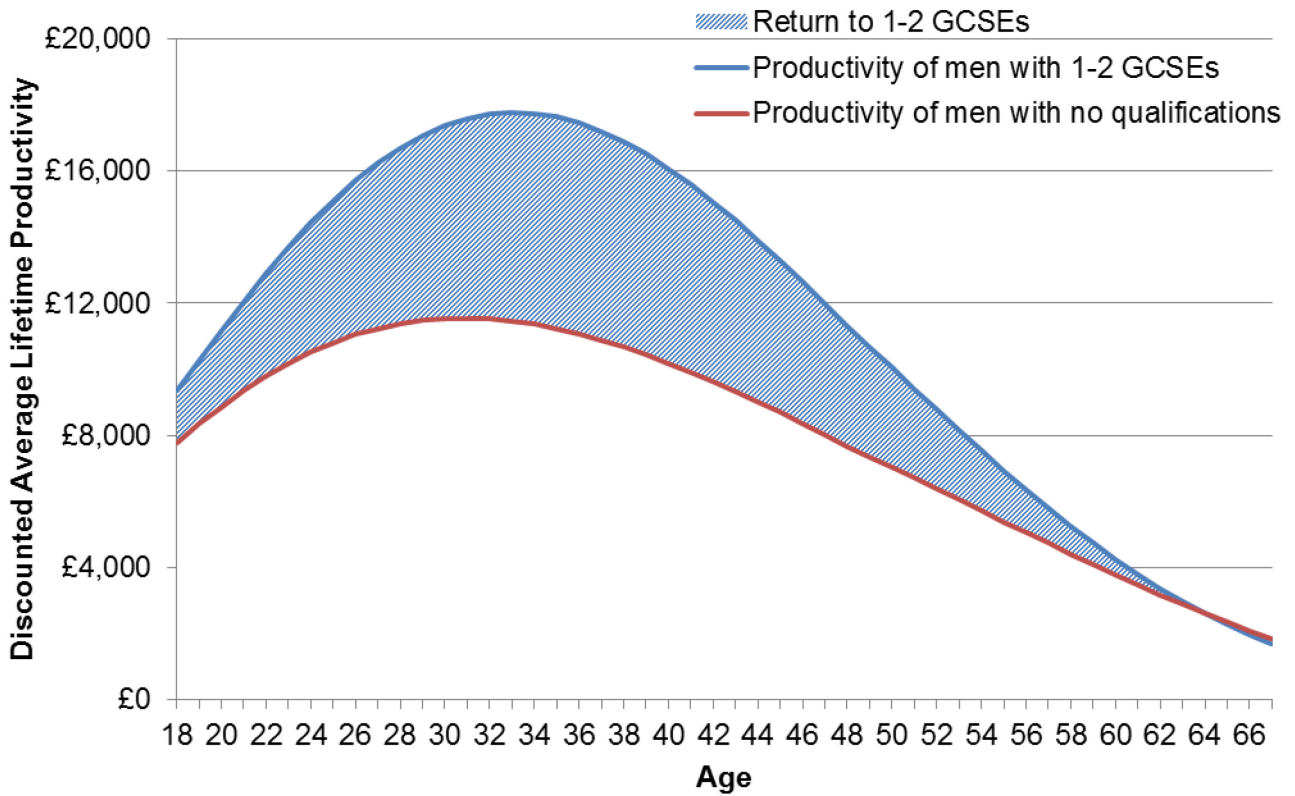**Figure 5: Marginal returns by age to 1-2 good GCSEs - men**

Legend:
- Return to 1-2 GCSEs
- Productivity of men with 1-2 GCSEs
- Productivity of men with no qualifications

Y-axis: Discounted Average Lifetime Productivity (£0, £4,000, £8,000, £12,000, £16,000, £20,000)
X-axis: Age (18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66)

Figure 6: Marginal returns to 2 or more A levels – men

Legend:
- Return to 2+ A-Levels
- Productivity of men with 2+ A-Levels
- Productivity of men with 5-7 GCSEs

Y-axis: Discounted Average Annual Productivity (£0, £5,000, £10,000, £15,000, £20,000, £25,000)
X-axis: Age (18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66)
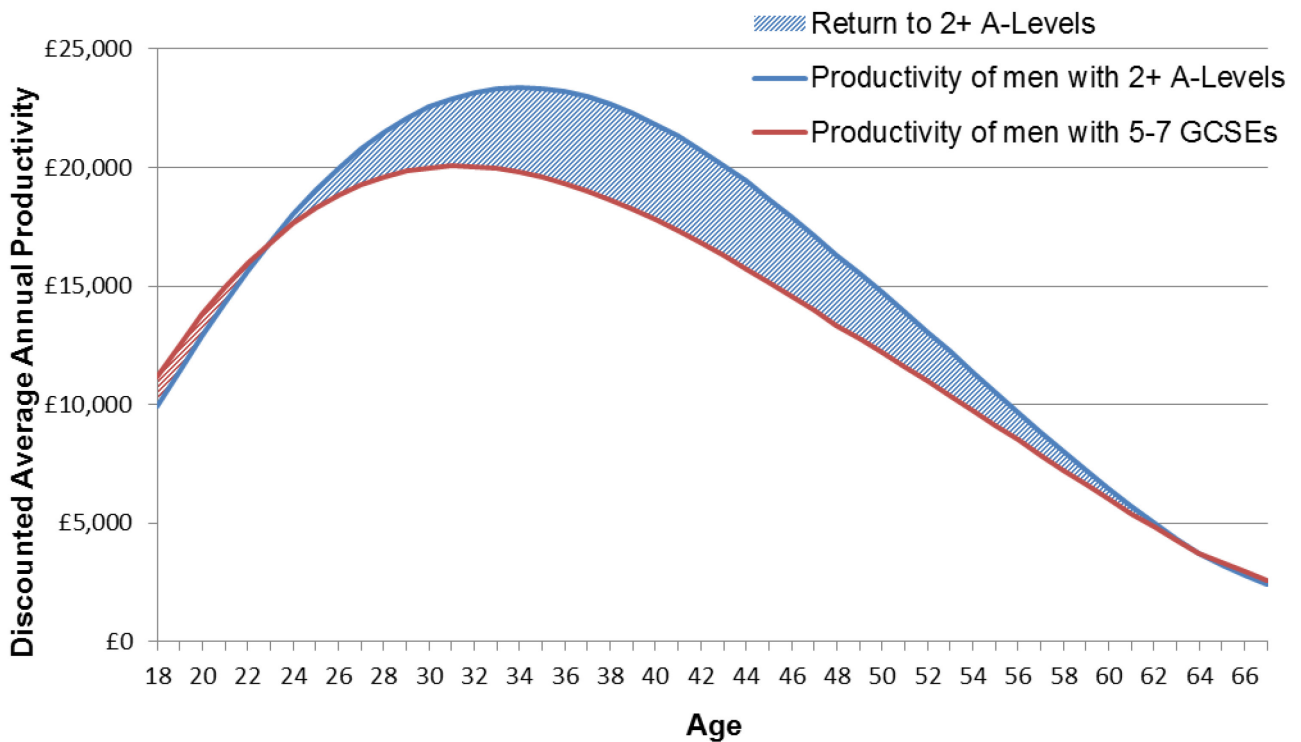
Figure 7: Marginal returns to 2 or more A levels - women

Legend:
- Return to 2+ A-Levels
- Productivity of women with 2+ A-Levels
- Productivity of women with 5-7 GCSEs

X-axis: Age
Y-axis: Discounted Average Annual Productivity (£0 to £14,000)
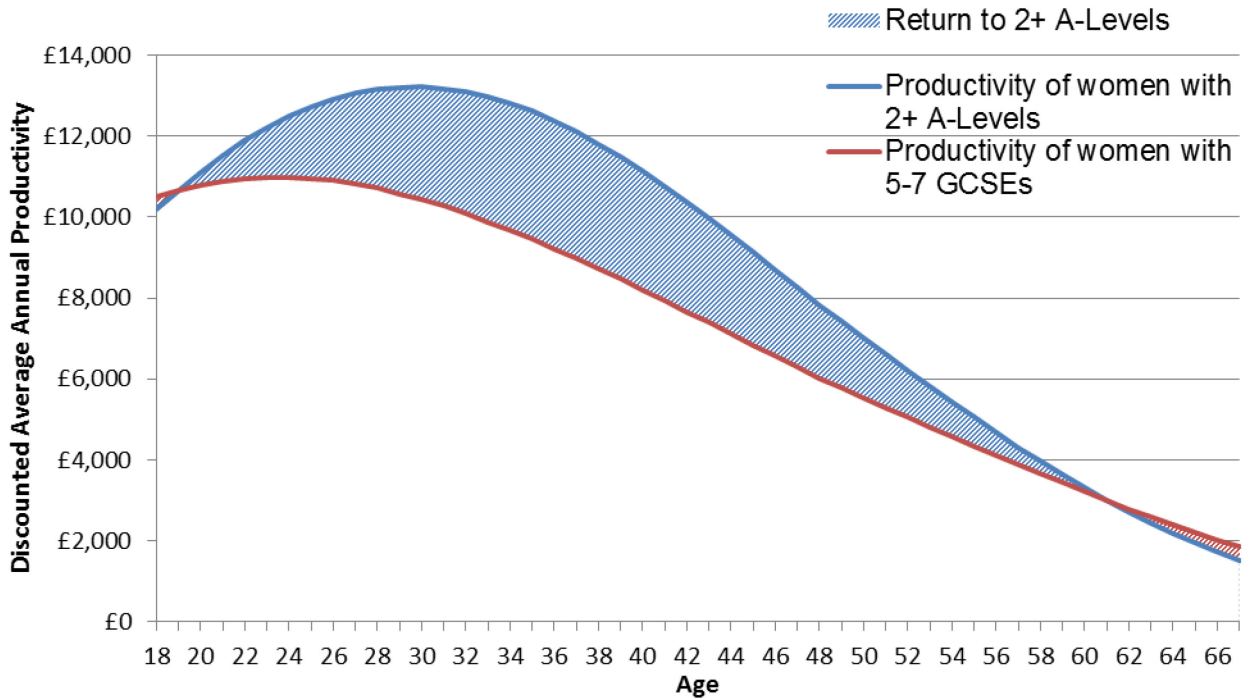
Figure 8: Returns to level 2 apprenticeships - women

Legend:
- Return to Level 2 Apprenticeships
- Productivity of women with Level 2 Apprenticeships
- Productivity of women with some qualifications

X-axis: Age
Y-axis: Discounted Average Annual Productivity (£0 to £12,000)
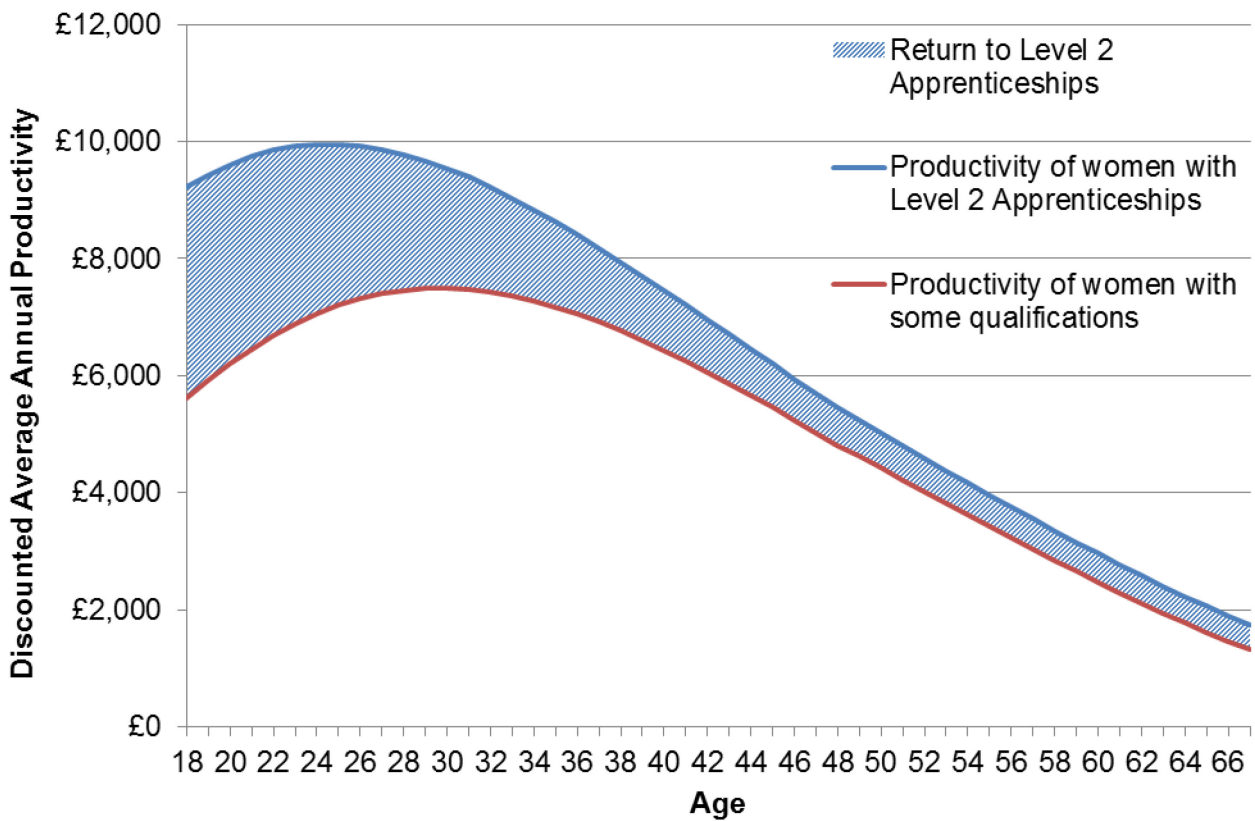
Further sensitivity analysis

Table 21 Effect of changing wage period and employment type on male lifetime productivity estimates

Qualification	Marginal or Average	Full sample		Active sample	
		Weekly	**Hourly**	**Weekly**	**Hourly**
1-2 good GCSEs vs no qualifications	Marginal	£170,984	£161,578	£105,547	£102,075
3-4 good GCSEs vs 1-2 good GCSEs	Marginal	£59,043	£52,270	£50,534	£41,518
	Average	£39,047	£34,088	£36,267	£28,724
5-7 good GCSEs including English & maths vs 3-4 GCSEs	Marginal	£72,999	£74,988	£67,456	£71,862
	Average	£60,611	£62,149	£67,559	£72,372
8+ good GCSEs vs 5-7 good GCSEs	Marginal	£2,909	£22,361	-£7,059	£19,784
	Average	£91,686	£90,481	£126,633	£127,529
5+ good GCSEs vs below level 2 or no qualifications	Marginal	£102,941	£120,832	£80,637	£112,455
	Average	£62,930	£74,007	£102,172	£121,781
5+ good GCSEs vs 1-4 good GCSEs	Marginal	£105,474	£120,832	£80,637	£112,455
	Average	£111,883	£74,007	£102,172	£121,781
2+ A levels vs 5-7 good GCSEs	Marginal	£90,020	£116,432	£112,476	£144,658
	Average	£57,973	£65,435	£66,825	£74,366
Level 2 apprenticeships vs some lower or equivalent qualifications	Marginal	£138,999	£98,609	£125,235	£81,820
Level 3 apprenticeships vs Level 2 qualifications	Marginal	£175,500	£125,697	£169,831	£109,517

Table 22 Effect of changing wage period and employment type on female lifetime productivity estimates

Qualification	Marginal or Average	Full sample		Active sample	
		Weekly	Hourly	Weekly	Hourly
1-2 good GCSEs vs no qualifications	Marginal	£110,395	£34,907	£140,036	£60,235
3-4 good GCSEs vs 1-2 good GCSEs	Marginal	£51,055	£63,727	£33,867	£38,213
	Average	£28,432	£42,465	£12,373	£23,601
5-7 good GCSEs including English & maths vs 3-4 good GCSEs	Marginal	£55,445	£62,932	£54,415	£59,775
	Average	£59,019	£57,187	£75,578	£73,286
8+ good GCSEs vs 5-7 good GCSEs	Marginal	£32,592	£36,909	£30,840	£34,681
	Average	£36,147	£57,020	£56,429	£91,547
5+ good GCSEs vs below level 2 or no qualifications	Marginal	£105,485	£123,315	£71,960	£76,946
	Average	£54,486	£64,413	£82,816	£100,824
5+ good GCSEs vs 1-4 good GCSEs	Marginal	£99,931	£118,154	£84,166	£94,691
	Average	£72,329	£89,712	£93,999	£120,552
2+ A levels vs 5-7 good GCSEs	Marginal	£76,099	£76,710	£89,630	£88,485
	Average	£42,982	£55,686	£56,460	£73,669
Level 2 apprenticeships vs some lower or equivalent qualifications	Marginal	£67,444	£66,856	£32,723	£10,129
Level 3 apprenticeships vs Level 2 qualifications	Marginal	£78,477	£62,343	£26,529	-£11,339

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