Department for Education

Key Stage 2 attainment and lifetime earnings

Research report

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Executive summary

This report provides estimates of the lifetime earnings return associated with improvements in attainment at Key Stage 2 (KS2), when pupils are aged 10-11. Our findings highlight the value of primary school education in terms of future earnings, and variation in this earnings gain across different subgroups of pupils.

While prior research by the department has provided estimates of the early career returns to KS2 attainment, this is the first study to estimate the cumulative value of improvements in attainment over a lifetime. In doing so, we add to a growing literature which has estimated the lifetime returns to attainment at different levels of education. Estimates of returns that take a whole career perspective are often used in the economic appraisal of education policy, informing policy decisions.

We use Longitudinal Education Outcomes (LEO), an administrative dataset linking educational attainment to earnings from employment and self-employment for every pupil in the English state school system. As LEO only enables us to observe the earnings of pupils born since 1985/86, we supplement this with information from the UK Labour Force Survey, which we use to simulate the future lifetime earnings of individuals in LEO.

We caution against overly strong causal or deterministic interpretations of the findings in this report. They simply show the association between KS2 attainment and lifetime earnings, controlling for a range of other factors that could drive these outcomes. Nevertheless, predictive lifetime earnings models are important as a component of value for money analysis, enabling us to monetise the benefits arising from policies aimed at improving attainment.

A note on language and values. The word 'returns' is used throughout the document for simplicity and is not meant to imply any causal or deterministic interpretation of the findings. Additionally, the value of these 'returns' are presented in terms of one standard deviation improvements in attainment, to be consistent with the literature. However, any specific policy is unlikely to apply a shift of this magnitude.

Lastly, it should be noted that we have not been able to control for prior attainment in this analysis, as we do not have data available on KS1 attainment for the cohorts used. Key Stage 1 attainment data was only collected in the National Pupil Database for 1997/98, too late to use for these cohorts. This creates a limitation on the results presented and generates potential omitted variable bias. As such, use of this analysis in economic appraisal should make appropriate adjustments to control for this limitation. We chose these older cohorts to be consistent with our previous published analysis of 'Key Stage 2 attainment and early labour market outcomes', as we expand this work from earnings at age 33 to covering the course of a lifetime. We also benefit from using these older cohorts, as they allow us to include more earnings data than younger cohorts, to improve our lifetime earnings estimations. We plan to conduct future analysis to continually build the evidence base on returns to education, and this future work will include younger cohorts, where we will be able to control for KS1 attainment.

Key findings

Our findings indicate that:

- Pupils who sat their KS2 assessments between 1996/97 and 1999/00 are expected, on average, to earn £1.1 million in undiscounted earnings over their lifetime, or £461,400 in present values at age 10-11.[1]

- Higher KS2 attainment is associated with higher lifetime earnings. A one standard deviation improvement in total KS2 English and maths attainment, after controlling for confounding variables, is associated with an average increase in the undiscounted value of lifetime earnings of £157,500, or £63,700 in present value terms.[2] This is equivalent to a 13.8% increase in lifetime earnings.

- Pupils with higher KS2 attainment, who realise higher earnings later in life, also tend to have higher educational attainment post KS2. Most of the return can be explained by pupils who do better at KS2 going on to do better in their GCSEs. This tells us that doing well in primary school is important because it is correlated with improvements in subsequent qualifications which, in turn, matter for future earnings.

- Returns are 59% larger for an equivalent improvement in KS2 maths attainment compared to KS2 English. A one standard deviation improvement in maths attainment is associated with an average increase in undiscounted lifetime earnings of £104,400, compared to £65,500 for the same improvement in English attainment. In present value terms this would be a £42,200 increase for maths, compared to £26,500 for English.

- Returns to an equivalent improvement in KS2 English and maths attainment are larger for women than men. This is despite men earning, on average, more than women. A one standard deviation improvement in total KS2 English and maths attainment is associated with a £186,000 (18%) increase in undiscounted lifetime earnings for women, compared to £129,100 (10%) for men. In present value terms this would be a £75,200 increase in lifetime earnings for women, compared to £52,200 for men. This suggests that increasing overall KS2 attainment could reduce the gender wage gap.

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[1] Using the standard HM Treasury discount rate of 3.5% over years 1 to 30, and 3% thereafter (HM Treasury (2020)). All earnings figures are deflated to September 2022 prices.

[2] A one standard deviation (s.d.) improvement is roughly equivalent to an average attainer moving from the 47th percentile of the attainment distribution to the 84th percentile. For example, a one s.d. improvement in English would be equivalent to an extra 15 marks out of 100. See Table 2 for further details.

- As a percentage of lifetime earnings, returns to an equivalent increase in KS2 attainment are similar for pupils who are eligible for Free School Meals (FSM) than for those who are not (14.4% and 13.7%, respectively). In cash terms, a one standard deviation increase in total KS2 English and maths attainment is associated with £162,000 in additional undiscounted earnings for non-eligible pupils, compared to £129,600 for FSM-eligible pupils. In present value terms this would be a £65,500 increase in discounted earnings for non-eligible pupils, compared to £52,400 for FSM-eligible pupils.

- Improvements in maths attainment could reduce earnings inequality. Though those nearer the top of the potential earnings distribution experience higher returns in cash terms, this is worth less as a percentage of earnings to those at the top. For English, the return as a percentage of earnings is flat across the potential earnings distribution.

- At least part of the return to KS2 English and maths can be explained by pupils who do well in these subjects also doing well in other primary school subjects that matter for future earnings but are not formally assessed at KS2. Controlling for attainment in KS2 science, for example, explains part of the return to English and maths.

- The benefits from doing better in KS2 maths are felt more strongly in the early stages of a person's career when we look at the percentage difference in earnings between those who do better and those who do worse. The return remains positive through to retirement, with those who do worse failing to catch up. Benefits from doing better in KS2 English remain more stable over time.

Introduction

This report provides estimates of the lifetime earnings return associated with marginal improvements in attainment at KS2 in England. KS2 assessments take place at the end of primary school, when pupils are aged 10-11. They are a key marker of children's educational progress, and have been a compulsory part of the national curriculum since 1995.

Previous studies have estimated the potential earnings gains of improvements in KS2 attainment by combining multiple sources of evidence, leading to uncertainty in the resulting estimates. Specifically, estimates have been produced by linking improvements in KS2 attainment with lifetime earnings via their correlation with GCSE attainment (Department for Education, 2022). This requires assumptions regarding the extent to which improvements in skills accumulate or dissipate over time. The uncertainty created by this process could be reduced by directly linking primary attainment with lifetime earnings.

Until recently, these could not be linked. The availability of Longitudinal Educational Outcomes (LEO) data – which links educational attainment to earnings records – has created the opportunity to do this. In a report published by the Department for Education, Hodge (2023) provides the first direct estimates of the early career returns associated with improvements in KS2 attainment. Here, we extend this analysis to consider earnings gains over a lifetime. Estimates of returns that take a lifetime perspective are often used in the economic appraisal of education policy, informing policy decisions.

The key questions we ask in this report are:

- What is the lifetime earnings return associated with increased KS2 attainment?
- How do lifetime earnings returns vary by subject?
- How do lifetime earnings returns vary across pupils grouped by:
    - Gender
    - Free School Meal eligibility
    - Income
    - Region
    - Ethnicity
- How do returns to KS2 attainment accumulate over the life cycle?
- What is the role of subsequent educational attainment in explaining the relationship between KS2 attainment and lifetime earnings?

Our estimates cannot be interpreted as causal. They simply show the association between KS2 attainment and lifetime earnings, controlling for a range of other factors that could drive these outcomes. This 'selection-on-observables' approach is standard in the literature on wage returns to education, as it is not generally possible to observe variation in pupils' educational attainment that is driven by exogenous shocks.

This does mean that *unobserved* factors which affect both KS2 attainment and lifetime earnings, such as family income, the home learning environment, and non-cognitive skills, may bias the causal interpretation of our estimates. While this is a limitation of these methods, we should not overlook the fact that we have, until now, been unable to say much about the relationship between marginal improvements in attainment and lifetime earnings. The sheer size of our dataset and the granularity with which it records individuals' educational attainment enables insight into the potential benefits of marginal improvements in attainment, which is often the relevant outcome for education policy.

Key Stage 2 assessments

Pupils sit KS2 assessments at the end of primary school at age 10 or 11. The system of assessment has evolved since its introduction in 1995. For a timeline of key changes, see Appendix A.

Our study cohort consists of those who sat KS2 assessments between 1997 and 2000. These pupils were assessed in English, maths and science, though in the science test ceased in 2009.[3] In this report, we focus on the return to English and maths as this is most relevant to current pupils. These tests are externally set and marked.

Estimating the returns to KS2 attainment is relatively straightforward, compared to estimating the returns to GCSEs and higher education. KS2 assessments are compulsory, which obviates the need to devise methods for dealing with selection problems. Meanwhile, the assessments are relatively low stakes for pupils in terms of the weight placed on them by future employers. They also have no bearing on the secondary school a pupil attends. This means they have little ‘signalling’ value, giving our results a cleaner interpretation. We return to this point in our discussion below.

A measure of total KS2 attainment is created by evenly weighting marks in English and maths. Total KS2 attainment and individual subject marks are standardised before the returns to marginal improvements are estimated.

[3] This has since been replaced by teacher assessments.

Literature

Numerous studies have used regression equations to estimate the returns to education since Mincer pioneered the technique (Mincer, 1958). These studies span all stages of education, looking at the returns to educational attainment measured with varying degrees of granularity. Here, we summarise the literature most relevant to this report: studies looking at returns to primary education in the UK; and studies looking at lifetime earnings returns. Appendix B lists the key studies looking at other stages of education.

Returns to KS2

Most evidence on the returns to primary education in the UK comes from studies based on a sample of adults born in April 1970, who were interviewed as part of the British Cohort Study (BCS). The BCS followed the same cohort of individuals from childhood through to adulthood.

Three studies – Machin and McNally (2008), Crawford and Cribb (2013), and Gregg, Macmillan and Vittori (2019) – used the BCS to estimate the earnings returns associated with attainment in reading and/or maths at age 10.

Machin and McNally (2008) estimate the return to improvements in age 10 reading attainment in terms of earnings at age 30. They find that a one standard deviation improvement in reading attainment is associated with an increase in annual earnings of 5-15%.[4] They extrapolated this over the course of a working life (20-65) assuming a discount rate of 3%,[5] which suggests a lifetime return of £23,100-60,200 (£38,700-100,700 in 2022 prices).

Crawford and Cribb (2013) estimate the returns to age 10 reading and maths skills in terms of earnings at age 30, 34 and 38. They estimate earnings returns conditional on employment. Earnings returns to maths tend to be larger than for reading, a finding we corroborate in this report. They estimate returns of 2-7% associated with a one standard deviation improvement in reading, and 7-15% associated with a one standard deviation improvement in maths. The relative return is similar across age groups.

Gregg, Macmillan and Vittori (2019) estimate the return to age 10 reading and maths in terms of earnings – including spells of unemployment – between age 26 and 42, for males.

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[4] Table 7 of Machin and McNally (2008) reports the percent earnings impact of a 0.091 increase in the standard deviation of reading scores. To aid comparison with other studies, we convert this to the effect of a one standard deviation improvement in reading skills by dividing the reported figures (which range from 0.5% to 1.4%) by 0.091 to obtain a range of 5-15%

[5] We convert the lifetime earnings gain associated with 0.083 of a standard deviation improvement in reading (reported in Machin and McNally as £1918-4995) to the gain associated with a one standard deviation improvement by dividing by 0.083. We then adjust estimates using the annual CPI index published by ONS: CPI INDEX 00: ALL ITEMS 2015=100 - Office for National Statistics (ons.gov.uk). Their extrapolation assumes that relative returns are constant over the life cycle, which our results below suggest may be a reasonable assumption for reading skills.

They estimate returns of 2.3% to a one standard deviation improvement in reading scores, and 6.3% to a one standard deviation improvement in maths. They also use quantile regression techniques to observe how returns vary across the distribution of potential earnings. They find that the relationship between relative returns and future earnings is ‘U’ shaped: those at the 10th percentile of the earnings distribution face a return to maths of 11.6%, which falls to 5% for those at the median and rises to 8% for those at the 90th percentile.

These studies provide insight into the labour market value of skills developed in primary school. However, their applicability to current cohorts – who face a very different education system from the one experienced by earlier cohorts – is uncertain. The 1970 birth cohort left primary school in 1981 – 14 years before KS2 assessments were introduced. In the absence statutory assessments, these earlier studies were restricted to focusing on attainment at age 10, measured using tests administered as part of the survey. It is unclear how the distribution of attainment measured in these tests relates to the distribution of KS2 attainment observed today. Labour market conditions, which can affect the earnings return to skills, have also changed considerably.

Though KS2 assessments have been in place since 1995, administrative data on attainment in these tests has only recently been linked to earnings data. Until the LEO dataset was made available for research in 2016, it was not possible to produce high quality estimates of the returns to KS2 attainment.

In a Department for Education report, Hodge (2023) presented the first direct estimates of the returns to KS2 attainment using these data. Hodge estimated the return to a one standard deviation improvement in KS2 attainment in maths, English and science in terms earnings up to age 33 – the latest year for which actual earnings can be observed in the data. This study finds that a one standard deviation improvement in total KS2 attainment is associated with 24% in additional earnings at age 33 conditional on being employed, and an increase in the probability of being employed of 2 percentage points.[6] This relative earnings return is equivalent to around £7,000 in additional earnings at age 33.

A key advantage of using these administrative data is that large sample sizes allow for analysis of how returns vary across subgroups. Hodge (2023) shows that the returns associated with improved KS2 attainment are greater – relative terms – for females than males. Pupils eligible for Free School Meals – one measure of socioeconomic disadvantage – tend to face lower returns in cash terms, but similar returns in as a percentage of income. These breakdowns can have important implications for the equity effects of education policy.

[6] Estimated separately, the return to a one standard deviation improvement in English is 5% at age 33; for maths, it is 15%.

Table 1: Summary of estimates of the returns to education from closely related studies

(a) Returns to primary education (age 10/KS2)

Study	Return to …	Return per individual
Machin and McNally (2008)	One standard deviation improvement in age 10 reading attainment, in terms of earnings at age 30.	Reading: 5-15%
Crawford and Cribb (2013)	One standard deviation improvement in age 10 reading and maths skills, in terms of (conditional) earnings at age 30, 34 and 38.	Reading: 2-7% Maths: 7-15%
Gregg, Macmillan and Vittori (2019)	One standard deviation improvement in age 10 reading and maths skills, in terms of (unconditional) earnings between ages 26-42 for males.	Reading: 2.3% Maths: 6.3%
Hodge (2023)	One standard deviation improvement in KS2 English, maths and science, in terms of (conditional) earnings at age 33.	Total KS2: 24% Maths: 15% English: 5% Science: 5%

(b) Lifetime returns to education using LEO data

Study	Return to …	Return per individual
Hodge, Little and Weldon (2021a)	One standard deviation improvement in total GCSE grades, in terms of lifetime earnings	Total GCSE grades: £96,000 (£108,000 in 2022 prices)
Britton, Dearden, et al. (2020)	Obtaining a university degree, in terms of lifetime earnings	For males: £240,000 (£276,000 in 2022 prices) For females: £140,000 (£161,000 in 2022 prices)

Despite the availability of evidence on the returns to KS2 attainment from Hodge (2023), we are still missing a key piece of the puzzle when it comes to policy appraisal – the *long-term* returns to primary education. The Department for Education is frequently required to appraise policies targeted at primary school, taking a long-term view on the economic costs and benefits. Until now, estimates of these benefits could only be produced by linking together evidence from multiple sources.

A lack of evidence on the direct relationship between KS2 attainment and lifetime earnings meant that the lifetime earnings gain associated with the KS2 attainment targets had to be computed indirectly, using a two-step approach. This involved linking evidence on the correlation between KS2 and GCSE attainment with estimates of the lifetime earnings returns associated with GCSEs. To do this, assumptions had to be made regarding the degree to which skills accumulate or dissipate overtime, introducing uncertainty. Paull and Xu (2017) used a similar two-step approach to estimate the earnings benefits associated with attainment in Early Years. The uncertainty surrounding these estimates could be reduced by the availability of direct estimates.

Estimating the lifetime earnings return associated with KS2 attainment is methodologically complex relative to estimating early career returns. We cannot observe the entire earnings trajectory of individuals who have sat KS2 assessments. We thus need to simulate lifetime earnings based on the earnings we do observe. The time it takes to develop this explains why evidence has been slow to materialise. Fortunately, these methods have now been developed and applied to estimate the lifetime earnings return associated with different stages of education. We now summarise the studies which developed these methods, which we apply in this report to the KS2 context.

Lifetime returns to education

Britton, Dearden, et al. (2020) were the first to use LEO data to estimate lifetime returns to education, focusing on undergraduate degrees. To extend lifetime earnings estimates beyond the latest available tax year, they supplement LEO with data from the LFS to simulate the lifetime earnings profiles of all individuals in LEO. Their simulation methodology underpins the approach we take in this report.

Britton, Dearden, et al. estimate that attending university is associated with a discounted lifetime earnings premium of £240,000 for men and £140,000 for women (£276,000 and £161,000 in 2022 prices). After accounting for tax paid, this represents a net lifetime earnings gain of 20% on average. They exploit the large sample size of LEO to explore variation in returns by subject and institution. Other studies conducted by the IFS use similar methods to estimate the early career returns to obtaining a degree by subject and institution type (Britton, Dearden, et al., 2020), socio-economic group and ethnicity (Britton, Dearden and Waltmann, 2021), degree classification (Britton et al., 2022) and postgraduate study (Britton, Buscha, et al., 2020).

In a previous report published by the Department for Education, Hodge, Little and Weldon (2021a) applied a similar methodology to the same data sources to estimate the lifetime earnings gain associated with marginal improvements in GCSE attainment. They estimate that a one standard deviation improvement in total GCSE grades (equivalent to 11.2 grades) is associated with £96,000 in additional discounted lifetime earnings (£108,000 in 2022 prices). They find wide variation in returns across GCSE subjects, higher relative returns for men than women, and higher relative returns for those not eligible for FSM relative to those who are.

Our approach to simulating lifetime earnings in this report closely follows the methodologies developed by Britton, Dearden, et al. (2020) and Hodge, Little and Weldon (2021a). Our regression model follows the design set out in Hodge (2023) to estimate the return to KS2 attainment. We make some innovations in methodological terms from the studies summarised above. These departures are explained in the methodology section below.

Data

Longitudinal Education Outcomes (LEO)

Longitudinal Education Outcomes (LEO) is an administrative dataset which links pupils' education records contained in the National Pupil Database (NPD) to HMRC and DWP records on the income and benefits that those pupils receive as adults.

The 1985/86 birth cohort – who sat their KS2 assessments in 1996/97 – is the earliest for which these data have been linked. For this cohort, we observe income records from age 18 (the 2004/05 tax year) up to age 34 (the 2019/20 tax year). In this report, we pool data for four cohorts: those who sat their KS2 assessments between 1996/97 and 1999/00. Pooling cohorts gives us a larger sample, allowing us to include a rich set of control variables and conduct subgroup analysis.

There is a trade-off between using older versus more recent cohorts. We observe the earnings of older cohorts over a longer time horizon, which reduces uncertainty in our lifetime earnings projections. However, the educational and labour market experiences of these cohorts may not resemble the experience of current and future cohorts – the targets of current education policy. The education system has undergone significant change since our study cohorts left the education system (discussed further below). Changes in recent years mean that there are no cohorts whose earnings we observe, whose educational experience closely matches that of current cohorts. We have therefore chosen to maximise the amount of earnings data we can use by using the oldest available cohorts. When discussing the implications of our results for current and future cohorts, we consider the effect of recent changes to the education system.

This trade-off between older versus more recent cohorts also prevents us from controlling for prior attainment at KS1, as Key Stage 1 attainment data was only collected in the National Pupil Database for 1997/98, too late to use for these cohorts. Using more recent cohorts might allow for the controlling of prior attainment, however, it comes at the cost of reduced earnings data.

The income data captured in LEO cover earnings from employment (from 2003/04) and self-employment (from 2013/14), which are the main income flows reflecting returns to human capital (and hence education). They do not contain information on dividends or other forms of capital income. These other income flows are 'mixed', in that they reflect returns on both human and non-human capital. In some circumstances capital income flows primarily reflect a return on human capital, such as when business owners choose to pay themselves in dividends rather than taking a salary.[7] The omission of these income flows from our data may skew our estimates of the returns to education as a result.

[7] See Miller, Pope and Smith (2019) for evidence on the incentives and behaviours of business owners with regard to how they choose to pay themselves.

Table 2 summarises key information on our study cohorts. For a full set of summary statistics, see Appendix C.

Table 2: LEO Summary Statistics - 1996/97 to 1999/00 cohorts

Value	Statistic
English mark	58 (15) [Max:100]
Maths mark (1996/97 cohort)	47 (15) [Max:80]
Maths mark (1997/98 - 1999/00 cohorts)	62 (20) [Max:100]
Total weighted mark English + maths	119 (32) [Max:199]
Female	943,294 (49%)
Male	981,382 (51%)
FSM eligible	299,036 (16%)

Notes: Total observations: 1,924,676; Statistic key: Mean *(standard deviation)* [Max:Maximum]; n(%)
Subject marks are weighted by dividing by the maximum possible mark in the subject for that cohort, then multiplying by 100. This gives each subject equal weight.

Labour Force Survey (LFS)

To simulate lifetime earnings beyond the point at which we stop observing actual earnings in LEO, we use the Labour Force Survey (LFS).

The LFS is a nationally representative survey which interviews participants for 5 consecutive quarters, and operates a rotating panel structure.[8] Information on earnings is collected in quarters 1 and 5, enabling us to observe participants' earnings and employment status in two consecutive years. We pool multiple waves of data spanning 2004 to 2019.[9] The sample size for these surveys fell from around 50,000 households in 2004 Q1, to around 36,000 households in 2019 Q4. To note, we only use LFS data up until 2019 Q4, so our analysis is unaffected by the much larger fall in survey responses since the COVID-19 pandemic.

We use data on all adults aged 25-65 who were observed in these years. This means that our simulation draws on information about the labour market trajectories of those who were KS2-age between 1950 and 2005. Though the labour market experiences of these cohorts will differ, we emphasise that we are not using information on the *levels* of earnings and employment faced by these cohorts. We are, however, using information on the probability of moving in and out of employment, and the relationship between an individual's position in the earnings distribution from one period to the next. These factors may differ for recent cohorts, and it is important to assess how accurate our lifetime earnings simulation is likely

[8] Once individuals have been interviewed for 5 quarters, they are replaced by new participants. For more details see ONS (2019).
[9] Specifically, the 5-quarter linked datasets 2004 Q1 – 2005 Q1 up to 2018 Q4 – 2019 Q4. Though more recent data are available, earnings and employment measures are likely to have been affected by lockdown restrictions arising from the coronavirus (COVID-19) pandemic. To prevent this from skewing our analysis of the average lifetime returns to education, we only use data from prior to the pandemic.

to be as a result. In Appendix D, we show that simulated early career trajectories line up reasonably well with what was actually observed.

The LFS collects data on participants' highest educational qualification and a range of demographic characteristics. Following Hodge, Little and Weldon (2021a), we stratify by gender and highest educational qualification, estimating the parameters of our earnings growth model separately for each group.

We use weekly pay as our earnings measure, which captures both variation in hourly wages and in the number of hours worked by individuals. This is more closely aligned with the concept of earnings we are interested in, though is not identical to the annual measure of earnings we observe in LEO. There are also differences in our measure of employment across the two data sources: in the LFS, this is based on whether the respondent was in employment the week prior to the survey interview; in LEO, an individual is classified as employed if they receive positive earnings in the tax year.

While our measure of earnings and employment in LEO includes self-employment, only individuals classified as employees are included in our LFS employment and earnings measures. As such, our lifetime earnings simulation model relies upon the assumption that earnings growth dynamics for self-employed workers are the same as the earnings growth dynamics of employees.

As in previous studies which draw on LFS data to simulate lifetime earnings, our earnings growth model makes use of information on *changes* in employment and earnings from one year to next, but not information on the *level* of employment or earnings in the LFS (Hodge, Little and Weldon, 2021a; Britton, Dearden, et al., 2020). This reduces the potential importance of differences in our measure of earnings and employment.

Table 3: LFS Summary Statistics

Variable	Value	Statistic
Gender	Male	125,499 (50%)
Gender	Female	123,238 (50%)
Highest Qualification	Level 2 (GCSE grades A*-C or equivalent)	48,737 (20%)
Highest Qualification	Level 3 (GCE, A-level or equivalent)	53,714 (22%)
Highest Qualification	Level 4,5 (CertHE, DipHE or equivalent)	24,935 (10%)
Highest Qualification	Level 6 (Degree or equivalent)	60,173 (24%)
Highest Qualification	No qualification	37,456 (15%)
Highest Qualification	Other qualifications	23,722 (9.5%)
Employment Flows	Employed -> Employed	180,377 (73%)
Employment Flows	Employed -> Not Employed	9,176 (3.7%)
Employment Flows	Not Employed -> Employed	7,306 (2.9%)
Employment Flows	Not Employed -> Not Employed	51,878 (21%)
Age	25-34	40,438 (16%)
Age	35-44	66,598 (27%)
Age	45-54	74,136 (30%)
Age	55-65	67,565 (27%)

Notes: Total observations: 248,737. Statistic key: n (%).

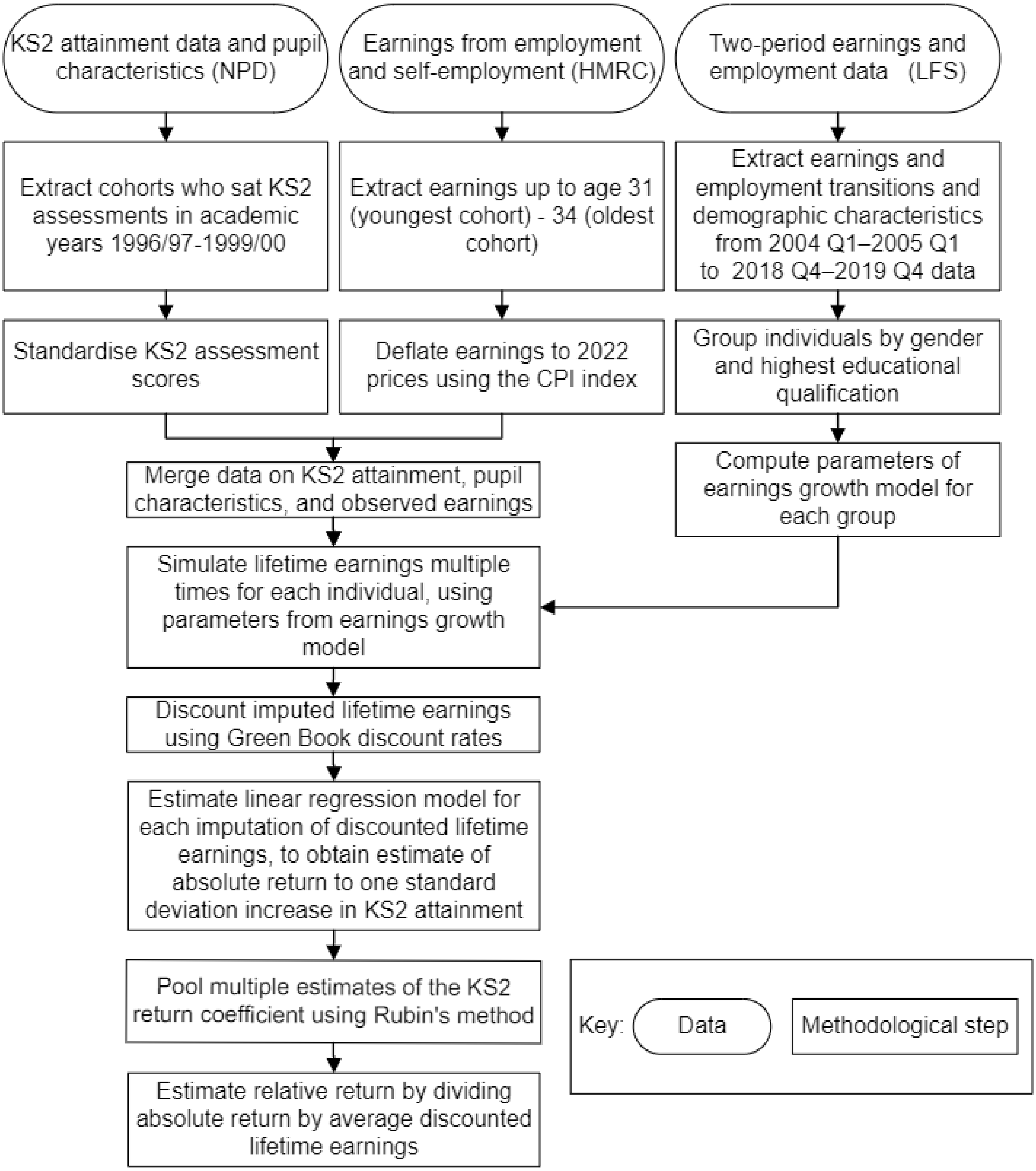
Methodology

This report provides estimates of the association between KS2 attainment and lifetime earnings. We capture both the direct effect of better KS2 attainment on subsequent earnings, as well as the indirect effect through the subsequent take-up of additional educational qualifications, such as GCSEs. This ‘total’ return is what matters most for policy appraisal.

In order to estimate this relationship, we first predict the earnings of individuals in our sample from the point at which we stop observing their annual earnings (aged 32-35) until the point of retirement (which we assume to be 68, in line with planned increases in the State Pension Age). To do so, we closely follow the lifetime earnings simulation methodology set out in Hodge, Little and Weldon (2021a), which is similar to the methodology developed by Britton, Dearden et al. (2020). We have made some small adjustments to this based on new insights from recent iterations of the LEO data. Below, we highlight the key features of our methodology and points of difference with previous methodologies. For further details, see Hodge, Little and Weldon (2021a).

Figure 1 provides a visual overview of the process and methods used to estimate the lifetime returns to KS2 attainment.

Figure 1: Schematic overview



Modelling lifetime earnings

We use LFS data to simulate a complete age-earnings profile for each individual in our study cohorts. We estimate the likelihood of transitioning into and out of work and an individual's position in the earnings distribution for those employed, depending on their earnings and employment status in the previous year. We estimate these parameters separately by gender and highest educational qualification.

The steps we take are as follows:

1. Group individuals in the LFS by gender and highest educational qualification (12 characteristic groups).[10]
2. Estimate employment transition probabilities between age a and $a + 1$, for each characteristic group
    a. for those employed at age a, as a function of their position (rank) in the earnings distribution
    b. for those unemployed at age a, based on the expected probability of becoming employed at age $a + 1$ conditional on being unemployed at age a
3. Model the dependence of an individual's earnings rank at age $a + 1$ on their earnings rank at age a using a series of copula functions, for each characteristic group. A copula function estimates the correlation between an individual's position in the earnings distribution at age a and their position in the earnings distribution at age $a + 1$.[11]
4. For those re-entering the labour market, estimate an earnings penalty, based on the ratio between the average earnings rank at age $a + 1$ for those who were unemployed at age a, and the average earnings rank at age $a + 1$ among those who were employed at age a, for each characteristic group.
5. Estimate real earnings growth between age a and age $a + 1$, for each characteristic group.

These steps provide us with the following set of parameters which we then use to simulate lifetime earnings among our LEO sample:

- Employment probabilities at age $a + 1$ for those unemployed at age a
- The parameters of a model to determine employment at age $a + 1$ given earnings rank at age a, for those employed at age a
- Earnings growth between ages a and $a + 1$
- A correlation parameter to simulate the relationship between an individual's position in the earnings distribution at age a and their position in the earnings distribution at age $a + 1$
- A penalty to an individual's position in the earnings distribution earnings rank for those returning to employment at age $a + 1$ from unemployment at age a.

[10] Highest educational qualification takes one of 6 values: Degree or equivalent; GCE, A level or equivalent; GCSE grades A*-C; Higher Education; No qualification; Other qualifications.
[11] For more information on the copula function approach, see pages 21-22 of Hodge, Little and Weldon (2021a).

As the LFS uses a different definition of employment from the LEO data, we adjust the estimated employment parameters so that they are consistent with the parameters estimated using the LEO data for individuals at age 30 – the last year observed for all cohorts. This differs from the approach taken in Hodge, Little and Weldon (2021a) and is similar to the approach taken by Britton, Dearden et al. (2020).

Simulating earnings

For each individual in our LEO sample, we simulate age-earnings profiles using the above parameters. We then use these parameters to predict earnings and employment for each individual in LEO through to retirement age. To do so, we follow the approach set out in the "Modelling lifetime earnings" section of Hodge, Little and Weldon (2021a), to which we refer the reader for full details. Here, we provide information on the key assumptions and points of difference with previous methodologies.

Hodge, Little and Weldon (2021a) begin their simulation from age 29 – the latest year for which the earnings of all cohorts could be observed at the time the analysis was undertaken. We now have two additional years of tax data (covering financial years 2018/19 and 2019/20), enabling us to reduce the number of years for which earnings are based on predictions rather than observed outcomes.

Given the high quality of our earnings data, making use of additional years of observed earnings should improve the accuracy of our lifetime earnings predictions. However, a simulation model which predicts future earnings based only on the latest observation of earnings and employment puts significant weight on recent changes in these variables. This could place undue importance on short-term deviations from the earnings paths experienced by earlier cohorts.

This is not an issue in and of itself, if we are prepared to take departures from the earnings pathway followed by previous cohorts seriously and accept the assumption that earlier observations of a cohort's earnings tell us nothing extra about the future earnings trajectories of those individuals. However, this is a strong assumption.

We want to avoid putting too much weight on deviations of earnings in a single period from the pathway followed by previous cohorts. To address this, we run multiple simulations for each individual, using different starting ages. In particular, for each cohort we simulate lifetime earnings five times using each of the latest three years of observed earnings as a starting point. This results in fifteen imputed values for lifetime earnings. In our regression analysis, we pool the coefficients based on these multiple imputations (see below).

In Appendix I, we show that pooling simulations based on the latest three years of observed earnings does not have much effect on point estimates for our marginal returns, relative to simulating from the latest single year in which earnings are observed for all cohorts.

However, pooling multiple simulation years widens the confidence interval associated with this point estimate. This, in our view, means that the range of estimates provided by our headline results better reflects the uncertainty that is inherent in using simulated data.

To account for real earnings growth, Hodge, Little and Weldon (2021a) assume a fixed 2% real earnings growth rate. This is consistent with the standard 3.5% discount rate specified in the Green Book, 2% of which represents a "wealth effect", which is based on the OBR's estimate of long-term real GDP per capita growth. To compute discounted earnings, we follow the Green Book guidance and use a discount rate of 3.5% for the first 30 years and 3% thereafter. This ties us to assuming 2% real earnings growth. Otherwise, our calculations would be logically inconsistent.

However, recent OBR estimates put real earnings growth at just 0.7% on average over the period 2015 to 2028, while estimates of real GDP per capita growth average 1.4% between 2028 and 2070.[12] These up-to-date forecasts allow us to more accurately predict *undiscounted* earnings, which we find when comparing actual earnings with simulated earnings starting from age 30 (accuracy of simulation shown in Appendix D). Thus, when reporting estimates of undiscounted earnings, we use the OBR's latest forecasts rather than assuming a fixed 2% real earnings growth rate.[13]

Total lifetime earnings are calculated by summing earnings from the first tax year post-KS4 (age 18) until the individual is aged 68. This is in line with current planned increases in the State Pension age. The present value of lifetime earnings is calculated by discounting to the year in which pupils sit their KS2 assessments (age 10-11).

Throughout the report, earnings figures are deflated to September 2022 prices.

Estimation of marginal returns

We estimate four attributes of the relationship between KS2 attainment and lifetime earnings:

1. The average return to KS2 attainment by subject and pupil characteristics
2. Variation in the return across the distribution of lifetime earnings
3. The accumulation of returns over the life cycle
4. The role of subsequent qualifications (such as GCSEs) in explaining the return to KS2 attainment

[12] Estimates of real earnings growth are taken from Chart 2.13 of the OBR's November 2023 Economic and Fiscal Outlook, which can be accessed at [Economic and fiscal outlook – October 2024 - Office for Budget Responsibility](). Estimates of long-term real GDP per capita growth taken from the OBR's March 2023 Long-term economic determinants supplementary forecast, which can be accessed at [Fiscal risks and sustainability – September 2024 - Office for Budget Responsibility]().

[13] Specifically, we use the OBR's short term real earnings growth forecast for the period this covers (up to 2028), and the long-term real GDP per capita growth forecast thereafter.

To estimate the marginal lifetime earnings return to an improvement in KS2 attainment, we run the following OLS regression:

$$PV_{ig} = \beta \boldsymbol{X_{ig}} + \gamma \boldsymbol{Z_{ig}} + \alpha_g + \varepsilon_{ig}$$

(1)

where PV_{ig} is the present value of lifetime earnings for individual i in school g; $\boldsymbol{X_{ig}}$ is a vector of standardised KS2 attainment; $\boldsymbol{Z_{ig}}$ is a vector of control variables; α_g is a school fixed effect and ε_{ig} is an error term. The coefficient of interest, β, can be interpreted as the absolute increase in lifetime earnings associated with a one standard deviation increase in KS2 attainment. 95% confidence intervals are constructed using cluster-robust standard errors (clustering at school-level).[14]

Different versions of this regression model are estimated, varying our measure of attainment ($\boldsymbol{X_i}$) and set of control variables ($\boldsymbol{Z_i}$). Specifically, $\boldsymbol{X_i}$ is measured as either:

- the standardised total test score in English and maths (adding English and maths scores together and standardising, weighting subjects equally)
- a vector of standardised test scores in English and maths (including standardised English and maths as two separate variables)

To standardise test scores, we subtract the mean score and divide by the standard deviation of test scores within each cohort.

In Appendix G, we provide results which include science in the vector of standardised subject scores, and a separate set of results which separates English into attainment in reading and writing. While these specifications are informative for understanding the returns to particular skills, changes to KS2 assessments mean that pupils are no longer externally assessed in writing or science (though a teacher assessment is still provided for these subjects[15]). This makes these results less relevant to modelling the lifetime returns faced by current and future cohorts.

We estimate the standardised marginal effect, rather than the effect of an increase in the level awarded to pupils under the national curriculum in force at the time. This is because current pupils are assessed differently, using ‘scaled scores’ rather than categorical levels. Though the system has changed, the distribution of attainment in each subject has remained broadly the same, giving us confidence that our standard returns estimates could be mapped onto current distributions of KS2 attainment for policy appraisal purposes. We return to this in our discussion section below.

[14] We estimate the fixed effects model using the within transformation.
[15] English writing teacher assessment is subject to external moderation by local authorities (25% of schools each year).

Our regression model is estimated separately for each of our imputed lifetime earnings estimates. This results in 15 sets of coefficients which are pooled using Rubin's (1987) multiple imputation method.[16]

The sets of control variables used are gender, Free School Meal (FSM) eligibility status, ethnicity, special educational needs (SEN), English as an additional language (EAL), local area income deprivation affecting children (the Income Deprivation Affecting Children Index (IDACI)), an academic cohort dummy, and month of birth. These control variables account for some of the background factors that can affect both educational attainment and earnings, reducing the degree to which our coefficient on KS2 attainment captures the effect of other background characteristics. A full breakdown of how these variables are used in the models is provided in Appendix E.

Unlike studies which estimate returns at later stages of education, we cannot control for prior attainment. Results of assessments at KS1 (either teacher or externally assessed) are not available for our study cohorts. In the context of estimating returns to post-compulsory education, an inability to control for prior attainment can make it difficult to control for the fact that pupils who have achieved higher levels of attainment are more likely to select into particular qualifications and subjects. In our context, this is not a concern as KS2 assessments are compulsory.

Without controlling for prior attainment, our returns estimates should be interpreted as the increase in earnings associated with doing one standard deviation better at KS2 regardless of prior attainment. It cannot be interpreted as the increase in earnings associated with a one standard deviation improvement in progress made between KS1 and KS2.

We also estimate the return separately for different subgroups. Specifically, we split the sample into groups defined by one of the following characteristics, and run the regression separately for each group while controlling for all other characteristics. [17]

- Gender
- FSM eligibility status
- Region
- Ethnicity

In doing so, we allow the coefficients on all independent variables and controls to vary across subgroups.

Estimating variation in returns across the income distribution

Returns may vary across the distribution of lifetime earnings. An equivalent improvement in KS2 attainment could yield a different return for someone with high potential earnings

[16] For further details, see Appendix F of Hodge, Little and Weldon (2021a).

[17] In this case, rather than de-meaning each variable using the within-school mean, we subtract the within-school mean among the group whose return we are estimating.

compared to someone with lower potential earnings. As a result, it is possible that improvements in KS2 attainment across pupils reduce or exacerbate inequality in lifetime earnings.

To investigate this, we use a quantile regression model which provides estimates of the returns to KS2 attainment at key quantiles (deciles) of the lifetime earnings distribution:

$$Q_T(PV_{ig}) = \beta(T)\boldsymbol{X_{ig}} + \gamma(T)\boldsymbol{Z_{ig}} + \alpha_g + \varepsilon_{ig}, \qquad T = 0.1, \dots, 0.9$$

(2)

where T is the quantile at which we are estimating the return, and Q is the conditional quantile function.[18] All other variables are as described in relation to equation (1).

The key coefficients are $\beta(T)$, which tell us the return to a one standard deviation improvement in KS2 attainment for someone at quantile T of the lifetime earnings distribution.

Estimating the accumulation of returns over the life cycle

Investigating how returns accumulate over the life cycle can tell us whether those who perform better at KS2 feel the earnings benefit immediately upon entering the labour market, or whether the return materialises gradually over the course of their working lives.

We estimate a version of regression (1) separately for 11 different age groups spanning 3-5 years each: 18-20 year olds, 21-25, 26-30,…, 66-68. The dependent variable is replaced by the present value of total earnings accumulated in the relevant age range. Specifically, we estimate:

$$PV_{ig}(a) = \beta(a)\boldsymbol{X_{ig}} + \gamma(a)\boldsymbol{Z_{ig}} + \alpha_g + \varepsilon_{ig}$$

(3)

KS2 attainment ($\boldsymbol{X_{ig}}$) as well as all background characteristics ($\boldsymbol{Z_{ig}}$) are fixed from the point that individuals leave school. However, we allow for their effect on earnings to vary over the life cycle. All control variables are the same as in our headline regression.

[18] Quantile regression techniques were originally proposed by Koenker and Basset (1978). We estimate our quantile regression model using the 'quantreg::rq()' function in R. This provides confidence interval estimates, but does not provide standard errors analogous to an OLS model. This means that while we can pool the point estimates from multiple regressions (by taking the average) as in Rubin's method, we cannot follow Rubin's method for pooling the standard errors. Instead, we construct upper and lower bounds by taking the outermost (minimum and maximum) bounds of the confidence intervals obtained from each regression.

Quantifying the role of subsequent qualifications as 'mediators'

Part of the return to KS2 may be explained by the fact that doing well at KS2 enables pupils to obtain higher educational qualifications later on. KS2 attainment may also have a 'direct' relationship with future earnings that is independent of the qualifications pupils subsequently achieve.

To quantify the relative importance of these channels, we conduct a mediation analysis. This involves adding controls M_{ig} for subsequent qualifications into our regression equation:

$$PV_{ig} = \beta \boldsymbol{X_{ig}} + \gamma \boldsymbol{Z_{ig}} + \delta M_{ig} + \alpha_g + \varepsilon_{ig}$$

(4)

M_{ig} is our potential mediator, measured, depending on the specification, as either:

- The highest educational qualification an individual achieves
- Total GCSE grade point score and number of GCSEs taken
- Whether an individual has obtained a degree

Data constraints mean we only observe the highest educational qualification achieved, and whether an individual obtains a degree, up to age 31 for our youngest cohort and 34 for our oldest cohort.

'Highest educational qualification' is commonly used in mediation analyses aimed at apportioning the mechanisms through which primary school attainment relates to future earnings (Machin and McNally, 2008; Crawford and Cribb, 2013; Hodge, 2023). However, this is a broad measure of educational attainment. It is possible that KS2 attainment affects future earnings by enabling individuals to improve their future educational attainment at a more granular level – by getting better grades at GCSE, for instance. Controlling for 'total GCSE grade point score' as a potential mediator allows us to explore this.[19] In doing so, we also control for the number of GCSEs taken, as this is likely to affect both the total grade point score and future earnings. This measure of GCSE attainment is consistent with measures used in Hodge, Little and Weldon (2021a).

Alternative measures, such as whether an individual goes on to obtain a degree, are even less granular than highest educational qualification, but may be of interest to policy-makers. Analysis of this mediation channel provides insight into whether improved KS2 attainment could boost lifetime earnings by enabling people to go to university.

[19] Our study cohorts sat their GCSEs prior to the introduction of the numeric grading system. Following Hodge, Little, and Weldon (2021a), we construct 'total GCSE grade points' by mapping the letter grades given at the time (U, G, F, E, D, C, B, A, A*) to numbers (0,1,2,3,4,5,6,7,8). This imposes the assumption that the marginal effect on lifetime earnings at each grade boundary is equal. The mapped grades are not equivalent to the new regime of numeric grades that runs from 0 to 9.

There is debate among econometric practitioners around the suitability of including, as controls, variables that are themselves outcomes of the independent variable of interest (also known as ‘post-treatment’ controls). Angrist and Pischke (2009) refer to this as the ‘bad control’ problem. Others point out that including post-treatment controls is not *always* bad – it depends on the effect you are interested in measuring and whether or not there are confounding factors affecting both the mediator and outcome variable that cannot be controlled for (Cinelli et al., 2022).

In order to interpret the coefficient on KS2 attainment in equation (4) as the ‘direct’ causal effect of KS2 attainment on lifetime earnings, we need to make even stronger assumptions than is necessary for interpreting the ‘total’ effect from our headline regression model (equation (1)) as causal. Namely, we need to assume that there are no other characteristics driving both our mediator variable (post-KS2 qualifications) *and* lifetime earnings, that we do not control for already. We reiterate that, because of this, our results should not be interpreted as causal. Results from our mediation analysis in particular should be treated as indicative.

Results

This section presents estimates of the lifetime return to marginal improvements in KS2 attainment. We measure the latter as either total standardised attainment in English and maths, or standardised attainment in English and maths measured separately.

In addition to the overall average return, we look at how this varies by:

- Gender[20]
- Free School Meal eligibility (FSM)
- Ethnicity
- Region (location of primary school)
- Lifetime earnings

We then look at how these returns accrue over the life cycle.

A complete set of estimates of the return to KS2 attainment broken down by pupil characteristics can be found in Appendix E. In Appendix J, we discuss how the results presented in this section compare to findings on the early career returns to KS2 attainment (Hodge, 2023) and the lifetime returns to GCSEs (Hodge, Little and Weldon, 2021a).

Before presenting our returns estimates, we first summarise our simulated lifetime earnings estimates.

Lifetime earnings statistics

Table 4 shows average lifetime earnings by gender and FSM eligibility. An average member of our study cohort would be expected to earn £1.1 million over their lifetime (£461,400 in present value terms). Discounted earnings are higher for men than women, reflecting historical gender pay gaps and differences in employment rates. We also see a disadvantage gap: pupils eligible for FSM earn less than pupils who are not eligible for FSM. This is likely to reflect intergenerational immobility, whereby those from lower-income households tend to earn less than their peers from higher-earnings households.

[20] Gender is a binary measure in model. This is a choice governed by the data, rather than a stance we are taking on how gender ought to be measured.

Table 4: Average lifetime earnings by gender and FSM eligibility

Characteristic	Discounted	Undiscounted
All	£461,400 (204,500)	£1,141,000 (465,500)
Female, FSM	£304,900 (171,200)	£790,200 (417,900)
Female, non-FSM	£425,700 (185,200)	£1,077,800 (442,500)
Male, FSM	£425,000 (174,400)	£1,052,000 (382,800)
Male, non-FSM	£530,000 (206,700)	£1,280,700 (458,100)

Notes: Statistic key: Mean *(standard deviation)*

These estimates differ slightly from those presented in Hodge, Little, Weldon (2021a), who estimated average undiscounted earnings at £1.3 million, or £515,000 in present values at age 16. There are four reasons for this. First, we use additional – and more recent – observations of actual earnings prior to the point at which we start simulating. We can do this thanks to the availability of more recent data. Second, we are discounting to age 10-11, when pupils sat their KS2 assessments, instead of age 16. For policy appraisal, the Green Book states that the present value of benefits should be calculated from the perspective of when the policy takes effect (HM Treasury, 2020). This may differ from the year in which KS2 attainment is first affected, but discounting to age 10-11 is the closest we can achieve in this report without tailoring to a specific policy.[21] Third, we are using a different price reference year (2022 rather than 2019). High inflation during 2022 means that our results are notably higher than they would be if expressed in 2019 prices. Fourth, for undiscounted earnings, we are using a different (and lower) real earnings growth rate than that assumed in Hodge, Little and Weldon (2021a) (see 'Methodology').

Average marginal returns

Total KS2 attainment

A one standard deviation increase in total KS2 English and maths attainment is associated with £63,700 (£61,400-66,000) in additional discounted lifetime earnings, on average (Figures 2.1 and 2.2).[22] This is equivalent to 13.8% in additional earnings over the life cycle.

[21] Policies which affect pupils prior to KS2 may affect KS2 attainment a year or more down the line. Analysts using our estimates to compute the present value on lifetime earnings should discount the total lifetime earnings return by 3.5% for each year between the year in which the policy is implemented, and the year in which the effect on KS2 will be realised.

[22] 95% confidence interval reported in brackets.

Figure 2.1: Average marginal effect of one standard deviation improvement in English and maths on the present value of lifetime earnings, absolute (£)

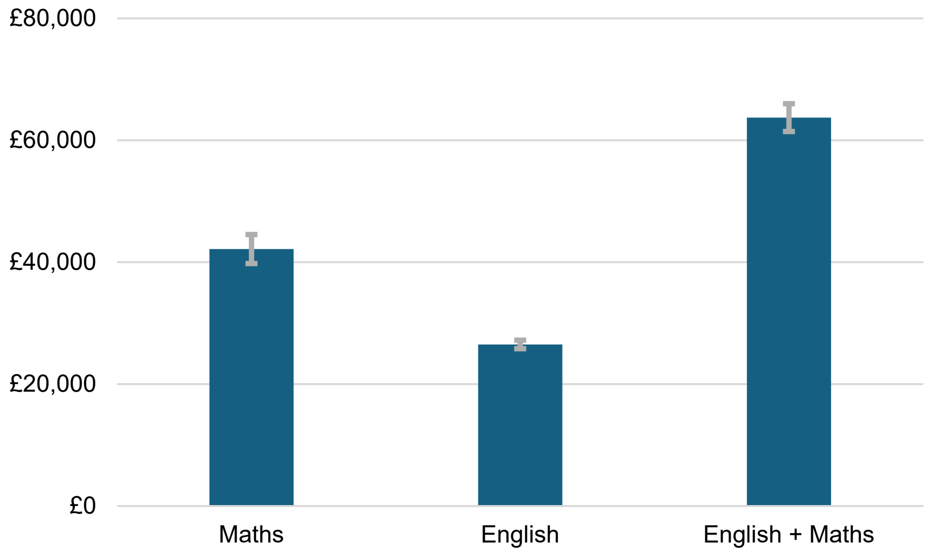
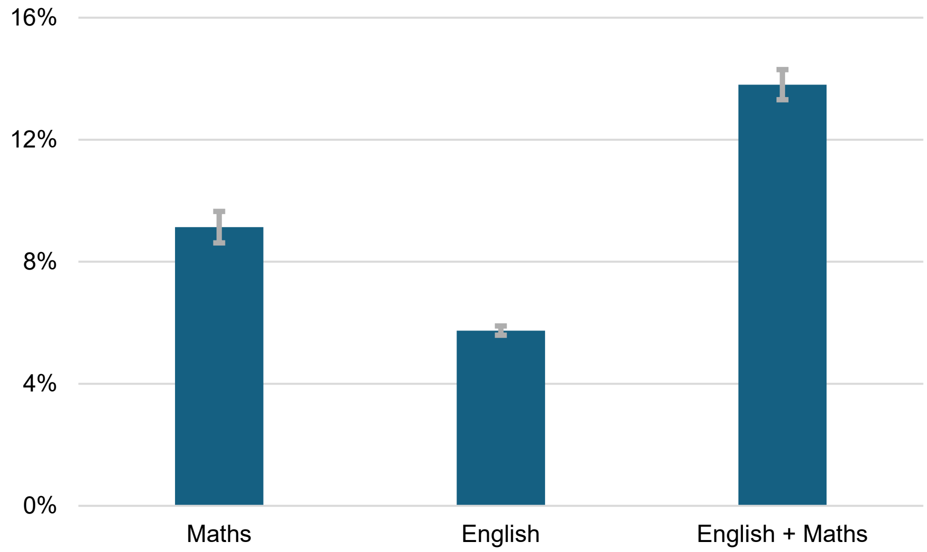


Figure 2.2: Average marginal effect of one standard deviation improvement in English and maths on the present value of lifetime earnings, relative (%)



Returns by subject

Earnings returns are higher in maths than English. A one standard deviation increase in maths attainment is associated with £42,200 (£39,800-44,500) in additional discounted lifetime earnings on average, while an equivalent improvement in English attainment is associated with £26,500 (£25,800-27,200) (Figure 2.1). This is equivalent to 5.7% of average discounted lifetime earnings for English, and 9.1% for maths (Figure 2.2).

Part of the estimated return to English and maths can be explained by attainment in other subjects. Current KS2 cohorts are externally assessed in English and maths alone, yet primary school pupils also receive education in a wide range of other subjects. In Appendix G, we show that omission of these from our model can have important effects on the coefficients for English and maths. We do this by including science – which was externally assessed for our study cohorts but not for current cohorts – as a control in our regression specification. The estimated returns to a one standard deviation improvement in maths falls from £42,200 to £36,100, while the return to English falls from £26,500 to £22,100.[23] This highlights the extent to which attainment in English and maths could be acting as a proxy for performance or skills in other subjects.

As we are unable to control for wider attainment, our headline results should be interpreted as the return to English and maths that includes benefits arising through skills that are common to other subjects. They should not be interpreted as a return on the skills that are unique to English and maths, nor do they capture the returns to improving skills in maths and English while holding attainment in other subjects constant.

This is very different to how we would interpret returns to English and maths at GCSE in Hodge, Little and Weldon (2021a), where attainment in other subjects is observed and controlled for. Returns to GCSE English and maths can, therefore, be interpreted as the return on skills acquired through those subjects specifically.

How do returns vary by pupil characteristics?

By gender

Overall, men experience lower returns than women: a one standard deviation increase in total KS2 English and maths attainment is associated with £52,200 in additional discounted earnings for men, compared to £75,200 for women (Figures 3.1 and 3.2).

This discrepancy is even more pronounced when we look at returns as a percentage of lifetime earnings. Women earn less than men, on average. This means that the extra earnings associated with improved KS2 attainment is worth even more as a percentage of average female lifetime earnings (18%) than the extra earnings received by men are (10%). This suggest that boosting overall KS2 attainment could play a role in reducing the gender wage gap.

The pattern of gender differences is similar across subjects. Table 9 and Table 10 show the return to English and maths separately by gender (Appendix F).

These results are consistent with previous findings on the returns to KS2 attainment (Hodge, 2023). By contrast, returns to improvements in overall GCSE attainment are found to be higher for men than women (Hodge, Little and Weldon, 2021a). The return to

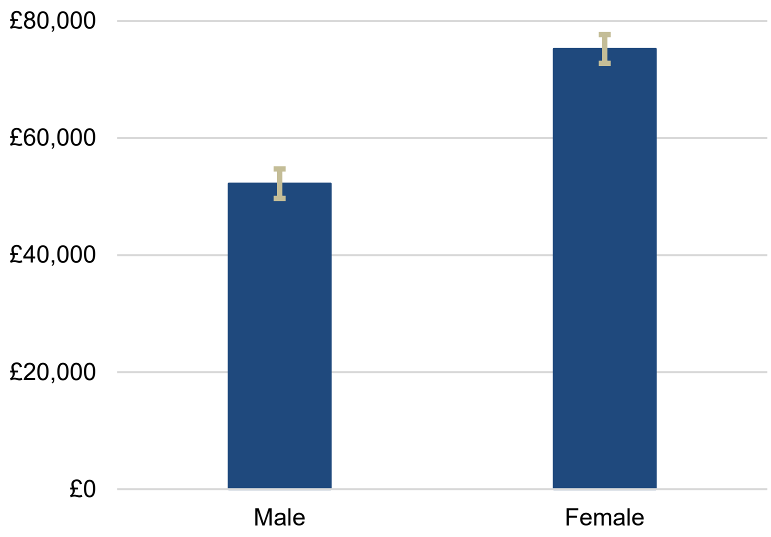
[23] In Appendix G, we also show the return to English broken down by reading and writing (writing, handwriting and spelling).

obtaining an undergraduate degree is also higher for men than women (Britton, Dearden, et al., 2020).

While it is difficult to fully account for the differences between this study's results and the gender differences in the returns to GCSE attainment (Hodge, Little, and Weldon, 2021a), two findings are worth noting. First, when we assess the role of subsequent qualifications separately by gender, we find that GCSE attainment explains a much lower proportion of the return to KS2 attainment for women (59%) than it does for men (72%).[24] This suggests that the variation in attainment that acts as a predictor of future earnings establishes at a younger age among women than it does for men.

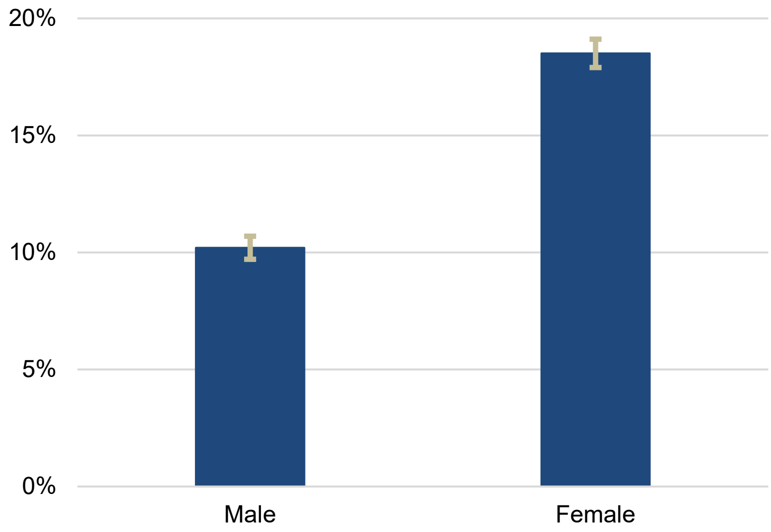
Second, our modifications to the lifetime earnings simulation methodology (see "Modelling lifetime earnings" section) – in particular the adjustment of employment transition probabilities to ensure they are consistent with the LEO data – reduces average unconditional earnings among men by more than it does among women. This adjustment improves the accuracy of our earnings predictions among both men and women. It is likely that if the GCSE returns were re-analysed using this adjustment, the gender difference would shrink, or potentially reverse.

Figure 3.1: Average marginal effect of one standard deviation improvement in English and maths on the present value of lifetime earnings, by gender, absolute (£)



[24] To assess this, we re-run the mediation analysis presented in the "Role of subsequent educational qualifications" separately by gender.

Figure 3.2: Average marginal effect of one standard deviation improvement in English and maths on the present value of lifetime earnings, by gender, relative (%)



By Free School Meal eligibility

FSM eligibility is measured as whether or not a pupil was eligible for FSM at any point between 2001/02 and the year they sat their GCSEs. Note that this results in a slightly different definition for each of our four cohorts depending on how many years of FSM eligibility data are available.[25] Ideally we would measure FSM eligibility by whether pupils were eligible for FSM at any point during primary school, possibly differentiating by the number of years for which pupils were eligible. This is not possible using the data available. Nevertheless, our results are indicative of the variation in returns that might exist between pupils from more or less socio-economically disadvantaged backgrounds.

In cash terms, the return to KS2 is higher for those who are not eligible for FSM than for those who are (Figures 4.1 and 4.2). A one standard deviation improvement in total KS2 English and maths attainment is associated with £65,500 in additional discounted lifetime earnings for non-FSM pupils and £52,400 for their FSM-eligible counterparts. However, as a percentage of average earnings, returns are similar across the two groups (at 13.7% and 14.4%, respectively).

These estimates are not causal. Unobservable factors such as parental education, which is likely correlated with both FSM eligibility and pupils' future earnings, could account for the lower return to KS2 for those eligible for FSM. Our results should not be interpreted as saying that pupils eligible for FSM benefit less from primary school than those who are not.

The discrepancies we see here likely reflect intergenerational immobility, whereby pupils from more disadvantaged backgrounds earn less for a given level of educational

[25] For the oldest cohort it is whether they were eligible for FSM in the year they sat their GCSEs only; for the youngest cohort it is whether they were eligible for FSM between the ages of 13 and 16.

attainment than pupils from less disadvantaged backgrounds. Our results reflect historical patterns of earnings for different groups. Patterns of intergenerational mobility change over time. Therefore, how returns to KS2 vary across current cohorts of pupils from different backgrounds may differ from the variation in returns seen here.

Note this does not mean that future investment would be better targeted at pupils who are not eligible for Free School Meals. Even if targeting investment toward more pupils from higher-income backgrounds would maximise the earnings return, there are other reasons not to do this – both on equity and efficiency grounds. On equity, it is clear that targeting investment toward more advantaged pupils would run contrary to efforts to improve social mobility.

On efficiency, it is worth noting that aim of policy in economic appraisal is generally to maximise 'social welfare', which is different from maximising total income added up across all individuals. Income improves people's wellbeing (or 'utility') at a decreasing rate. This is why HM Treasury (2020) propose the use of 'welfare weights' in cost-benefit analysis, which involves placing more weight on increases in income for those who earn less to begin with. The Department for Education's Schools Policy Appraisal Handbook describes how weights can be applied to estimates of the lifetime return to education (Hodge, Little and Weldon, 2021b).

Figure 4.1: Average marginal effect of one standard deviation improvement in English and maths on the present value of lifetime earnings, by Free School Meal (FSM) eligibility status, absolute (£)

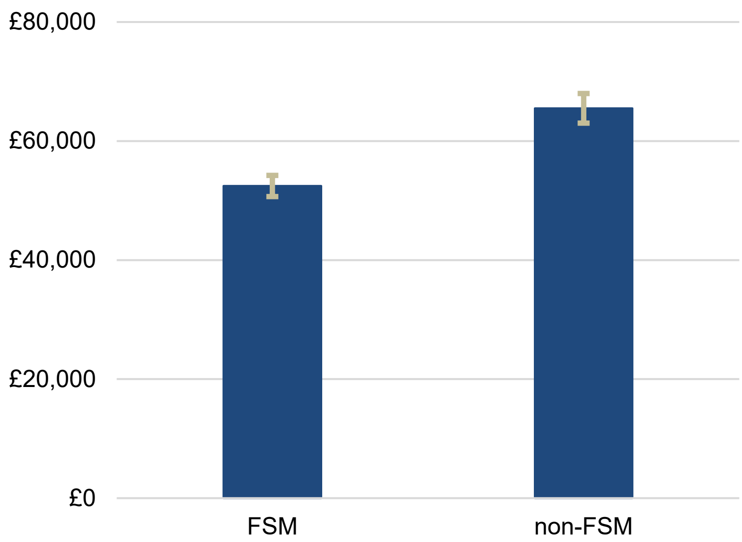
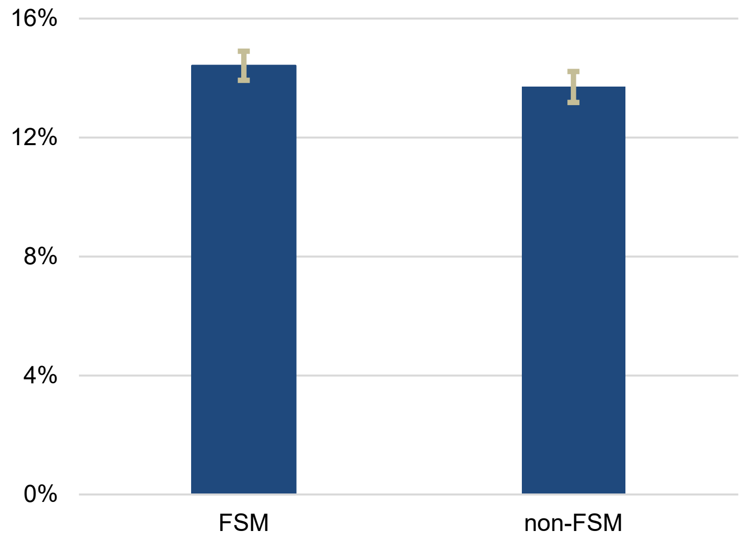


Figure 4.2: Average marginal effect of one standard deviation improvement in English and maths on the present value of lifetime earnings, by Free School Meal (FSM) eligibility status, relative (%)



By income

Results from our conditional quantile regression suggest that improving overall KS2 attainment could help to reduce income inequality among pupils who share similar characteristics. However, the story as a whole is more nuanced than this.

Lifetime earnings returns are positive, but vary across the earnings distribution (Figure 5). In cash terms, those with higher potential earnings face higher returns to improved KS2 attainment than similar peers who earn less: the lifetime earnings gain to a one standard deviation improvement for someone at the 90th percentile is roughly three times as large as the lifetime earnings gain for someone at the 10th percentile (Figure 5, left hand panel). Specifically, the earnings gain is £29,000 higher for a one standard deviation improvement in English, and £39,500 higher for a one standard deviation improvement in maths. This might suggest that policies designed to boost overall KS2 attainment could unintentionally skew earnings gains towards those who are already likely to be better off.

However, this does not mean that individuals higher up the earnings distribution experience higher welfare gains than those lower down. This is because extra earnings improve wellbeing at a diminishing rate – extra income is worth more to those nearer the bottom of the distribution. This is why HM Treasury (2020) propose the use of 'welfare weights' in cost-benefit analysis, which involves placing more weight on increases in income for those who earn less to begin with. The Department for Education's Schools Policy Appraisal Handbook describes how weights can be applied to estimates of the lifetime return to education (Hodge, Little and Weldon, 2021b).

In terms of the effect of improved KS2 attainment on lifetime earnings inequality measured by the share of income going to the top, the story is more positive. The extra earnings received by those at the 90th percentile who do one standard deviation better in KS2 maths than similar peers is worth less as a share of their lifetime earnings than the extra earnings received by those at the 10th percentile who make the same attainment improvement (Figure 5, right hand panel). This suggests that the share of lifetime earnings received by those at the top could fall in response to an overall improvement in KS2 maths attainment – improving maths attainment across the board may help to reduce earnings inequality.[26] For English, the earnings gain as a percentage of earnings is similar across the distribution, suggesting overall improvements in English attainment would have minimal impact on earnings inequality.

These results must be interpreted with care. They are based on a *conditional* quantile regression. This means that the returns estimates tell us how marginal improvements in KS2 attainment could affect those at different points in the distribution of lifetime earnings among pupils who share a similar set of background characteristics. The findings do not tell us how improvements in KS2 attainment might affect those at different points in the *unconditional* distribution of lifetime earnings, where we rank all individuals on lifetime earnings without accounting for background characteristics.[27]

This limitation notwithstanding, the results are still informative for understanding the potential distributional effects of improved attainment among pupils who are similar in other respects. Under the assumption that the position of individuals in the distribution of earnings among those with similar characteristics would be the same if all individuals in that group had done one standard deviation better at KS2,[28] we can interpret our regression results as the association between doing one standard deviation better at KS2 and lifetime earnings at different points in the earnings distribution of otherwise-similar pupils.

Note that while these results are indicative of what *could* happen as a result of overall improvements in attainment, they are technically only valid for small changes in the overall attainment distribution. Economic theory suggests several reasons why improving the attainment of large groups – or entire cohorts – might not generate the same returns as we would obtain by summing the micro-level estimates we have presented across all individuals. If, for example, improving the attainment of entire cohorts leads to an increase

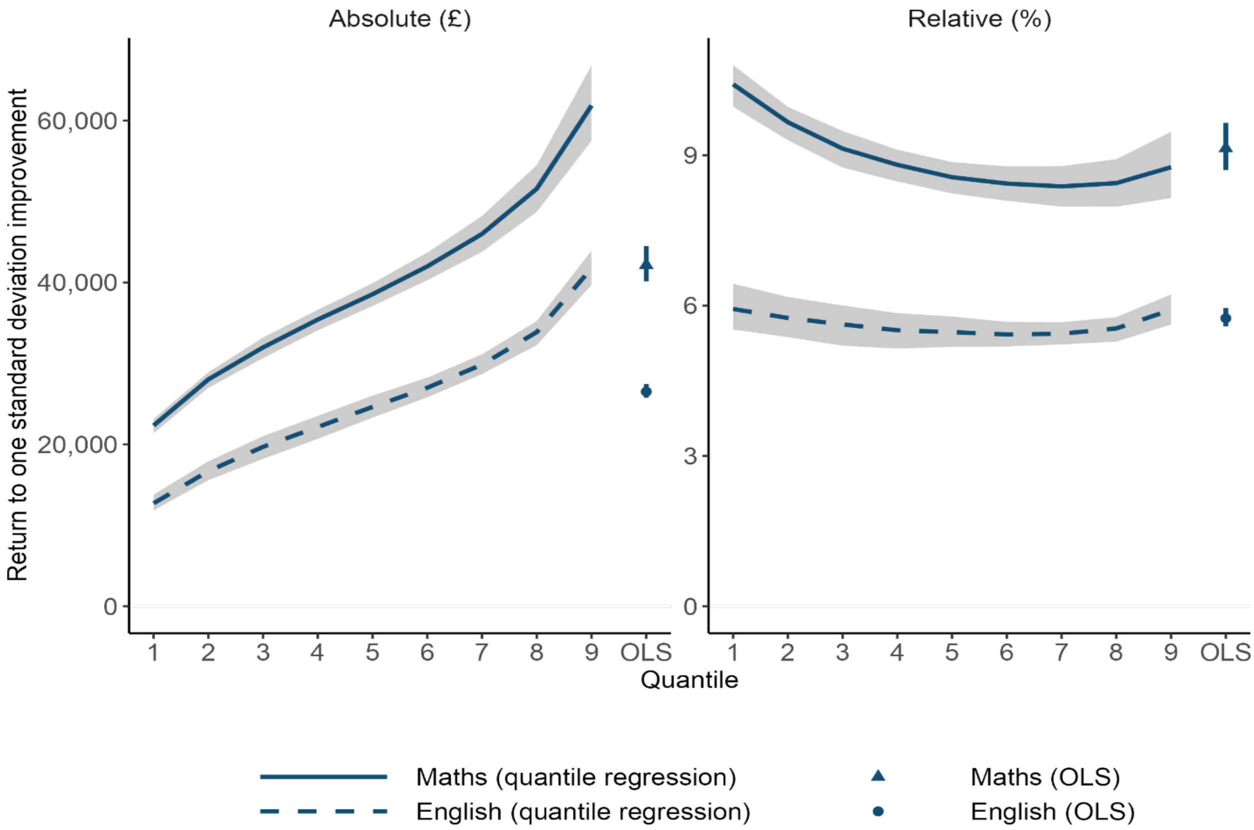
[26] A simple example to illustrate this point: Suppose a company hires two employees, one on a £20,000 salary and one on a £40,000 salary. If both receive a 5% pay rise, that is worth £1,000 to the lower earner and £2,000 to the higher earner. However, both have experienced a pay rise at the same rate and total earnings (summing the earnings of both employees) has also risen by 5%. Each worker's share of the total remains the same. If instead the higher earner were given a 2.5% pay rise, the absolute amount each worker gained would be the same (£1,000), but now the higher earner would be receiving a lower share of total earnings, i.e. earnings inequality will have fallen.

[27] For further discussion of the difficulties in interpreting conditional quantile regression results, see Gregg, Macmillan and Vittori (2019).

[28] This assumption is sometimes called 'rank invariance'.

in the supply of skills that outpaces demand, this will lead to diminishing returns to education for the cohort as a whole.

Figure 5: Marginal effect of one standard deviation improvement in English and maths on the present value of lifetime earnings, at each decile of the lifetime earnings distribution



By region

We see some variation in returns depending on the geographical region in which pupils attend primary school (Figures 6.1 and 6.2). The absolute return to a one standard deviation improvement in total KS2 English and maths attainment is slightly higher for pupils studying in London, the South East, and the East of England, relative to other areas. [29] As a proportion of average earnings among pupils from those regions though, we see little variation in the return to KS2.

That these returns are not too dissimilar largely reflects the fact that we are comparing pupils who are observably similar along dimensions other than the region they grew up in, i.e. local area deprivation (IDACI), ethnicity, FSM eligibility, whether they have special

[29] Most, but not all, of these differences are statistically significant. The difference in returns faced by pupils in London relative to pupils in the West or East Midlands is not statistically significant at the 5% level, using a two-sided t-test. The difference in returns faced by pupils in the South East relative to pupils in the West or East Midlands is also not statistically significant.

educational needs, gender, speaking English as an additional language, academic cohort, and season of birth.

This is positive news for those concerned that investing in some regions more than others – perhaps on distributional grounds – will have an efficiency cost and lead to a reduction in economic productivity. That said, we are comparing large geographical areas here. It is possible that we do see variation in returns across smaller areas that vary in their degree of disadvantage.

What these results do not tell us is which regions capture the benefits of improved KS2 attainment. Our results show returns by region of *origin*, rather than *destination*. Regions that see a net outflow of high-achieving pupils may benefit less from improvements in attainment, as they retain less of the earnings gain.

Britton, van der Erve, et al. (2021) show that higher education appears to reduce inequality of opportunity between people who grow up in different areas, by enabling them to move to labour markets that offer better career opportunities. We know, for example, that around 35% of graduates move out of the travel to work area they lived in at age 16 by the time they reach age 27. Around a quarter of graduates who move go to London. Mobility may partly explain why the returns by region of origin, shown here, appear not to differ greatly. The flip side of this is that areas offering less attractive career opportunities may miss out from improvements in the educational attainment of its pupils.

In a recent report published by the Skills and Productivity Board, Advani, Cornish and Crawford (2022) provide evidence on the relationship between educational attainment and mobility across travel to work areas. They conclude that poorer-performing areas are likely to benefit from investment in skills, as enough individuals remain within the local labour market for those areas to retain at least some of the benefit.

The findings of the Skills and Productivity Board are valuable for understanding the potential economic benefits to poorer-performing areas from encouraging pupils to pursue higher qualification levels. They tell us less about the geographical distribution of benefits arising from improvements in attainment at a more granular margin, such as pupils' grades. This margin of improvement is often more relevant to the types of policy implemented by government. Exploring how mobility patterns relate to marginal improvements in education attainment – at KS2, GCSE, and other stages of education – would be a valuable next step toward better understanding the distributional effect of education policy.

Figure 6.1: Average marginal effect of one standard deviation improvement in English and maths on the present value of lifetime earnings, by region, absolute (£)

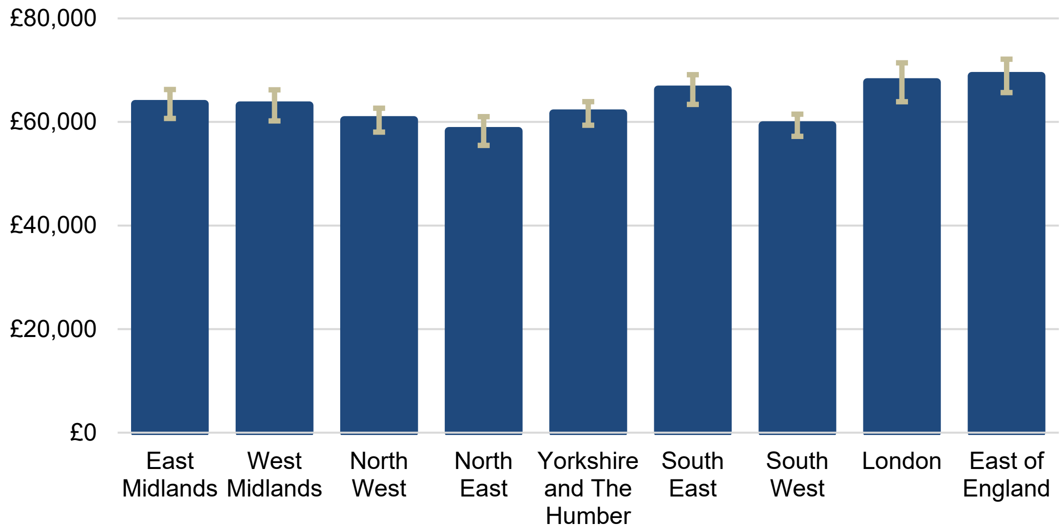
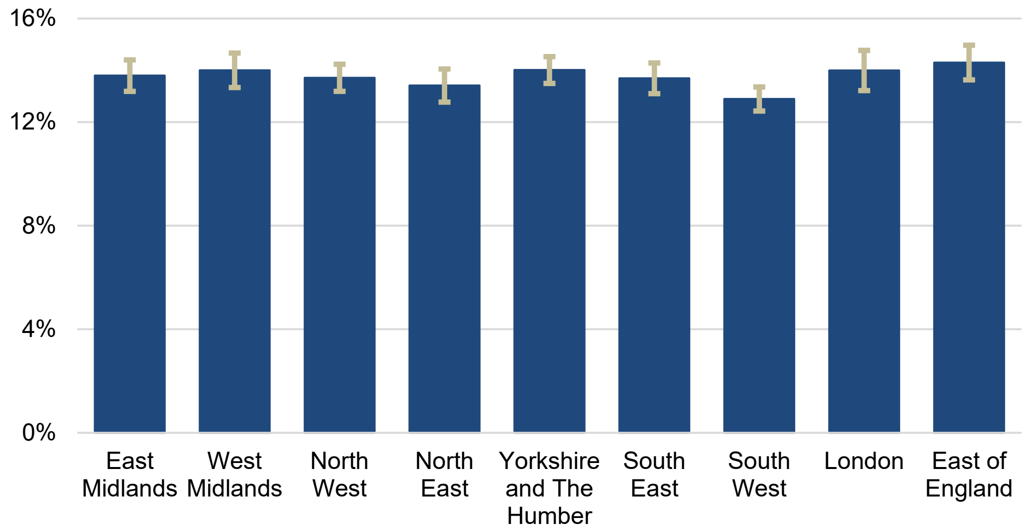


Figure 6.2: Average marginal effect of one standard deviation improvement in English and maths on the present value of lifetime earnings, by region, relative (%)



By ethnicity

Figures 7.1 and 7.2 show how our lifetime returns estimates vary across pupils from different ethnic groups. The lifetime earnings gain associated with a one standard deviation improvement in total KS2 English and maths attainment is lower for Black pupils (£53,200) than for pupils from other ethnic groups, which ranged from £63,400 to £68,800. Differences between other ethnic groups are not statistically significant. This does not rule out the possibility of substantial variation within these broadly defined ethnic groups.

These estimates are not causal. They do not show that belonging to a different ethnic group causes an individual to benefit less from primary education than belonging to any other ethnic group. We are not able to control for all factors that could be correlated with both ethnicity and income, such as parental income and occupation, motivation or effort, and cultural differences in emphasis on the importance of education.

These estimates capture historical differences in labour market experiences and outcomes between ethnic groups. As with patterns of intergenerational mobility, it is not necessarily the case that variation in returns across ethnic groups will be the same for current cohorts of pupils.

When considering the distributional effect of education policies that aim to boost attainment across all pupils, it is worth bearing in mind that a reliance on historical earnings data may suggest that some ethnic groups benefit more than others. While that may be the case for current and future cohorts, it is certainly not a given.

Because some schools have very few pupils from certain ethnic groups, there is a potential external validity issue which must be borne in mind when interpreting these results. In particular, they are not necessarily representative of the returns faced by those who are the only pupil in their school belonging to a particular ethnic group. This is because we use a fixed effects model where we deduct the school average from each pupil's data values. Cases where there is just one pupil in an ethnic group in the school 'drop out' as a result of this process, and are omitted from the model.

Figure 7.1: Average marginal effect of one standard deviation improvement in English and maths on the present value of lifetime earnings, by ethnic group, absolute (£)

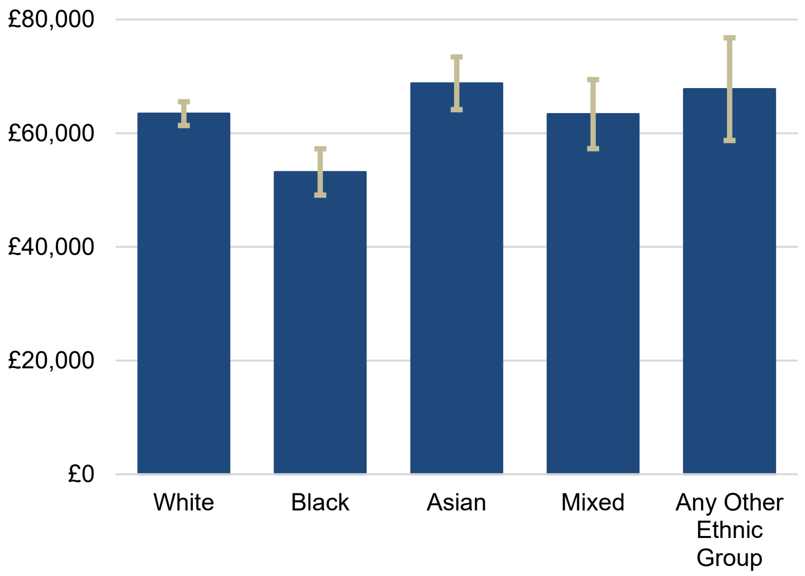
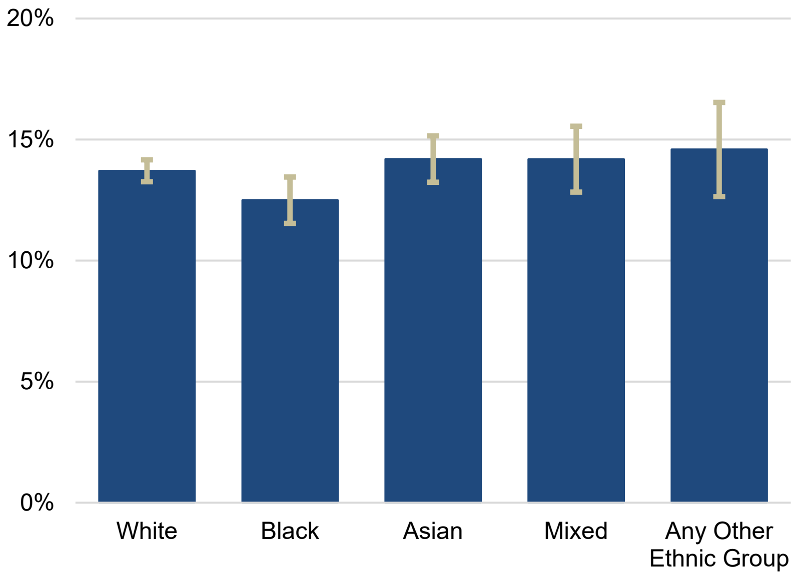


Figure 7.2: Average marginal effect of one standard deviation improvement in English and maths on the present value of lifetime earnings, by ethnic group, relative (%)



Accumulation of returns over the life cycle

Thus far we have said nothing about *when* individuals benefit from higher KS2 attainment over the course of their working lives. Do those with higher attainment benefit from a higher starting salary? Do those with lower attainment gradually catch up as they accumulate more work experience? Figure 8 shows the return associated with a one standard deviation improvement in English and maths in different age ranges, relative to the earnings of those the same age who score one standard deviation lower.

There are three key findings from this life cycle analysis:

- Returns emerge early on and persist through to retirement. On the whole, pupils who score one standard deviation lower in KS2 English and maths do not catch up with their higher-achieving peers in terms of earnings, even as they approach the end of their working lives.

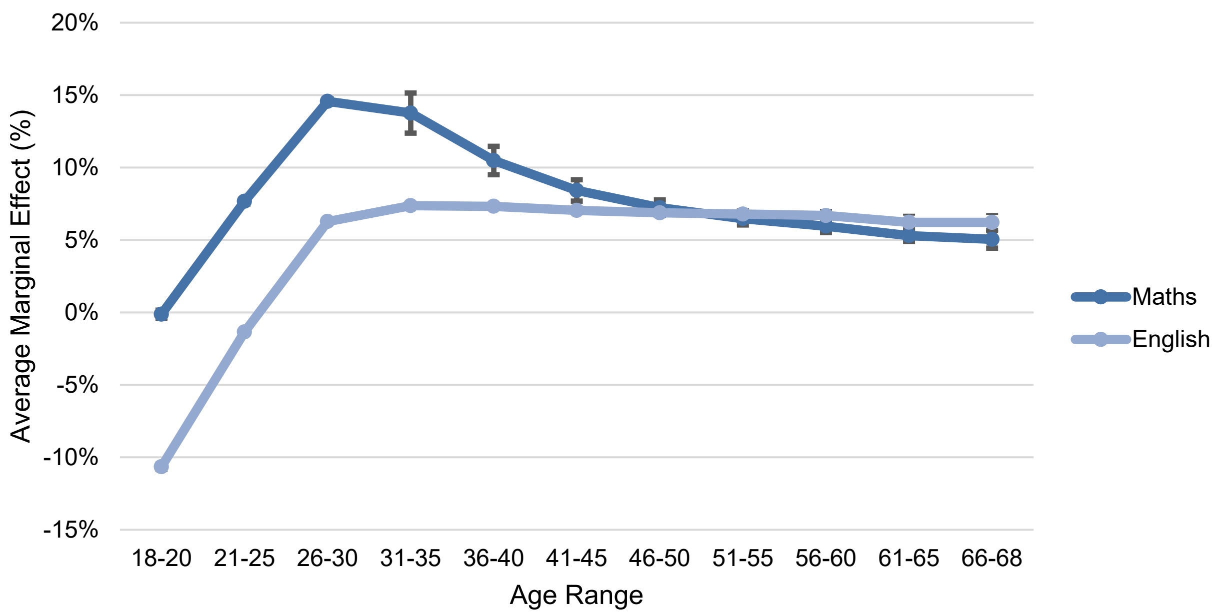
- Returns are either negative or non-existent for the few years after pupils leave compulsory education: individuals aged 18-20 who do better in their KS2 English assessments earn around 11% less, on average, than their counterparts who scored one standard deviation lower. For maths, the return is zero at this point in the life cycle. This reflects the fact that higher achievers at KS2 are more likely to pursue further education, delaying their entry into the labour market.

- The life cycle of returns is starkly different across subjects. The difference in earnings between those who do better in English versus those who score one standard deviation lower is relatively stable across the life cycle. By contrast, pupils benefit much more from higher maths attainment in the early stages of their career, and this relative earnings gain declines as individuals progress through their careers.

The diminishing importance of maths attainment for earnings could be explained by individuals with different levels of educational attainment selecting into careers which offer different rates of earnings growth. Alternatively, it could reflect patterns of employer learning and statistical discrimination. Employers may use observed attainment in maths to inform initial wage offers, at a time when they cannot observe the true ability of prospective employees.[30] Over time, as employers learn the true productivity of their employees, wages may become less strongly tied to educational attainment (and more strongly tied to true ability) (Altonji and Pierret, 2001; Galindo-Rueda, 2003). The contrasting pattern of returns for English could be explained by English attainment conveying less useful information about an individual's ability.

[30] This explanation does not require that employers take *KS2* attainment in maths into consideration when making hiring decisions and wage offers. It could be that we observe these dynamics in the return to KS2 attainment because doing well in KS2 maths enables pupils to attain higher grades in GCSE maths, and employers take GCSE attainment into account.

Figure 8: Relative return to KS2 English and maths by age



Notes: The ‘Average Marginal Effect (%)’ is the percentage increase in earnings received in the age range associated with a one standard deviation improvement in KS2 English/maths attainment.

In policy appraisal, we discount earnings to reflect a social time preference for seeing the benefits of policy sooner rather than later. This means that even though the returns to English are reasonably stable over the life cycle as a percentage of earnings, the early career returns contribute more to our estimate of the present value of lifetime earnings gained than the returns received towards retirement. This also means that the early career returns to maths dominate the later-life returns in our total discounted returns estimate.

Role of subsequent educational qualifications

In this section we look at the extent to which returns to KS2 are explained by the subsequent educational qualifications that pupils go on to achieve.

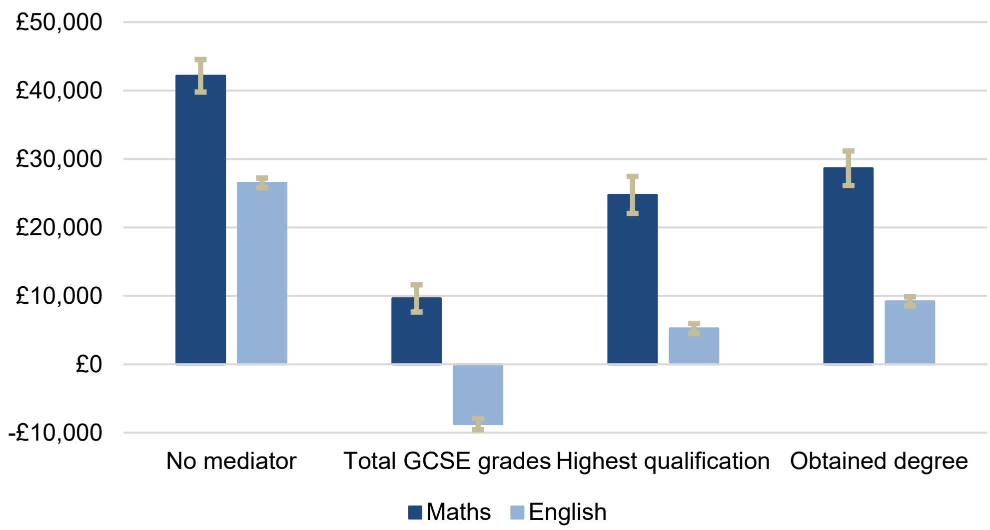
Figure 9 shows that the relationship between KS2 attainment and lifetime earnings is largely explained by the effect of KS2 attainment on subsequent qualifications. Like Hodge (2023), we find that subsequent qualifications explain a larger proportion of the KS2 return for English than they do for maths. This suggests that KS2 maths attainment retains some direct value in the labour market even after accounting for the subsequent qualifications facilitated by primary attainment. The direct value of KS2 English attainment is much smaller.

Once we control for GCSE attainment, the return directly associated with a one standard deviation improvement in total KS2 maths attainment falls from £42,200 to £9,600. GCSE attainment thus explains 77% of the overall return. For English, controlling for GCSE attainment reduces the return from £26,500 to -£8,700. Hodge (2023) found that the relationship between KS2 attainment and the probability of being employed between the ages of 27 and 33 is negative once we account for an individual's highest educational qualification. This could partly explain the negative lifetime earnings return estimated here.

Including broader measures of subsequent attainment, such as highest qualification or whether an individual obtains a university degree, explains less of the overall KS2 return. 'Highest qualification' explains 41% of the overall return to maths, and 80% for English; 'obtained degree' explains 32% for maths, and 65% for English. This is not particularly surprising. Doing well at KS2 can enable individuals to go on to obtain higher levels of qualification, but this is not the only thing that matters for future earnings. Also important is *how well* individuals do in those qualifications. This 'quality' aspect is captured in our measure of GCSE attainment, but is not captured by measures which indicate whether an individual has achieved a particular qualification or not.

As discussed in our methodology section, interpreting these results as the unbiased, causal effect of KS2 attainment on future earnings that is not explained by subsequent qualifications requires making additional assumptions compared with our previous analysis. Namely, we must assume that there are no unobserved factors which affect both the subsequent educational qualifications that pupils go onto achieve, and their lifetime earnings. A plausible counter-example to this might be pupils' determination to succeed, if this becomes more salient once pupils enter secondary school. We should therefore treat these results with an extra degree of caution.

Figure 9: Return to total KS2 English and maths attainment before and after accounting for subsequent qualifications as mediators (£)



What implications do these results have for how we should view previous attempts to quantify lifetime returns to KS2 attainment, which use a two-step approach first linking KS2 attainment to GCSE attainment, then GCSE attainment to lifetime earnings? (Department for Education, 2022). A key limitation of the two-step approach is that it only attempts to quantify the effect of KS2 attainment that is channelled through the effect of KS2 on GCSE attainment. Any independent effect that KS2 attainment may have on lifetime earnings is omitted by construction. Though not causal, the results above suggest that the direct relationship between KS2 attainment and lifetime earnings is small. This implies that previous estimates did not systematically exclude an important part of the return to KS2 attainment. It remains the case, however, that the two-step approach imposes an extra layer of uncertainty. It also requires strong assumptions to be made with regard to the degree to which changes affected by policy at KS2 ‘fade out’ over time.

Discussion

Causality and indirect effects

Despite the rich set of information available in LEO, it is not possible to control for all factors that could influence educational attainment and earnings. To be given a causal interpretation, our results depend on the 'selection-on-observables' assumption – that there are no omitted background characteristics that influence KS2 attainment and earnings. If this assumption does not hold, our results will suffer from 'omitted variable bias', where we involuntarily capture these unobservable influences in our estimate of the relationship between KS2 attainment and earnings. It is likely that omitted variables do bias our estimates. Factors such as parental income, parental education, the home learning environment, and non-cognitive skills, are all likely to influence both attainment and earnings. Many of these are likely to contribute to upward bias. Our results should be interpreted as correlations that control for the influence of a wide range of characteristics, but not as causal effects.

Previous research has found that potential bias in the overall return to education is likely to be small (Card, 1999). However, we lack evidence on the potential scale of bias within models looking at recent cohorts, and that account for the range of observable characteristics available in LEO. Recent innovations in data linkage may enable us to shed light on some sources of omitted variables bias. The Department for Education has linked data on educational attainment with household income at an individual-level (Department for Education, 2017).[31] Further research using these data could explore how controlling for household income affects estimates of the return to education.

As well as the direct relationship between KS2 attainment and lifetime earnings, our headline estimates also capture benefits that arise through the educational and labour market pathways that doing well at KS2 can open up. In the previous section, we provide estimates indicating what the direct relationship between KS2 attainment and lifetime earnings might be after controlling for the role of subsequent qualifications. These findings should be treated with extra caution, as they require stronger assumptions regarding the absence of unobserved confounding factors.

While several sources of omitted variable bias could plausibly lead to over-estimates of the earnings return, another source of bias which acts in the opposite direction stems from measurement error in lifetime earnings. As we cannot take KS2 attainment into account in our model for predicting lifetime earnings, our model will 'average out' differences in the earnings trajectories among those with different levels of KS2 attainment. This is partially corrected for by stratifying by highest qualification (see 'Methodology'). However, as

[31] A technical consultation document presenting initial findings from these data is available here: https://consult.education.gov.uk/school-leadership-analysis-unit/analysing-family-circumstances-and-education-1/

highest qualification is not perfectly correlated with KS2 attainment, measurement error in our earnings trajectories across the distribution of KS2 attainment will remain, and will tend to lead to downward bias in our results.

Lastly, it should be noted that we have not been able to control for prior attainment in this analysis, as we do not have data available on KS1 attainment for the cohorts used. Key Stage 1 attainment data was only collected in the National Pupil Database for 1997/98, too late to use for these cohorts. This creates a limitation on the results presented and generates potential omitted variable bias. We plan to conduct future analysis to continually build the evidence base on returns to education, and this future work will include younger cohorts, where we will be able to control for KS1 attainment.

Human capital and signalling

People are often concerned that returns to education reflect ‘signalling’ rather than skills (‘human capital’) accumulation. Obtaining a particular qualification can send a message to prospective employers that an individual is more capable than someone who did not choose to obtain the same qualification, regardless of whether that qualification actually enhanced their productivity.

Whether it is mainly human capital or signalling that drives the earnings return associated with education does not affect the private return individuals face, and thus the choices made by individuals. However, which of these explanations dominates does have important policy implications. If education enhances productivity, this implies a social return to education and supports state spending on education. If education merely serves as a means for individuals to signal their existing ability, this calls into question whether state spending on education is a worthwhile investment.

In a recent review of the evidence on human capital and signalling, Wyness, Macmillan and Anders, 2021, conclude that human capital effects predominate: education does indeed increase productivity. Signalling does play a role in explaining the returns to education in some contexts, such as in explaining the returns to passing the former key achievement threshold of 5 A*-C grades at GCSE in England (Anderson, 2022). Overall, though, its role is limited. The Schools Policy Appraisal Handbook published by the Department for Education concludes that while signalling may play an important role in certain contexts, and this should be considered in any cost benefit analysis, it does not invalidate the use of education returns estimates in policy appraisal (Hodge, Little and Weldon, 2021b).

In the primary school setting, signalling is arguably less of a concern. This is largely because all pupils must sit KS2 assessments. Pupils must still choose how much effort to put in, and may exert more effort if doing well at KS2 has a high signalling value. However, unlike for higher qualifications, they do not choose whether to sit KS2 assessments or which subjects to take.[32] Moreover, though KS2 assessments are high stakes for primary schools in terms of institutional reputation, they are relatively low stakes for pupils themselves. Marks in KS2 assessments could affect the future educational pathway chosen by pupils, but it is unlikely that employers will put much weight on levels of achievement at age 10-11, and KS2 results are not visible to employers. It is more likely, therefore, that our results tell us something about the labour market value placed on the human capital acquired at KS2, rather than the signalling value of those qualifications.

However, we also see that a large proportion of the benefits associated with KS2 appear to be explained by those doing well at KS2 going on to perform better in their GCSEs. Although pupils cannot choose whether to sit KS2 assessments in order to signal their ability to prospective employers, it is possible that signalling plays an indirect role if higher KS2 attainment enables pupils to select into GCSE subjects that have a signalling value associated with them. Overall, we cannot conclude that no part of our overall return is explained by signalling rather than human capital accumulation.

Macroeconomic benefits and total productivity

Our estimates do not capture the effects of individual-level improvements in educational attainment on total productivity or economic growth.

In this microeconomic analysis, we measure benefits only in terms of earnings received by individuals. This is just one component of the private returns to education. There are social returns too. The value of skills to employers exceeds the wages they pay to their employees. Employers are willing to pay additional labour costs to hire workers, such as National Insurance and pension contributions. They may also benefit from a rise in their profits as a result of hiring more skilled workers. The Department for Education's Schools Policy Appraisal Handbook outlines how and why one might apply a 'productivity uplift' in policy appraisal to account for these broader productivity effects (Hodge, Little and Weldon, 2021b).

More broadly, improvements in individual KS2 attainment could have wider economic benefits, for example through spill-overs of skills across workers. However, macroeconomic approaches to estimating the effect of educational attainment on economic growth are even more difficult to assign a causal interpretation. Cattan and Crawford (2013), in a review of the literature commissioned by the Department for Education, conclude that macroeconomic estimates might serve as an 'upper bound'. They are worthwhile considering, particularly for policies which affect large populations. However, the lack of fine-grained measures of attainment in macroeconomic data make these estimates less well suited to detailed policy appraisal. For further details, see Hodge, Little and Weldon (2021b).

[32] Pupils also do not generally choose whether to sit GCSEs, but they do have some flexibility to choose which subjects they take.

Wellbeing

Ultimately, the goal of policy is to improve personal wellbeing. Earnings is just one of the channels through which improvements in educational attainment can have an effect on wellbeing. Other benefits, such as improved mental and physical health, reduced crime, reduced unemployment, and healthier relationships, could also be significant.

Current data limitations make many of these channels difficult to quantify and monetise. Policy appraisal tends to focus on valuing what *can* be measured, rather than what *should* be. The Schools Policy Appraisal Handbook sets out how wellbeing effects can be taken into account throughout all stages of policy appraisal, not just cost benefit analysis (Hodge, Little and Weldon, 2021b).

One aspect of wellbeing effects which can – and should – be considered as part of a well-rounded policy appraisal, is that income generally improves personal wellbeing at a decreasing rate (Layard et al, 2018). Taking this into account could shift perspectives on the benefits of targeting policies towards certain segments of the population. HM Treasury (2020) propose the use of 'welfare weights' to reflect this. Hodge, Little and Weldon (2021b) discuss how these can be applied to education policy.

Implications for recent and future pupil cohorts

Our findings are based on cohorts of pupils who sat their KS2 assessments up to the academic year 1999/00. Both the education system and labour market conditions have changed since. We need to be aware of these changes when considering how these findings apply to current and future cohorts of primary school pupils.

The current KS2 national curriculum tests were only introduced in 2016. As we must wait to observe individuals' earnings before we can provide any estimate of the return to educational attainment, it is not currently possible to estimate returns specifically for pupils who experienced KS2 assessments as they are today.

Our study cohorts sat national curriculum tests in English, maths and science. English could be further sub-divided into reading, writing, handwriting, and spelling. Test marks in each of these subjects were mapped onto a national curriculum 'level' which was awarded to pupils. In our analysis, we use the standardised test score in English, maths, or the sum of scores in English and maths, as our main measures of KS2 attainment.

Current cohorts of pupils sit KS2 tests in maths, reading, and 'grammar, punctuation and spelling'. Writing and science is no longer part of the formal assessment, but is teacher assessed. Raw marks in each subject are converted to a 'scaled score', which is awarded to pupils.

The distribution of standardised maths attainment – measured as the total standardised maths score for our study cohorts, and the standardised 'scaled score' for current cohorts

– is slightly more concentrated around the mean for those sitting KS2 assessments in 2018/19 than it was for our study cohorts.[33] Moreover, it is possible that current national curriculum tests capture a slightly different set of skills, which may have different value in the labour market.

The distribution of standardised English attainment – which includes writing for our study cohorts but not for current cohorts – is remarkably similar for the 2018/19 cohort compared to our study cohorts. However, we know that the set of skills measured has changed (since writing is no longer included). We also know that the labour market value of writing differs from other components of English (see Appendix G). It is therefore possible that the labour market value of a one standard deviation in English overall differs for current cohorts compared to previous ones.

Wider changes to the education system could also affect the extent to which our earnings returns apply to current cohorts. The introduction of, and increases in, university tuition fees in 2006 and 2012 affect current cohorts to a greater extent than our study cohorts. These changes push up the cost of obtaining a degree, which could ultimately affect the overall return to attainment at KS2. Current cohorts are also now required to remain in education or training until age 18, a policy introduced in 2013 which did not affect our study cohorts.

Finally, education returns may differ because current cohorts do not face the same labour market conditions as previous cohorts. This could include changes in intergenerational mobility or labour market discrimination, the historical presence of which is reflected in our results. As we cannot estimate earnings returns to education without relying on historical data, it is difficult to address this issue. For these reasons, it is important that our returns estimates are not interpreted deterministically.

Notwithstanding these issues, predictive lifetime earnings models are an important component of value for money analysis, enabling us to provide monetised estimates of the potential benefits arising from education policy. This necessarily relies on the use of historical data, and we should remain aware and transparent about the caveats involved in doing so.

Who captures the gains?

We estimate changes in individuals' gross earnings associated with improved attainment. From an individual's perspective, it is the net return that matters when deciding how much time, energy, and financial resource to invest in education: how much of the earnings gain do they expect to receive after paying taxes, and after incurring the costs of additional qualifications they choose to pursue as a result of increasing their primary attainment?

[33] We focus on 2018/19 here, as formal assessments for more recent cohorts were cancelled during the COVID-19 pandemic. Assessments return in 2022 after two years of cancellations.

From a policy appraisal perspective, we care about the total gain to individuals, employers, and the government, and are typically interested in how the gains are distributed across these groups.

An individual's net return differs from their gross return in part due to changes in the amount of tax they pay or benefits they receive as a result of increasing their educational attainment. These gains are captured by the exchequer.

Unlike gross returns, net returns would also account for costs incurred by pupils in pursuing additional qualifications. This includes student loans for attending higher education, but also any costs incurred in financing further education and training. Some of these costs are met by the government, reducing its net gain from improvements in primary attainment. Employers may also face different in-work training costs if there is a change in the prior educational attainment of the workforce.

Note that individuals also incur an opportunity cost – in the form of foregone earnings – from pursuing post-compulsory qualifications. This *is* accounted for in our estimates, as our total lifetime earnings measure includes the years of zero earnings for those still in education.

Estimating who captures what is beyond the scope of this work. Modelling changes in tax and benefits, and potential costs for subsequent qualifications, is complex. Britton, Dearden et al. (2020) provide some evidence on the exchequer returns to obtaining a degree. They estimate the present value of gains to the exchequer in terms of lifetime Income Tax receipts and National Insurance Contributions, after accounting for the cost to the exchequer of tuition fees and maintenance loans. The results do not account for savings made in reduced benefit payments, nor the effect on VAT receipts. They estimate that the discounted return to the exchequer per pupil who attends higher education are around 46% of the gross lifetime earnings gain for men, and 21% for women.

Comparing returns to different qualifications

In this report, we show that a one standard deviation improvement in total KS2 English and maths attainment is associated with £63,700 in additional discounted lifetime earnings. Hodge, Little and Weldon (2021a) show that a one standard deviation improvement in GCSE attainment is associated with £108,000 in additional discounted lifetime earnings.[34] Other studies provide estimates of the lifetime returns to alternative qualifications (Britton, Dearden et al., 2020; Hayward, Hunt and Lord, 2014).

We cannot conclude from these findings alone that investing in education at some stages represents better value for money than investing at others. Comparing returns at different stages of education is complex. So too is understanding how to combine these estimates, which can be relevant for policies that affect the same cohort of pupils at different stages

[34] This estimate has been uprated to 2022 prices as in Table 1.

in their educational careers. In this section we outline some of the issues, highlighting what can and cannot be inferred from these estimates. Future research could explore these issues further, developing a coherent framework for using and interpreting the wide range of returns estimates.

Controlling for prior attainment

In this report, we do not control for prior attainment. This is primarily because no data are available on prior attainment for our study cohorts. This is less of a concern from a selection bias perspective than it would be for later education stages, as assessment in KS2 English and maths is compulsory. Though a small number of pupils are exempted, the vast majority are assessed. Our estimates are therefore representative of the average return across all pupils, not those who 'select into' KS2.

It does, however, affect the interpretation of our findings. Our results should be interpreted as the relationship between lifetime earnings gains and increases in skills acquired *at all ages up to* KS2. If we could control for attainment at KS1, the interpretation would be different: it would be the increase in lifetime earnings associated with an increase in progress made between KS1 and KS2.

This differs from how we would interpret the returns associated with GCSE attainment (Hodge, Little, and Weldon, 2021a) and obtaining a degree (Britton, Dearden, et al., 2020), which control for prior attainment. In these contexts, controlling for prior attainment is important, as pupils can choose which subjects they study or whether to go to university, and do so based partly on their ability. Not controlling for prior attainment would introduce selection bias into estimates of the return to these qualifications.

What these studies capture is effectively the return to progress made since prior attainment was measured. In the case of GCSEs, this is progress made between KS2 and KS4. A comparison is being made between the lifetime earnings of someone who achieved a particular set of GCSE grades, and the lifetime earnings of someone who did even better at GCSE despite having achieved the same level of attainment at KS2. These estimates of the returns to GCSE attainment are thus complementary to ours, providing information on the returns to progress made once pupils have sat their KS2 assessments.

Avoiding double counting

When combining multiple estimates of the return to education, we must avoid double counting. Double counting would occur if we added estimates of GCSE returns to KS2 returns that already accounted for benefits received via subsequent qualifications.

To illustrate, suppose we are interested in a policy that will target pupils at age 10-11 only. The direct outcome would be an improvement in their KS2 attainment, which may enable pupils to go on to perform better in subsequent educational qualifications. To calculate the lifetime earnings gain associated with the policy, we would want to use estimates of the overall return to KS2 which includes the benefits received via subsequent qualifications. We would not combine this with separate estimates of returns to those subsequent qualifications.

Suppose that the policy were instead to affect pupils from age 10-11 and again at age 16. An example might be a programme to provide an extra hour of tuition per week to pupils in each of the key exam years (school years 6 and 11). This would require making (potentially strong) assumptions on the extent to which effect sizes 'add up' or 'fade out' over time. Nevertheless, if we were comfortable with assuming that tuition at age 10-11 improved KS2 attainment by some effect size, x, and tuition at age 16 will improve GCSE attainment by a further effect size y, over and above the improvement sustained from the age 10-11 tuition (call this z), then we could estimate the total return as

$$R(x) + R(y)$$

$R(x)$ is the overall return to an improvement in KS2 attainment of x, including the benefits received via improvements in GCSE attainment that result from higher KS2 attainment. $R(y)$ is the return to an improvement in GCSE attainment of y, including the benefits received via improvements in post-GCSE qualifications.

If we were to add to this the return to improvements in GCSE attainment that are driven by improved KS2 attainment (the return to an improvement in GCSE attainment of z, $R(z)$), then we would be double counting this part of the policy's effect.

What if we just considered the total effect on GCSE attainment ($y + z$) and estimated the return based on this effect size ($R(y + z)$)? This would only capture the return to improvements in KS2 attainment that is explained by improvements in GCSE attainment. It would ignore any direct effect that increased KS2 attainment may have on lifetime earnings. In this case, we have shown that controlling for GCSE attainment explains most of the overall return to KS2 attainment (Figure 9). However, this may not be true in other contexts, in which case this approach would yield a lower bound.

Observing attainment in other subjects

Returns to English and maths should be interpreted differently at KS2, where we cannot observe attainment in other subjects, compared to GCSE, where we can. As pupils are not assessed in all subjects at KS2, we cannot control for the extent to which skills used in English or maths boost attainment in other subjects. Our returns estimates capture the relationship between skills unique to English/maths and lifetime earnings, *as well as* the return to skills in English and maths that are also beneficial for other subjects. At GCSE, we can control for attainment in all subjects undertaken. This means that only the first of these relationships is captured.

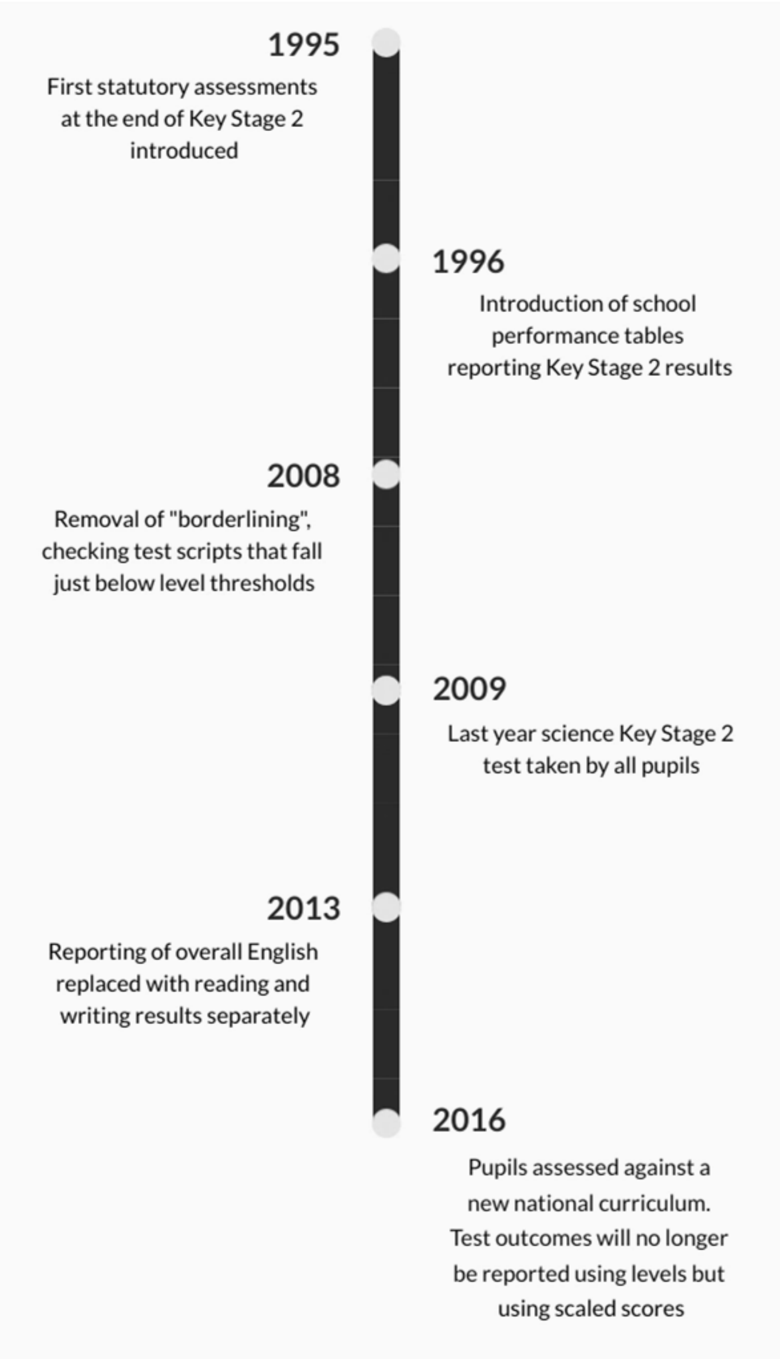
Discounting

Returns to education measured in terms of discounted lifetime earnings are not comparable in a more direct sense, which is that the estimates are discounted to a different base year. This is generally the age which pupils sit their assessments (11 for KS2; 16 for GCSE). In the case of obtaining a university degree, Britton, Dearden et al. (2020) discount to the age at which individuals enter university (18). This makes it difficult to compare estimates, as differences partly reflect the fact that an equivalent increase in *undiscounted* lifetime earnings is worth less in net present value terms to someone aged 10-11 than it is to someone aged 16. Comparing returns measured in terms of undiscounted earnings addresses this issue, but does not resolve any of the other issues of comparability outlined above.

Appendices

A. Key changes to KS2 assessments

Figure 10: Timeline of key changes to KS2 assessments



Source: Hodge (2023). See p.43 of Bew (2011) and Annex F in Department for Education (2016) for a more detailed history of statutory assessment since the 1998 Education Reform Act and the introduction of the National Curriculum.

B. Returns to education literature

Education stage	Key studies
Early Years	Paull and Xu (2017)
Reception	Hodge, Little and Tymms (2023)
Age 10 or KS2	Machin and McNally (2008) Crawford and Cribb (2013) Gregg, Macmillan and Vittori (2019) Hodge (2023)
GCSE	Hodge, Little and Weldon (2021) Hayward, Hunt and Lord (2014)
A level	Hayward, Hunt and Lord (2014)
Further education: Level 2 English and maths	Cerqua and Urwin (2016)
Further education: Level 3 vocational	Bibby et al. (2014)
Higher education	Belfield et al. (2018) Britton, Dearden, et al. (2020) Britton, Buscha, et al. (2020) Britton, Dearden and Waltmann (2021) Britton et al. (2022)

C. Summary Statistics

Table 5: LEO Summary Statistics - 1996/97 to 1999/00 cohorts, full table

Value	Statistic
English mark	58 (15) [Max:100]
Maths mark (1996/97 cohort)	47 (15) [Max:80]
Maths mark (1997/98 - 1999/00 cohorts)	62 (20) [Max:100]
Total weighted mark English + maths	119 (32) [Max:199]
Science mark	53 (13) [Max:80]
Reading mark	27 (9) [Max:50]
Writing mark (writing + handwriting + spelling)	31 (7) [Max:50]
Female	943,294 (49%)
Male	981,382 (51%)
FSM eligible	299,036 (16%)
No SEN	1,558,281 (81%)
SEN	331,518 (17%)
SEN with statement	34,877 (1.8%)
English as an Additional Language	136,914 (7.1%)
IDACI (end-KS4)	0.15 (0.07, 0.30)
Level 0	49,619 (2.6%)
Level 1	246,060 (13%)
Level 2	442,343 (23%)
Level 3	477,057 (25%)
Level 4	34,147 (1.8%)
Level 5	48,284 (2.5%)
Level 6	458,494 (24%)
Level 7	152,101 (7.9%)
Level 8	16,571 (0.9%)
East Midlands	168,523 (8.8%)
East of England	210,076 (11%)
London	237,643 (12%)
North East	108,335 (5.6%)
North West	293,662 (15%)
South East	294,434 (15%)
South West	184,619 (9.6%)
West Midlands	221,939 (12%)
Yorkshire and The Humber	205,445 (11%)
Any Other Ethnic Group	16,326 (0.8%)
Asian	113,957 (5.9%)
Black	51,993 (2.7%)
Mixed	28,567 (1.5%)

Value	Statistic
Unclassified	17,943 (0.9%)
White	1,695,890 (88%)
Month of birth: Jan-Apr	632,636 (33%)
Month of birth: May-Aug	663,833 (34%)
Month of birth: Sep-Dec	628,207 (33%)

Notes: Total observations: 1,924,676; Statistic key: Mean *(standard deviation)* [Max:Maximum]; n (%)

Subject marks are weighted by dividing by the maximum possible mark in the subject for that cohort, then multiplying by 100.

D. Accuracy of lifetime earnings simulation

In this section, we explore the accuracy of our lifetime earnings simulation by comparing earnings at ages 30-34, simulated from age 30, to actual earnings.

Table 6: Cohorts for which data on actual earnings are available at specified age

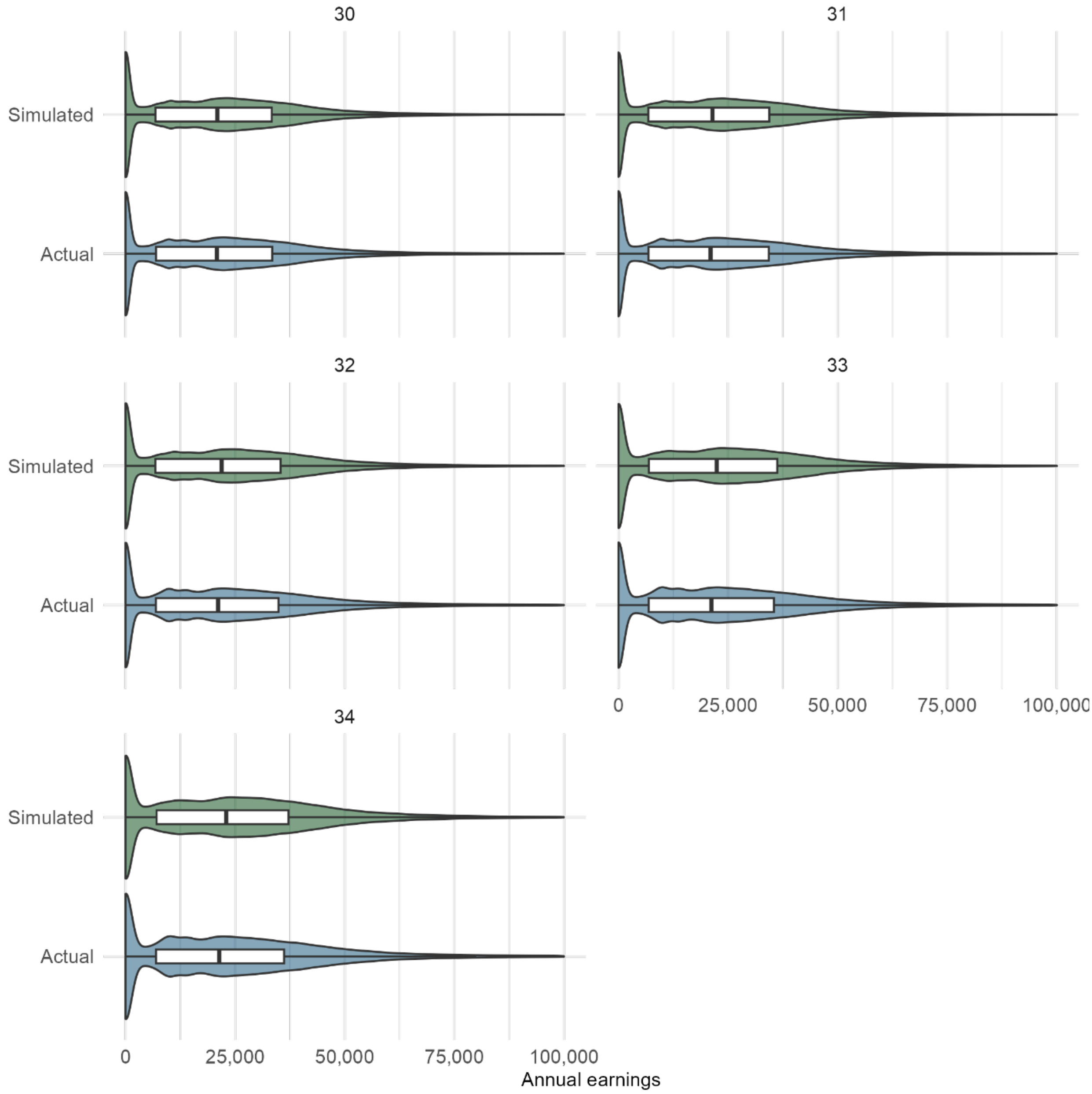
Age	Cohorts for which data on actual earnings are available
30	All (1996/97, 1997/98, 1998/99, 1999/00)
31	All (1996/97, 1997/98, 1998/99, 1999/00)
32	1996/97, 1997/98, 1998/99
33	1996/97, 1997/98
34	1996/97

Our main analysis uses the latest years of available earnings as the starting point for simulation. This means we will not be able to assess the accuracy of the results until additional data become available. We can, however, explore the accuracy of simulations starting at an earlier age. We focus here on earnings simulated from age 30, the year used in the most recent study that follows the same approach (Hodge, Little and Weldon, 2021). In Annex E of their report, Hodge, Little and Weldon assess the accuracy of simulations starting at age 26. Since their report was published, two additional years of earnings data have been made available. We can use these to assess the accuracy of simulations which start at a later age.

While we cannot yet assess the accuracy of earnings simulations starting from the latest year of observable earnings, we show in Appendix I that varying the point of simulation makes little difference to simulated earnings trajectories, nor does it have much of an effect on our estimated return to KS2 attainment. This provides reassurance that, conditional on the earnings simulation approach delivering accurate predictions when simulating from earlier starting points, our results should be reasonably robust.

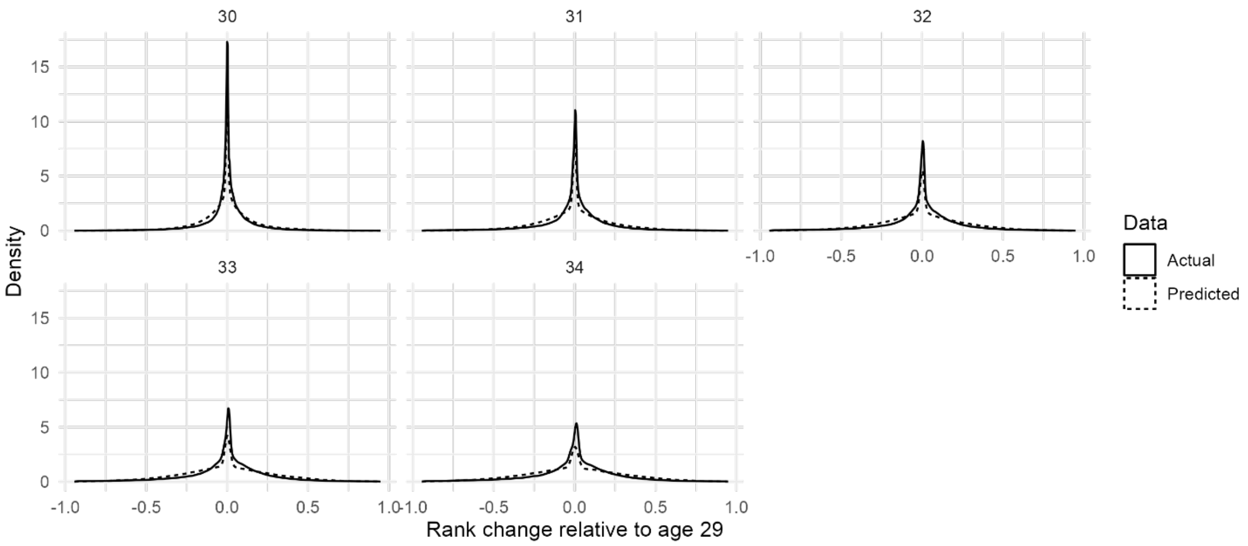
Figure 11 shows the distribution of actual and simulated earnings by age, using a simulation which starts from age 30 (where age 29 is the last year of actual earnings used). The predicted distribution closely replicates the distribution of actual earnings at age 30. We do a good job of tracking average earnings over time. At age 30, average predicted (actual) earnings are £22,700 (£22,900). By age 34, this rises to £25,500 (£25,500).

Figure 11: Distribution of actual and simulated earnings by age, simulated from the age of 30



As well as looking at how well our model predicts the overall earnings distribution, we can also look at the extent to which the model captures individual earnings trajectories. We do this by comparing differences in an individual's rank in the earnings distribution age 29 and their rank in the earnings distribution at ages 30-34. Figure 12 shows that individuals typically move further away from their original (age 29) rank in the earnings distribution over time. This is true in both our actual and simulated earnings data. However, we see more dispersion in the rank difference under our simulation compared to actual earnings. Our model does not fully capture individuals' movements around the earnings distribution over time.

Figure 12: Difference in earnings rank between age 29 and ages 30-34, using actual and simulated earnings data



E. Variables in the KS2 lifetime model

This section describes all variables used in the headline KS2 lifetime returns model and supplementary versions of the regressions shown in the appendices. Variables are included in the model as either:

- Independent variable: this is the measure of KS2 attainment we are interested in.
- Fixed effects: the variable is included as a fixed effect, which is not estimated but is differenced out of the regression equation before estimation.
- Subgrouping variable: a variable used to group observations to run subgroup analyses, where we estimate the regression model separately for each group.
- Controls: other variables are included in the right hand side of the regression equation that are potential confounders.

Table 7: Variables in the KS2 lifetime returns model

Variable	Inclusion in the model	Details
KS2 English + maths attainment	Independent variable	Standardised total mark in English plus maths KS2 assessments. Each subject is weighted by dividing by the maximum possible mark for that subject in that cohort, then multiplying by 100.
KS2 English attainment	Independent variable	Standardised mark in KS2 English
KS2 maths attainment	Independent variable	Standardised mark in KS2 maths
KS2 science attainment	Independent variable (Appendix G)	Standardised mark in KS2 science
KS2 reading attainment	Independent variable (Appendix G)	Standardised mark in KS2 reading
KS2 writing attainment	Independent variable (Appendix G)	Standardised mark in KS2 writing (sum of writing, handwriting and spelling)
School	Fixed effect	Unique school identifier
Gender	Control, subgrouping variable	Male, Female
FSM status	Control, subgrouping variable	Whether the pupil was eligible for Free School Meals at any point between 2001/02 and the year they sat their GCSEs. Note that this results

Variable	Inclusion in the model	Details
		in a slightly different definition for each of our four cohorts (depending on how many years of FSM eligibility data are available).
Region	Subgrouping variable	9 English Regions: North East, North West, Yorkshire and The Humber, East Midlands, West Midlands, East of England, South East, South West, London
IDACI rank	Control	Fraction of children living in income deprived families (0–1) in the local area in which the pupil took their KS4 assessments.
English as Additional Language	Control	Whether pupil is recorded as speaking English as an additional language
Ethnic group	Control, subgrouping variable	Major ethnic group to which pupil belongs (Asian, Black, Mixed, White, Any other ethnic group, unclassified).
Special educational needs status	Control	Whether the pupil was identified as having a special educational need (with or without statement) at any point between 2001/02 and the year they sat their GCSEs. Note that this results in a slightly different definition for each of our four cohorts (depending on how many years of SEN data are available).
Academic year that KS2 completed	Control	1996/97 to 1999/00
Month of birth (grouped)	Control	September-December, January-April, May-August
Age group	Subgrouping variable	11 groups: 18-20, 21-25, 26-30, 31-35, 36-40, 41-45, 46-50, 51-55, 56-60, 61-65, 66-68

F. Returns by subgroup

Table 8: Discounted lifetime earnings return associated with one standard deviation improvement in KS2 attainment by subgroup: English + maths

Subgroup	Return (£)	Return (%)	Lower bound (£)	Upper bound (£)
All	63700	13.8	61400	66000
Male	52200	10.2	49700	54700
Female	75200	18.5	72800	77700
FSM	52400	14.4	50700	54200
non-FSM	65500	13.7	63000	68000
White	63400	13.7	61400	65500
Black	53200	12.5	49100	57300
Asian	68800	14.2	64100	73400
Mixed	63400	14.2	57300	69400
Any Other Ethnic Group	67800	14.6	58700	76800
East Midlands	63500	13.8	60700	66300
West Midlands	63200	14	60200	66200
North West	60300	13.7	58000	62700
North East	58200	13.4	55500	61000
Yorkshire and The Humber	61600	14	59400	63900
South East	66300	13.7	63400	69100
South West	59400	12.9	57200	61500
London	67700	14	63900	71400
East of England	68900	14.3	65700	72100

Table 9: Discounted lifetime earnings return associated with one standard deviation improvement in KS2 attainment by subgroup: English

Subgroup	Return (£)	Return (%)	Lower bound (£)	Upper bound (£)
All	26500	5.7	25800	27200
Male	19200	3.7	18000	20300
Female	34100	8.4	33200	35000
FSM	23600	6.5	22000	25100
non-FSM	26900	5.6	26100	27700
White	26500	5.7	25700	27300
Black	21900	5.1	17300	26600
Asian	29400	6.1	25900	32800
Mixed	22600	5.1	14900	30200
Any Other Ethnic Group	19300	4.2	9300	29300
East Midlands	26300	5.7	24000	28500
West Midlands	27300	6.1	24800	29800
North West	26600	6	24800	28300
North East	25900	5.9	22300	29400
Yorkshire and The Humber	25800	5.9	23700	28000
South East	26900	5.6	25100	28700
South West	25700	5.6	23200	28100
London	26200	5.4	23900	28600
East of England	28600	5.9	26300	30900

Table 10: Discounted lifetime earnings return associated with one standard deviation improvement in KS2 attainment by subgroup: Maths

Subgroup	Return (£)	Return (%)	Lower bound (£)	Upper bound (£)
All	42200	9.1	39800	44500
Male	36800	7.2	34400	39300
Female	47300	11.6	44800	49800
FSM	33200	9.1	31200	35200
non-FSM	43600	9.1	41100	46200
White	41900	9.1	39600	44200
Black	35300	8.3	30600	40000
Asian	44800	9.3	40500	49100
Mixed	45200	10.1	38600	51900
Any Other Ethnic Group	52900	11.4	43600	62300
East Midlands	42100	9.2	39000	45300
West Midlands	40900	9.1	37600	44300
North West	38600	8.8	36000	41300
North East	37100	8.5	33400	40800
Yorkshire and The Humber	40700	9.2	37900	43500
South East	44400	9.2	41300	47400
South West	38400	8.3	35700	41200
London	46400	9.6	42900	50000
East of England	45600	9.5	42500	48700

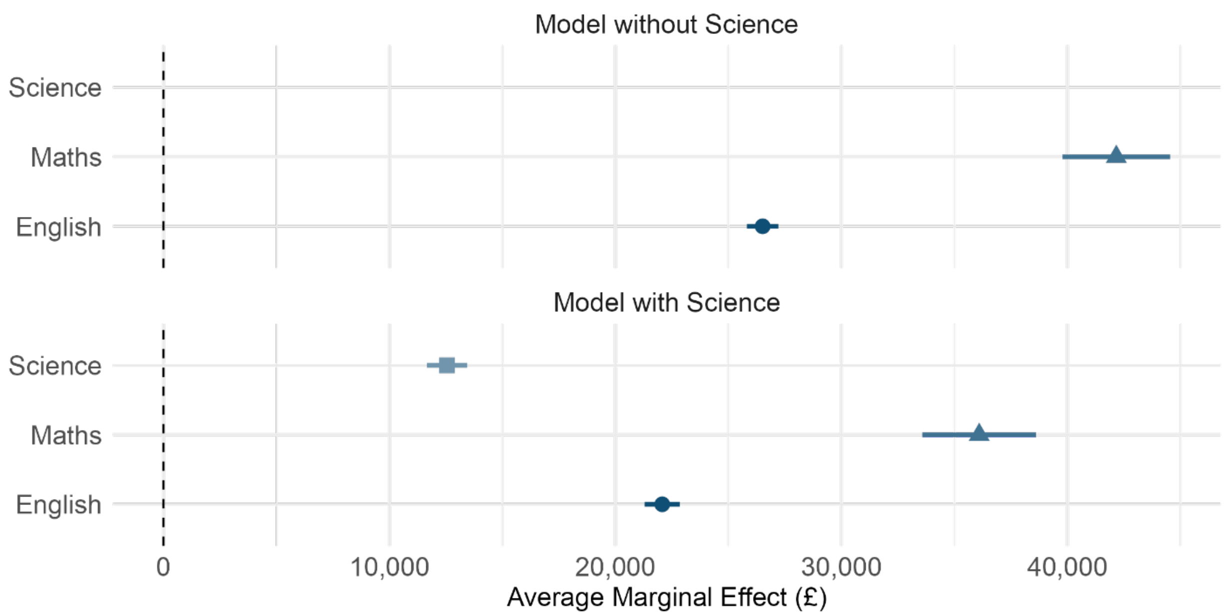
G. Supplementary regression results

Including science attainment in our model

Figure 13 shows how average returns to a one standard deviation improvement in KS2 English and maths are affected by the inclusion of science attainment as a control variable. Science attainment is positively correlated with both English and maths attainment, and has an independent relationship with lifetime earnings. As a result, the inclusion of science in our regression model reduces the estimated return to maths and English. The return to English (maths) in discounted lifetime earnings is £26,500 (£42,200) in our headline model. When we hold attainment in science constant, these estimates fall to £22,100 (£36,100). A one standard deviation improvement in science attainment itself is associated with £12,500 in additional discounted lifetime earnings.

This highlights the need to take care in interpreting the results from our regression model. As attainment in subjects other than English, maths and science (or, for current cohorts, just English and maths) is unobservable, we should think of our returns estimates as reflecting the lifetime earnings gain associated with the sorts of skills needed to do well in English and maths. They do not reflect the direct effect of subject-specific skills and knowledge on future earnings.

Figure 13: Average marginal effect of one standard deviation improvement in subject attainment in model with and without science

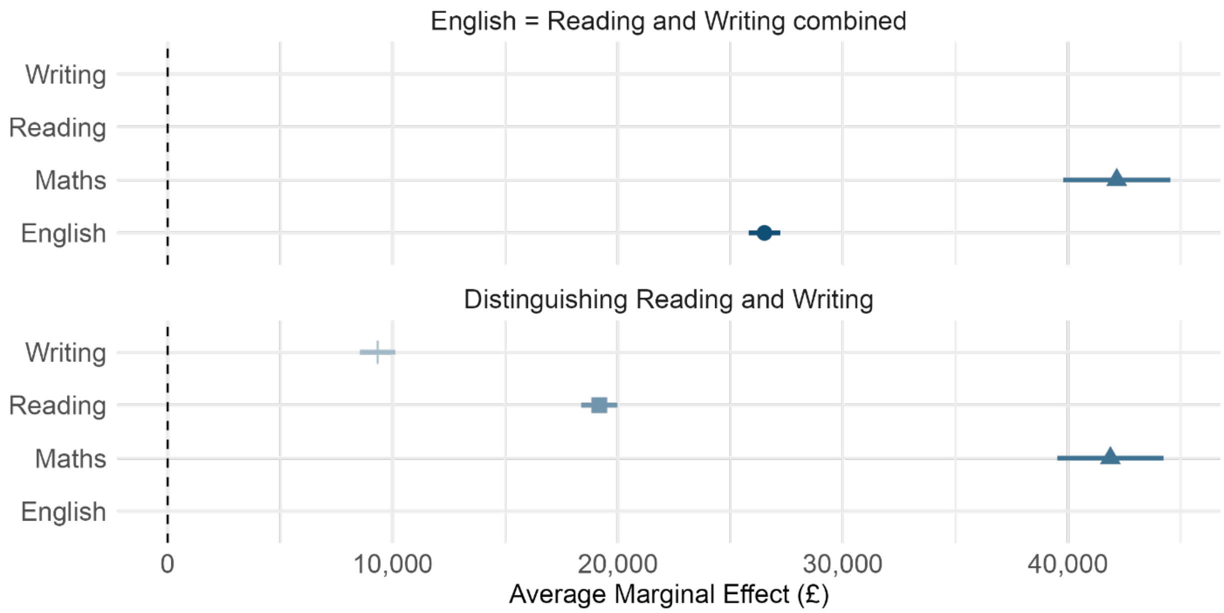


Distinguishing between attainment in reading and writing

Attainment in reading and writing is assessed separately under the current KS2 curriculum. In policy appraisal, we may be interested in the returns associated with each of these sub-skills separately. For our study cohort, who sat their KS2 assessments between 1996/97 and 1990/00, both reading and writing were externally assessed. An overall mark for writing was awarded by combining marks from tests taken in writing, handwriting, and spelling. A separate test was taken to assess reading.

Figure 14 shows the average lifetime earnings return associated with reading, writing and maths. We see that the lifetime earnings returns associated with attainment in reading are higher than writing: a one standard deviation improvement in reading is associated with £19,200 in additional discounted lifetime earnings; in writing the associated return is £9,300.

Figure 14: Average marginal effect of one standard deviation improvement in subject attainment, separating reading and writing

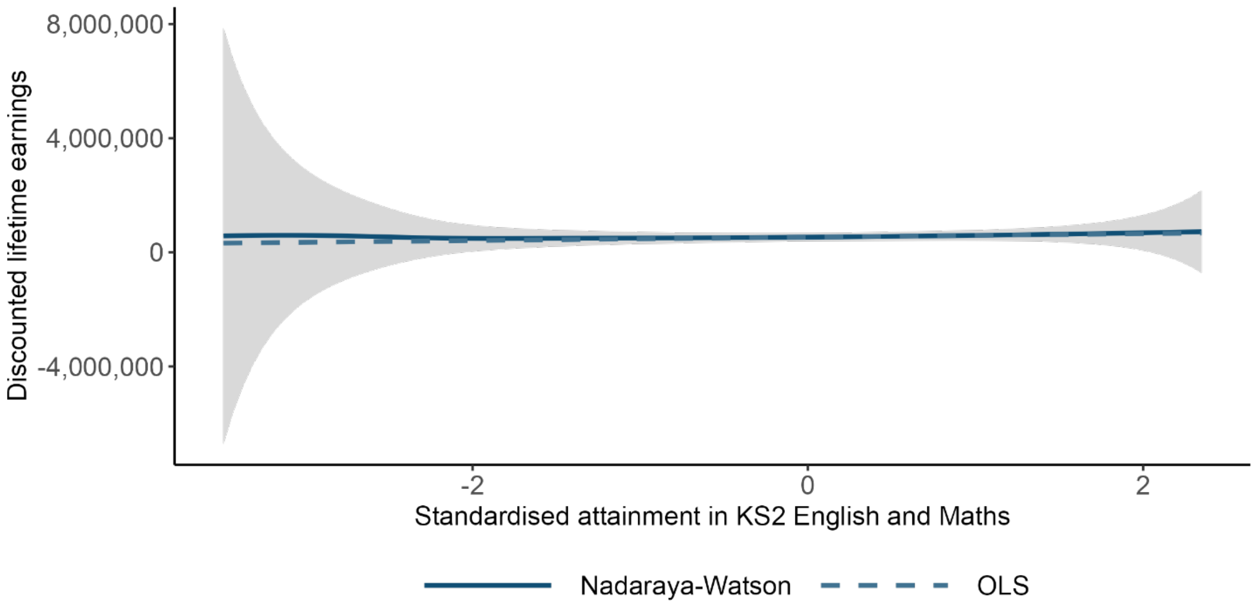


H. Non-parametric methods

Our headline regression model specified in equation (1) imposes that earnings returns are constant across the distribution of KS2 attainment. To test this linearity assumption, we use non-parametric methods. Specifically, we estimate a Nadaraya-Watson regression to estimate the local average return to improvements in KS2 attainment within narrowly defined ranges (‘kernels’) of KS2 attainment. This functional form is more flexible than the OLS regression used to estimate our headline findings.

Figure 15 shows that the relationship between total KS2 English and maths attainment and discounted lifetime earnings is approximately linear. This supports the assumption of constant returns that underpins our headline model.

Figure 15: OLS vs. Nadaraya-Watson regression of (discounted) lifetime earnings on KS2 attainment



Notes: Based on a randomly drawn sample of 10,000 observations. A single imputation of lifetime earnings is used. Nadaraya-Watson regression of discounted lifetime earnings on standardised attainment in English and Maths, controlling for gender, FSM eligibility, region, English as an additional language, ethnicity, IDACI, special educational needs status, academic cohort, and month of birth. Model does not include school fixed effects.

I. Alternative simulation start points

In this section, we compare key lifetime earnings statistics and our estimated returns when we simulate from different ages.

We begin by comparing lifetime earnings simulated from ages 29, 30, or 31, which we can construct for each of our study cohorts as we observe actual earnings the year prior for all individuals. Figure 16 shows that varying the point at which we begin our lifetime earnings simulation has a very small effect on simulated earnings trajectories.

In our main regression analysis, we use simulations based on the latest three years of observed earnings for each cohort, which means simulating from up to age 34 for the oldest cohort in our sample. To provide reassurance that simulating from these later ages also has little effect on our results, we show how the age earnings profile simulated for the oldest cohort – those born in 1985/86 – varies when we simulate from ages 31-34 (Figure 17). Again, this makes little difference.

Figure 16: Average real earnings conditional on employment by age, simulating from different ages (all cohorts)

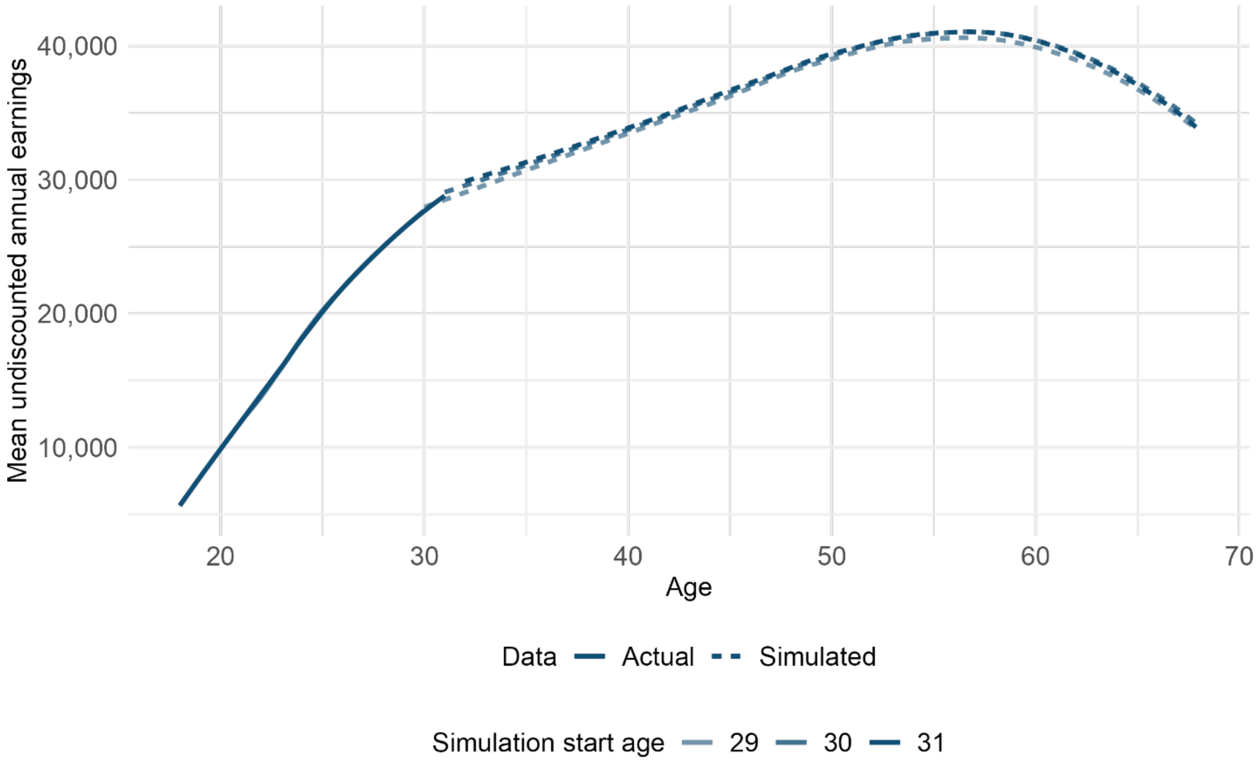
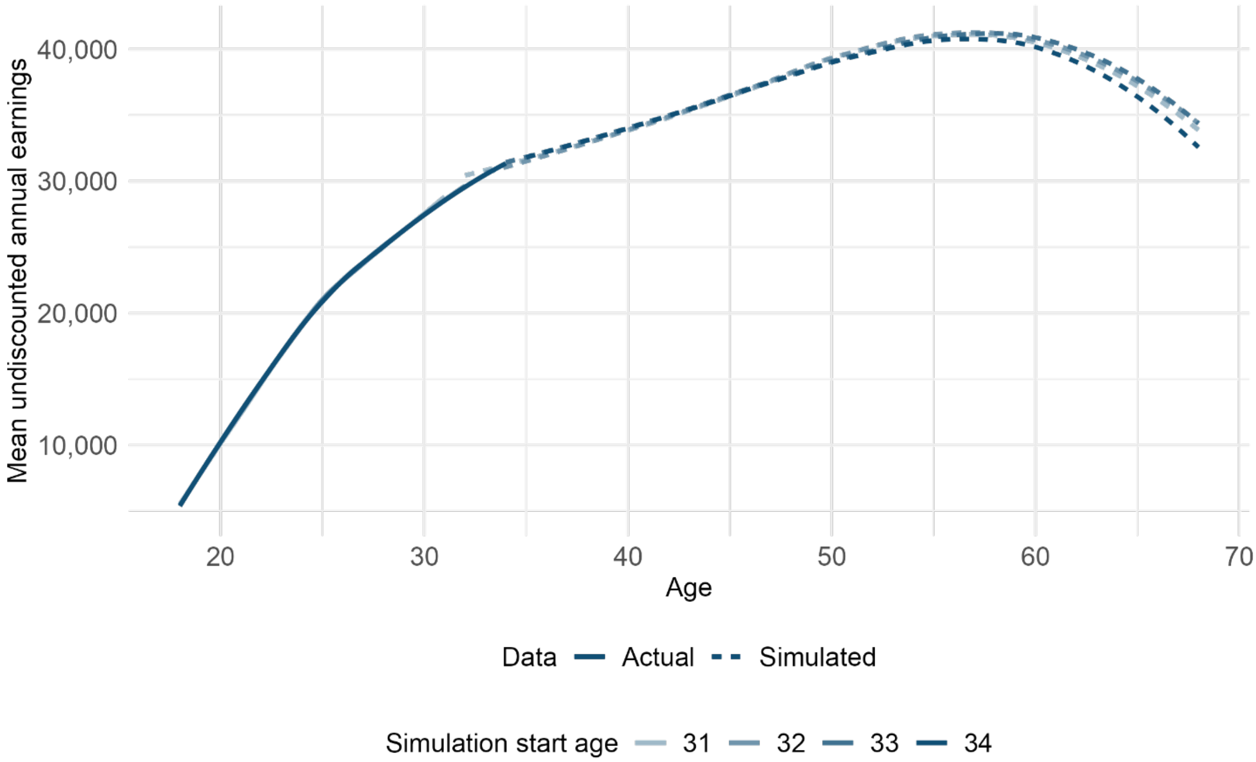


Figure 17: Average real earnings conditional on employment by age, simulating from different ages (oldest cohort)



What matters for our estimates of the return to KS2 attainment is whether these small differences in simulated lifetime earnings are correlated with KS2 attainment. To investigate the robustness of our regression results to the starting point of our lifetime earnings simulation, we re-run our main regression model (equation (1)) replacing the 15 imputations of lifetime earnings that stem from the latest three years of observable earnings, with 10 imputations of lifetime earnings that stem from earnings observed at age 28, 29 or 30 (where the first year of simulation is age 29, 30, or 31, as in Figure 16).

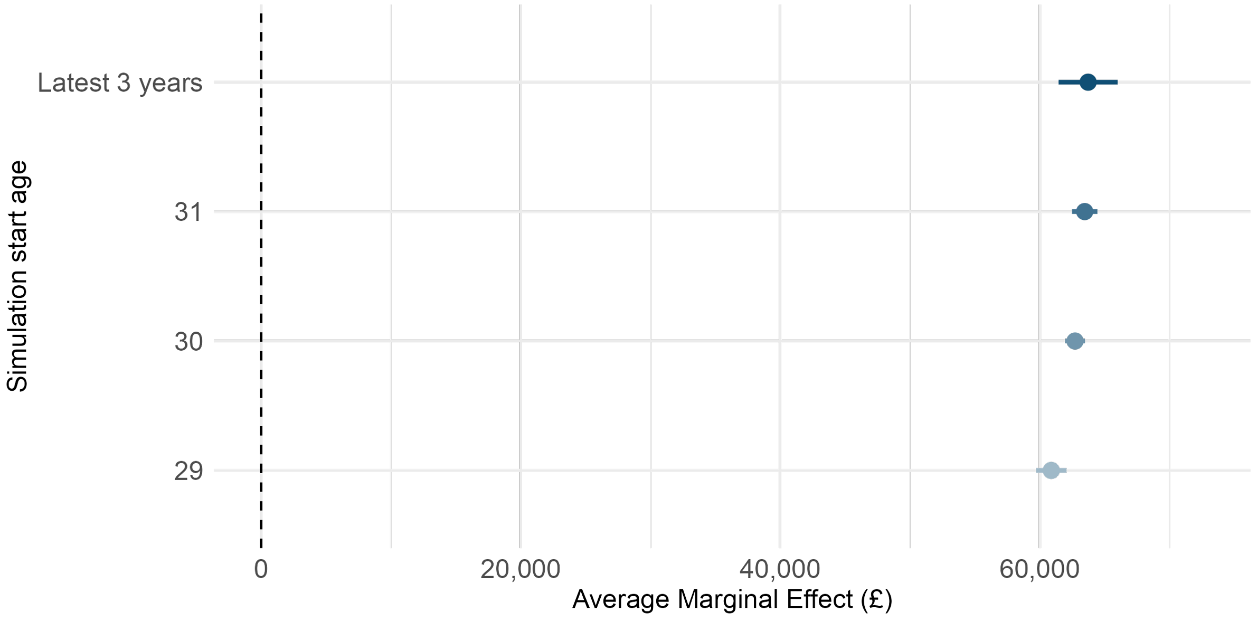
Figure 18 shows that the estimated lifetime return to total English and maths attainment is slightly higher when we use simulations starting from ages 30, 31, or the latest 3 years, relative to when we simulate from age 29.[35] However, there is no statistically significant difference between the average return estimated using our headline approach (latest 3 years) – and the average return we get when we simulate from age 31, which is the latest year we could use across all cohorts.[36]

We can see, however, that the confidence interval widens when we base our simulation on the latest three years of observed earnings, rather than using a single year. This, in our

[35] Differences between returns based on simulations starting from age 29 and 30, 29 and 31, and age 29 and the latest 3 years, are statistically significant at the 5% level.
[36] At a 5% significance level, using a two-sided t-test.

view, means that the range of estimates provided by our headline results better reflects the uncertainty that is inherent in using simulated data.

Figure 18: Average marginal effect of one standard deviation improvement in English and maths on the present value of lifetime earnings, when we vary the simulation start point



J. Comparison with previous literature

In this section, we summarise how the results in this study compare to the findings of the two most closely related studies:

- KS2 attainment and early labour market outcomes (Hodge, 2023)
- GCSE attainment and lifetime earnings (Hodge, Little & Weldon, 2021)

It is difficult to make direct comparisons for the reasons explained in the Methodology and Discussion sections of this report. In particular, note that:

- Different studies use different present value base year: we use age 10-11, the age at which pupils sit their KS2 assessments. The GCSE results use age 16.
- Different studies use different price years: we us 2022, Hodge (2023) uses 2021 and Hodge, Little and Weldon (2021) use 2019.
- GCSE returns control for attainment in other subjects. For KS2, we cannot do this.
- Hodge (2023) estimates returns for those in employment, whereas this study and Hodge, Little and Weldon (2021) include periods of zero earnings. This means the early career returns do not account for variation in employment patterns across those with different levels of KS2 attainment.

Measure	This study	Early career KS2 returns (Hodge, 2023)	GCSE returns (Hodge, Little & Weldon, 2021)
Overall return	Overall return to one standard deviation improvement in English + maths: £63,700 (13.8%) in discounted earnings at age 10-11, 2022 prices. Return 59% larger for Maths than English.	Overall return to one standard deviation improvement in English + maths is around £7,000 (24%) for those in employment at age 33 (undiscounted), 2021 prices. Return 166% larger for Maths than English. This is consistent with our finding that the return to Maths declines over the life cycle (see below).	Overall return to one standard deviation improvement in total GCSE grades is £96,000 (20%) in discounted earnings at age 16, 2019 prices. Return to one grade improvement is 100% higher for maths than English.

Measure	This study	Early career KS2 returns (Hodge, 2023)	GCSE returns (Hodge, Little & Weldon, 2021)
Return by gender	Overall return 44% larger for women in absolute terms (£75,200 for women vs. £52,200 for men). Relative return 18% for women, 10% for men.	For non-FSM pupils, return is 40-50% higher for women than men at age 25. This gap closes by age 33. These results are based only on those in employment, whereas our study includes periods of zero earnings. For FSM eligible pupils, gender gap is smaller. (See Figure 6).	Overall return 18% larger for men than women.
Return by FSM	Larger in absolute terms for non-FSM pupils (£65,500 vs. £52,400). Similar in relative terms (14%).	Larger in absolute terms for non-FSM pupils. Similar in relative terms. (See Figure 6).	Absolute return is 9% larger for non-FSM pupils than those eligible for FSM.
Return by income	In relative terms, return to Maths broadly decreasing in earnings; return to English relatively flat. In absolute terms, return to English and maths higher at top of potential earnings distribution.	In relative terms, the return to Maths is decreasing in earnings in the late twenties. By the early thirties, the return follows a ‘U’-shaped pattern. For English, the return is flat across the earnings distribution.	Not studied.
Return by ethnicity	In absolute terms, return lower for Black pupils than other ethnic groups. In relative terms, differences are mostly	Not studied.	Not studied.

Measure	This study	Early career KS2 returns (Hodge, 2023)	GCSE returns (Hodge, Little & Weldon, 2021)
	statistically insignificant.		
Return by region	In absolute terms, return slightly higher in London, South East and East of England than other regions. In relative terms, returns broadly similar.	Not studied.	Not studied.
Accumulation of returns over life cycle	Relative returns to maths and English are increasing up to age 30. For English, returns are then flat over the life cycle. For Maths, the return declines and flattens off at around the same return as for English (5-7%).	Relative returns are increasing for both maths and English between ages 25-33.	Not studied.
Role of subsequent qualifications	GCSE attainment explains 77% of the return to Maths and accounts for more than 100% of the return to English. ‘Highest qualification’ explains 41% of the return to maths and 80% for English.	At age 33, ‘highest qualification’ explains around 20% of the return to maths and 100% of the return to English.	Not studied.

References

Advani, A., Cornish, J., & Crawford, C. (2022). *Would additional investment in skills benefit areas of the country that are poorer performing economically? .* Department for Education, Skills and Productivity Board.

Altonji, J., & Pierret, C. (2001). Employer learning and statistical discrimination. *The Quarterly Journal of Economics, 116*(1), 313-350.

Anderson, O. (2022). *Walking the line: Does crossing a high stakes exam threshold matter for labour market outcomes?* UCL CEPEO Working Paper No. 22-05.

Angrist, J., & Pischke, J. (2009). *Mostly Harmless Econometrics: An Empiricist's Companion.* Princeton University Press.

Belfield, C., Britton, J., Buscha, F., Dearden, L., Dickson, M., van der Erve, L., . . . Zhu, Y. (2018). *The impact of undergraduate degrees on early-career earnings.* Department for Education.

Bew, P. (2011). *Independent Review of Key Stage 2 Testing, Assessment and Accountability: Final Report.* London, UK: Department for Education.

Bibby, D., Buscha, F., Cerqua, A., Thompson, D., & Urwin, P. (2014). *Estimation of the labour market returns to qualifications gained in English Further Education.* Department for Business, Innovation & Skills, BIS Research Paper Number 195.

Britton, J., Buscha, F., Dickson, M., van der Erve, L., Vignoles, A., Walker, I., . . . Zhu, Y. (2020). *The earnings returns to postgraduate degrees in the UK.* Department for Education.

Britton, J., Dearden, L., & Waltmann, B. (2021). *The returns to undergraduate degrees by socio-economic group and ethnicity.* Department for Education.

Britton, J., Dearden, L., van der Erve, L., & Waltmann, B. (2020). *The impact of undergraduate degrees on lifetime earnings.* Department for Education.

Britton, J., van der Erve, L., Waltmann, B., & Xu, X. (2021). *London calling? Higher education, geographical mobility an early-career earnings.* Department for Education.

Britton, J., Walker, I., Waltmann, B., & Zhu, Y. (2022). *How much does it pay to get good grades at university?* Department for Education.

Card, D. (1999). The causal effect of education on earnings. In *Handbook of Labor Economics* (Vol. 3, pp. 1801-1863).

Cattan, S., & Crawford, C. (2013). *Assessing the Economic Benefits of Education: Reconciling Microeconomic and Macroeconomic Approaches.* Centre for Analysis of Youth Transitions.

Cerqua, A., & Urwin, P. (2016). *Returns to Maths and English Learning (at level 2 and below) in Further Education.* Department for Business, Innovation & Skills, BIS Research Paper Number 286.

Cinelli, C., Forney, A., & Pearl, J. (2022). A crash course in good and bad controls. *Sociological Methods & Research*.

Crawford, C., & Cribb, J. (2013). *Reading and maths skills at age 10 and earnings in later life: A brief analysis using the British Cohort Study.* Centre for Analysis of Youth Transitions, Impact Study REP03.

Department for Education. (2016). Attainment in primary schools in England: Quality and methodology information. *Statistical First Release 39*.

Department for Education. (2017). *Analysing family circumstances and education.* Department for Education.

Department for Education. (2022). *Economic benefits of meeting the ambitions set out in the Schools White Paper.* Department for Education.

Galindo-Rueda, F. (2003). *Employer learning and schooling-related statistical discrimination.* IZA Discussion Paper No. 778.

Gregg, P., Macmillan, L., & Vittori, C. (2019). Intergenerational income mobility: Access to top jobs, the low-pay no-pay cycle and the role of education in a common framework. *Journal of Population Economics, 32*, 501-528.

Hayward, H., Hunt, E., & Lord, A. (2014). *The economic value of key intermediate qualifications: estimating the returns and lifetime productivity gains to GCSEs, A levels and apprenticeships.* Department for Education.

HM Treasury. (2020). *The Green Book: Central Government guidance on appraisal and evaluation.*

Hodge, L. (2023). *Key Stage 2 attainment and early labour market outcomes.* Department for Education.

Hodge, L., Little, A., & Tymms, P. (2023). *The economic benefits of effective Reception classes in England.* Department for Education.

Hodge, L., Little, A., & Weldon, M. (2021a). *GCSE attainment and lifetime earnings.* Department for Education.

Hodge, L., Little, A., & Weldon, M. (2021b). *Schools Policy Appraisal Handbook.* Department for Education.

Koenker, R., & Bassett, G. (1978). Regression Quantiles. *Econometrica, 46*(1), 33-50. doi:10.2307/1913643

Layard, R., Clark, A., Flèche, S., Ward, G., & Powdthavee, N. (2018). *The origins of happiness: The science of wellbeing over the life course.* Princeton, NJ: Princeton University Press.

Machin, S., & McNally, S. (2008). The literacy hour. *Journal of Public Economics, 92*, 1441-1462.

Miller, H., Pope, T., & Smith, K. (2019). *Intertemporal income shifting and the taxation of owner-managed businesses.* IFS Working Paper W19/25.

Mincer, J. (1958). Investment in Human Capital and Personal Income Distribution. *Journal of Political Economy, 66*(4), 281-302.

ONS. (2009). *LFS User Guide, Volume 11 - Longitudinal Datasets.*

Paull, G., & Xu, X. (2017). *Study of Early Education and Development (SEED): The potential value for money of early education.* Frontier Economics.

Rubin, D. (1987). *Multiple imputation for nonresponse in surveys.* Wiley.

Wyness, G., Macmillan, L., & Anders, J. (2021). *Does education raise people's productivity or does it just signal their existing ability?* UCL Centre for Education Policy & Equalising Opportunity, Briefing Note.

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