Report

Assessing the impact of pay and financial incentives in improving shortage subject teacher supply

National Foundation for Educational Research (NFER)

Assessing the impact of pay and financial incentives in improving shortage subject teacher supply

Jack Worth, Sarah Tang and Maria A. Galvis

Published in June 2022

By the National Foundation for Educational Research,

The Mere, Upton Park, Slough, Berkshire SL1 2DQ

www.nfer.ac.uk

How to cite this publication:
Worth, J., Tang, S. and Galvis, M. (2022). *Assessing the impact of pay and financial incentives in improving shortage subject teacher supply*. Slough: NFER.

Contents

Executive Summary

England has been facing a significant teacher supply challenge, marked particularly by undersupply of the maths, physics and chemistry teachers required to deliver a high-quality science, technology, engineering and maths (STEM) education across the country. There has been chronic under-recruitment and higher-than-average leaving rates for maths and science, primarily due to STEM graduates having relatively attractive career options outside of teaching, compared to teachers of other subjects (MAC, 2017; Worth and Van den Brande, 2019).

Teacher pay in England is not differentiated by subject, so differences in the financial attractiveness of outside options matters greatly for the health of supply in these subjects. Subject-specific bursaries, with the highest levels for maths and science subjects, have provided some level of remedy, but in recent years this has not been enough to ensure sufficient teacher supply. The piloting of early career payments[1] for maths and physics teachers has also shown promising evidence of being effective at increasing teacher retention (Sims and Benhenda, 2022).

Covid-19 provided a short-term boost to recruitment and retention, due to relatively low levels of hiring and job security in the wider labour market. In contrast, as teachers continued to be recruited during the pandemic and with the profession being seen as a safe career option, applications to teacher training rose and retention rates were higher (Worth and Faulkner-Ellis, 2021). For example, in the 2020/21 academic year, the number of initial teacher training (ITT) enrolments as a percentage of the respective target was 85 per cent for maths, 80 per cent for chemistry and 45 per cent for physics, which all represented increases on the previous year. Overall STEM teacher recruitment to ITT was 94 per cent in 2020/21, compared to 77 per cent in the previous year.

However, since Covid-19 restrictions were lifted during the spring and summer of 2021, the wider labour market has recovered rapidly, eroding the relative attraction of teaching as a career option and therefore making recruitment and retention more challenging again (Worth and Faulkner-Ellis, 2022).

In this context, supported by the Gatsby Foundation, we conduct new quantitative research to explore two research questions that are key for informing an appropriate policy response to the challenge of ensuring sufficient teacher supply in the current economic environment:

1. What is the relationship between the level of recruitment to ITT by subject and: (a) the subject-specific financial attractiveness of entering teaching compared to alternative careers; and (b) the state of the wider labour market?
2. Within the expected economic context over the next four years, what are the implications of different teacher pay and financial incentive packages for the supply of STEM teachers?

In our first research phase, we estimate a statistical model of the relationship between teacher recruitment in different subjects, teacher pay relative to the pay in subject-specific alternative

---

[1] Early career payments are payments made to teachers of eligible shortage subjects teaching in state-sector schools in the first five years of their teaching career. For more information see: https://www.gov.uk/guidance/early-career-payments-guidance-for-teachers-and-schools

graduate careers, subject-specific training incentives and the state of the wider labour market. Using econometric analysis of 20 years of subject-level data from seven distinct sources, we estimate how responsive the level of ITT recruitment in England is to economic and financial factors.

The key findings from the analysis are that:

- **The relative attractiveness of teacher pay matters for teacher recruitment**. The level of the teacher starting salary relative to the value of graduates' outside options in a certain subject is associated with the number of ITT applicants to that subject. We estimate that, all else equal, a one per cent increase in the teaching starting salary – over and above the change in the outside-teaching graduate starting salary – is associated with a two per cent increase in applicants to ITT.
- **The strength of the wider labour market also matters for teacher recruitment**. We estimate that, all else equal, an increase of one percentage point in the UK unemployment rate (i.e. a weaker wider labour market) is associated with a 6 per cent increase in applicants to ITT. This is not estimated using data during the Covid-19 pandemic because, due to the furlough scheme, the unemployment rate acted as a poor proxy for the state of the labour market during that period.
- **There is strong and consistent evidence that training bursaries are associated with increases in ITT recruitment**. The bursary elasticity of recruitment has been the focus of a number of previous studies, and consistently estimated to be a 2.9 per cent increase in ITT applications associated with each additional £1,000 of bursary (NAO, 2016; Worth and Hollis, 2021). We provide new estimates that are consistent with these previous estimates.
- **There is little compelling evidence that early career payments/ phased bursaries are associated with increased recruitment**. Our estimate of the association between early career payments and ITT recruitment is statistically insignificant, suggesting that graduates may be far less responsive to early career payments, compared to bursaries. This may in part be due to their design to incentivise retention rather than recruitment, *per se*. However, we also have limited sample size – particularly for early career payments – and therefore higher levels of uncertainty, to estimate this elasticity.

In our second research phase, we use these key insights on how responsive ITT recruitment is to various economic and financial factors, and insights from other research in this area, to forecast future teacher supply. We develop a scenario-testing model that integrates teacher recruitment and retention. We use the model to produce forecasts and assess the likely implications for teacher supply of a range of different financial policy options for attracting and retaining teachers.

The forecasting model combines a range of input data and elasticities (i.e. how responsive teacher recruitment and retention behaviour is to changes in economic and financial factors) to estimate outputs of interest. The input data includes, for example, the past number of ITT enrolments, the number of teachers and pay structure of the existing teacher workforce in England, existing rates of teacher retention and the value of subject-specific bursaries. The inputs and elasticities are combined with policy variables, which allow different pay and financial incentive policy scenarios to be inputted, and assess their implications for teacher supply in future years.

The central output of the model is a set of forecasts of the number of enrolments to ITT in each subject in each year 2022-2025 and a set of forecasts of each subject's respective target of required entrants to meet future supply. We also model the total cost of the pay and financial incentive policy options under consideration in each scenario. The forecasts produced by the model are not highly accurate forecasts, as any forecast inherently involves a considerable degree of uncertainty. Therefore, the numbers presented in the findings should not be considered to be precise forecasts, but indicative forecasts of the overall trend for each subject. The model also focuses on the financial attractiveness of teaching and does not account for future changes in the non-financial attractiveness of teaching and its impact on recruitment and retention.

The key findings from the scenario-modelling analysis are that:

While the Department for Education's (DfE) pay proposals to the School Teachers' Review Body (STRB)[2] are likely to improve teacher supply in shortage subjects relative to a uniform pay award, overall they do not improve the relative competitiveness of teacher pay enough to support the achievement of targets in key STEM subjects.

The latest economic forecasts suggest that the wider labour market environment is even more challenging for teacher supply than previously thought, meaning the teacher supply implications of DfE's pay proposals are neutral at best. We estimate that, under DfE's proposals and the latest economic forecasts, the ITT recruitment target for mathematics is likely to be met over the next four years, but is unlikely to be met in physics, chemistry, computing and across all three science subjects combined.

Additional financial incentives could be implemented to improve teacher supply, especially those that are targeted at shortage subjects.

These policies could include increasing bursaries beyond their current £24,000 maximum and applying the 'levelling up premium' early career retention payment to teachers of shortage subjects across the whole of England. For some STEM subjects, combinations of additional financial measures could support the improvement of teacher supply. For example, a £30,000 bursary could increase to the recruitment of chemistry trainees enough to meet its target.

Separating the primary and secondary teacher pay scales could be effective at targeting resource where it can have greater gains in terms of overall teacher supply, in a way that is cost neutral within an existing spending envelope.

Such a policy could enable the government to set lower pay increases for primary teachers (where teacher recruitment tends to be consistently above the target and pupil numbers are falling) and higher increases for secondary teachers (where teacher recruitment across a number of subjects tends to be consistently below target and pupil numbers are rising). There are plenty of international precedents for this split in primary and secondary teacher pay. For example, starting

---

[2] DfE has proposed to increase teacher pay by an average of 3.9 per cent in 2022/23 and 2.6 per cent in 2023/24, but with higher awards to early career teachers (starting salary outside of London increasing by 8.9 per cent in 2022/23 and 7.1 per cent in 2023/24, in order to raise it to £30,000) and lower awards to more experienced teachers (three per cent in 2022/23 and two per cent in 2023/24 for teachers on the upper pay scale and leadership group). This results in flatter pay scale progression through the main pay scale. i.e. during teachers' first six years in the profession.

salaries for secondary teachers in Finland are 15 per cent higher than their primary counterparts, and secondary starting salaries are 6 per cent higher in Sweden.

Similar proposals have previously been made about varying pay for shortage subjects, given the mismatches between supply teacher and demand (Sibieta, 2018). Such a policy change could be complex to implement, introducing fairness issues about different pay scales for teachers of the same experience. However, the option of splitting primary and secondary pay scales potentially balances these concerns better than by subject, since it would not introduce multiple pay scales within the same schools.

Implementing such a policy could still be challenging, particularly in the short term since school funding allocations have already been published. The change could also have a negative impact on primary teacher morale, add complexity to the teacher pay structure and may have implications for teacher quality. However, these factors should be considered in the round alongside the potential net benefits for teacher supply.

Physics and computing are highly unlikely to meet their respective recruitment targets under any package of measures.

Combinations of additional financial measures could support the improvement of teacher supply in physics and computing, but no reasonable set of measures are compatible with the current target being met. In relation to physics, this finding should prompt debate about how the education system can realistically and sustainably staff science departments in schools with a range of specialists. This could include considering the range of ITT courses offered, additional subject specialism training in physics, for trainees and teachers in the classroom, ensuring physics teachers are deployed to teach physics rather than other subjects (for example, see Sims, 2019), targeting recruitment of graduates with engineering degrees into physics teaching, and addressing the relatively low numbers of students studying physics at A level and as an undergraduate degree.

We recommend that:

1. In light of new economic forecasts, which show that the wider labour market is stronger than was thought when the DfE pay proposals were developed, the STRB should consider recommending that teacher pay should increase by more than 3.9 per cent overall in 2022/23, to maintain teacher pay competitiveness and support teacher supply. This should be done in a way that is affordable for schools.
2. The DfE and STRB should explore the feasibility of implementing separate pay scales for primary and secondary teachers from 2024/25 onwards, and develop plans to use the flexibility to increase teacher supply**.**
3. The DfE should consider increasing bursaries in shortage subjects up to a maximum of £30,000 and expanding the 'levelling up premium' to apply to teachers working in schools across England, to further improve recruitment and early career teacher retention.
4. The DfE should publish the full Teacher Workforce Model, to improve stakeholder, researcher and public understanding of the postgraduate ITT target-setting process, methods and rationale.
5. As part of its future evidence to STRB, the DfE should publish full impact assessments of the overall teacher supply impact of its pay and financial incentive proposals. Where an impact assessment suggests supply is unlikely to be met, the DfE should set out the financial and non-financial actions being taken to improve teacher supply, particularly in subjects not expected to reach their respective targets.

This work was produced using statistical data from ONS. The use of the ONS statistical data in this work does not imply the endorsement of the ONS in relation to the interpretation or analysis of the statistical data. This work uses research datasets which may not exactly reproduce National Statistics aggregates.

1 Introduction

England has been facing a significant teacher supply challenge, marked particularly by undersupply of the maths, physics and chemistry teachers required to deliver a high-quality science, technology, engineering and maths (STEM) education across the country. There has been chronic under-recruitment and higher-than-average leaving rates for maths and science, primarily due to STEM graduates having relatively attractive career options outside of teaching, compared to teachers of other subjects (MAC, 2017; Worth and Van den Brande, 2019).

Teacher pay in England is not differentiated by subject, so differences in the financial attractiveness of outside options matters greatly for the health of supply in these subjects. Subject-specific bursaries, with the highest levels for maths and science subjects, have provided some level of remedy, but in recent years this has not been enough to ensure sufficient teacher supply. The piloting of early career payments[3] for maths and physics teachers has shown promising evidence of being effective at increasing teacher retention in specific targeted STEM subjects (Sims and Benhenda, 2022).

Covid-19 provided a short-term boost to recruitment and retention, due to relatively low levels of hiring and job security in the wider labour market. In contrast, as teachers continued to be recruited during the pandemic and with the profession being seen as a safe career option, applications to teacher training rose and retention rates were higher (Worth and Faulkner-Ellis, 2021). For example, in the 2020/21 academic year, the number of initial teacher training (ITT) enrolments as a percentage of the respective target was 85 per cent for maths, 80 per cent for chemistry and 45 per cent for physics, which all represented increases on the previous year. Overall STEM teacher recruitment to ITT was 94 per cent in 2020/21, compared to 77 per cent in the previous year.

However, since Covid-19 restrictions were lifted during the spring and summer of 2021, the wider labour market has recovered rapidly, eroding the relative attraction of teaching as a career option and therefore making recruitment and retention more challenging again (Worth and Faulkner-Ellis, 2022).

In this context, supported by the Gatsby Foundation, we conduct new quantitative research to explore two research questions that are key for informing an appropriate policy response to the challenge of ensuring sufficient teacher supply in the current economic environment:

1. What is the relationship between the level of recruitment to ITT by subject and: (a) the subject-specific financial attractiveness of entering teaching compared to alternative careers; and (b) the state of the wider labour market?
2. Within the expected economic context over the next four years, what are the implications of different teacher pay and financial incentive packages for the supply of STEM teachers?

To address the first research question, we estimate a statistical model of the relationship between teacher recruitment in different subjects, teacher pay relative to the pay in subject-specific

---

[3] Early career payments are payments made to teachers of eligible shortage subjects teaching in state-sector schools in the first five years of their teaching career. For more information see: https://www.gov.uk/guidance/early-career-payments-guidance-for-teachers-and-schools

alternative graduate careers, subject-specific training incentives and the state of the wider labour market. We use 20 years of data from seven distinct sources, and use econometric analysis to estimate the how responsive the level of recruitment to initial teacher training in England is to these economic and financial factors.

To address the second research question, we use these key insights on how responsive ITT recruitment is to various economic and financial factors, and insights from other research in this area, to forecast future teacher supply. We develop a scenario-testing model that integrates both teacher recruitment and retention. We use the model to produce forecasts and assess the likely implications for teacher supply of a range of different financial policy options for attracting and retaining teachers.

The forecasting model combines a range of input data and elasticities (i.e. how responsive teacher recruitment and retention behaviour is to changes in economic and financial factors) to estimate outputs of interest. The input data includes, for example, the past number of ITT enrolments, the number of teachers and pay structure of the existing teacher workforce in England, existing rates of teacher retention and the value of subject-specific bursaries. The inputs and elasticities are combined with policy variables, which allow different pay and financial incentive policy scenarios to be inputted, and assess their implications for teacher supply in future years.

The central output of the model is a set of forecasts of the number of enrolments to ITT in each subject in each year 2022-2025 and a set of forecasts of each subject’s respective target of required entrants to meet future supply. We also model the total cost of the pay and financial incentive policy options under consideration in each scenario. The forecasts produced by the model are not highly accurate forecasts, as any forecast inherently involves a considerable degree of uncertainty. Therefore, the numbers presented in the findings should not be considered to be precise forecasts, but indicative forecasts of the overall trend for each subject.

Section 2 describes the data sources, methodology and presents the findings from the econometric analysis. Section 3 describes the model inputs and methodology, and presents the findings from the scenario modelling analysis. Section 4 draws conclusions from both pieces of analysis, explains the policy implications and makes a series of policy recommendations.

2 Estimating elasticities of teacher recruitment to a range of economic factors

This section presents the data and findings from our econometric analysis of the economic and financial factors associated with higher or lower levels of recruitment to initial teacher training in England.

2.1 Data and methods

2.1.1 Key variables and data sources

Our analysis draws on data from seven distinct sources. We construct a dataset relating to each ITT subject for each year, where data is available, between the years 2000 and 2020. This section sets out details about the key variables used in the analysis and their corresponding data sources. It also explains the strengths and weaknesses of the underlying data sources, and explains how these influence how we develop the econometric analysis approaches.

2.1.1.1 Postgraduate ITT applications

The main outcome variable in our econometric analysis is the number of applicants to postgraduate ITT courses in each secondary curriculum subject and in primary. We use summary data from the Graduate Teacher Training Registry (GTTR) on the number of applications from the 1999/2000 to 2012/13 ITT application cycles.

The dataset includes applications to institutions in England, Scotland and Wales. Using data on the number of applications by provider in 2011/12[4],= and identifying which providers are based in the three countries, we apply a proportional reduction factor to the total number applications by subject to estimate the number of applicants to England-based providers only.

We use application-level data from the Universities and Colleges Admissions Service (UCAS) to calculate the number of postgraduate ITT applications from 2014 to 2021, corresponding to the 2013/14 to 2020/21 application cycles. The UCAS microdata is structured in terms of *applications* rather than applicants, so we cleaned the data to attribute each individual to one curriculum subject using a series of decision rules. First, where an applicant was accepted, we attribute them to the main subject on their accepted application. Where applicants were not accepted, we identify the most common subject among the courses they applied for.[5] Finally, for a very small number of applicants where there was no clear main subject, we chose one subject at random.[6]

The resulting dataset is the number of applicants for each ITT subject from 2000 to 2021. Table 1 displays the 18 curriculum subjects we gathered data on.

---

[4] We use the 2011/12 for all years as the country breakdown was not consistently published during this period.

[5] No information was available in the data about undergraduate degree subject, which could have provided more detail on applicants' subject speciality and preference.

[6] We also considered dropping these cases from our analysis, but decided against it as the number of applicants is a key variable and dropping data could have introduced more bias than random assignment.

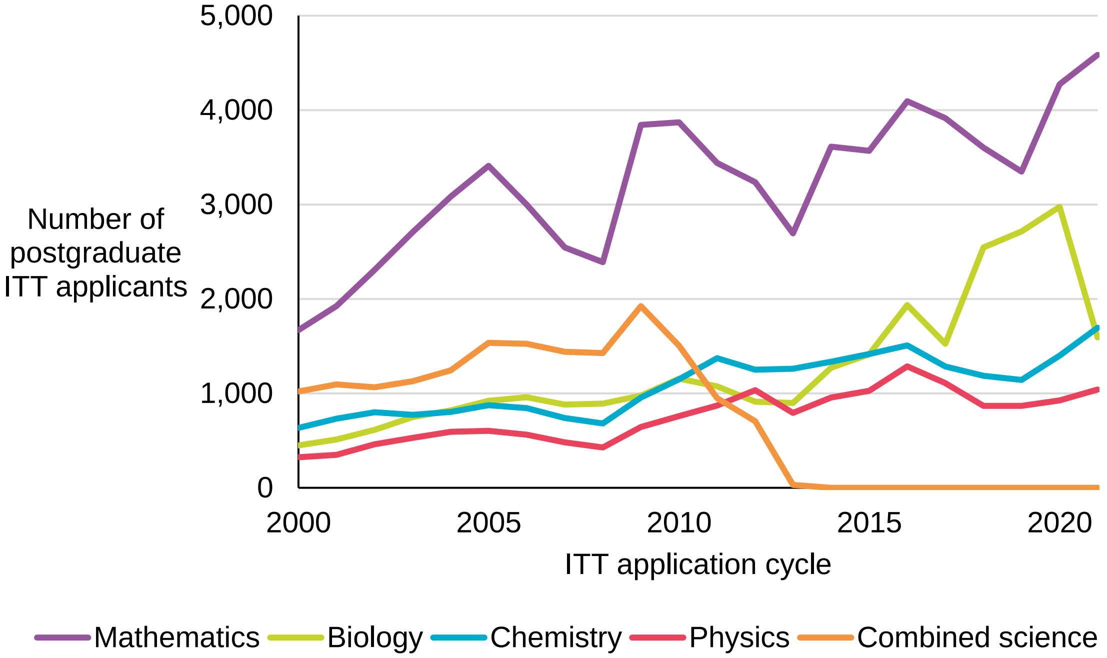
Table 1 ITT curriculum subjects included in the analysis

Art and design	Design and technology	Mathematics
Biology	Drama	Music
Business and economics	English	Physical Education
Chemistry	Geography	Physics
Combined science	History	Primary
Computing (includes ICT)	Modern languages	Religion

Figure 1 shows the trend in applications for mathematics, biology, chemistry, physics and combined science over the period 2000 to 2021. The general trend across all subjects has been upwards, due to growing pupil numbers in secondary schools requiring more new teachers during the period. The trends for each subject also show considerable volatility: for example, the number of mathematics applicants falling in the mid-2000s before recovering during the 2008 recession, falling and rising again, culminating in a large rise during the 2020 pandemic and recession.

The data also shows the changing composition of science subjects during the period. The most significant change was the shift from combined science forming a distinct curriculum subject to just the three sciences.

Figure 1 The numbers of applicants to postgraduate ITT have generally risen over time due to a rising need for teachers



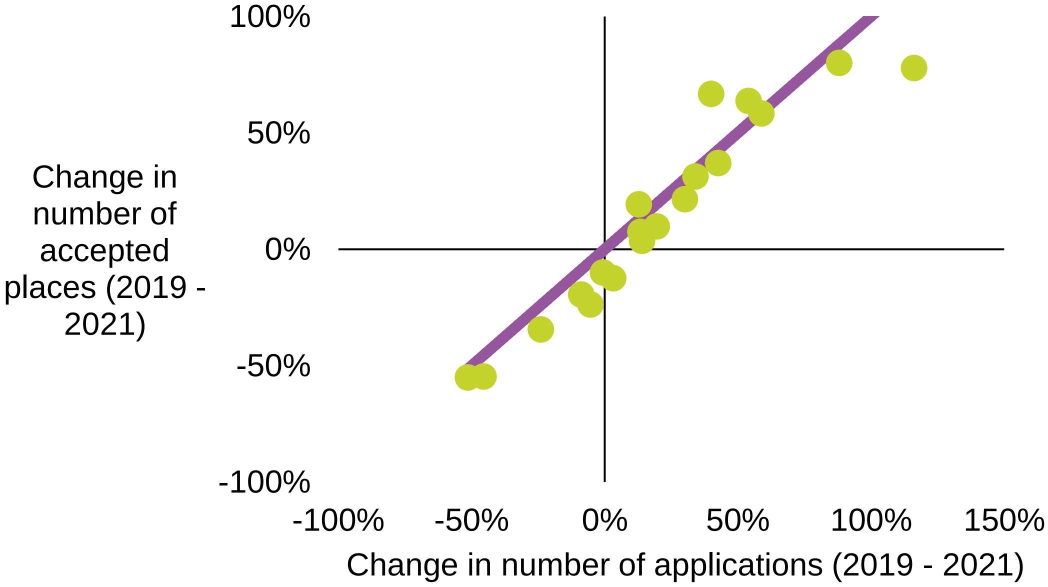
Source: NFER analysis of GTTR and UCAS postgraduate ITT applications data.

We use the number of applicants to courses instead of the number of people enrolled on courses in our analysis because we want to measure *latent demand* for entry into a subject (i.e. the underlying level of interest in entering teaching). Historically the number of enrolments has been capped by the number of places made available by the Department for Education. Focussing on enrolments risks reducing some of the useful variation in the data, particularly for subjects that typically reached their place caps more easily, such as history and PE.

The presence of place caps could still have led to fewer applications, for example if courses closed to applicants once the cap was reached. However, we nonetheless believe the measure is a better measure of latent 'interest in teaching' than enrolments would be. In addition, caps are not an important part of the current policy environment, since they were removed for most subjects from the 2018/19 cycle onwards to maximise the number of applications.

Data from the 2019-2021 recruitment cycles suggests that in this context, the number of applications to postgraduate ITT translates very closely into the number of subsequent enrolments (see Figure 2 below). Figure 2 shows the change in the number of ITT applications between the 2019 and 2021 application cycles (vertical axis) and the change in the number of ITT enrolments between 2019/20 and 2021/22. Each point is a subject and the purple line indicates the equality line, where one perfectly predicts the other. That the points are clustered around the equality line provides confidence that our estimates of the recruitment elasticities are equally applicable to predictions about application behaviour as they are to subsequent enrolments.

Figure 2 The change in the number of applications to ITT courses in the period 2019-2021, is highly correlated with the corresponding change in the number of subsequent enrolments



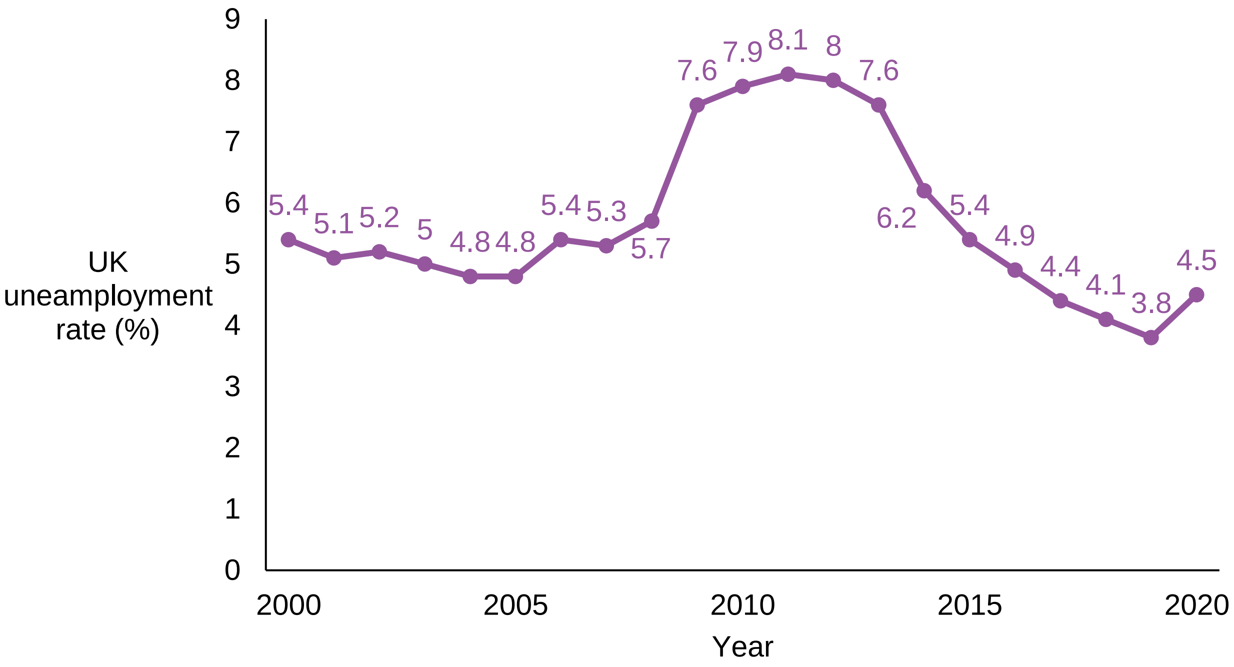
Source: NFER analysis of UCAS data.

2.1.1.2 Unemployment rate

We use the UK unemployment rate (age 16 and over, seasonally adjusted) from the Office for National Statistics (ONS) as a proxy measure of the strength of the wider labour market and the security of employment opportunities outside of teaching. The graduate unemployment rate in England would arguably be a better proxy for the strength of the external labour market specifically for teachers. However, we use the overall UK unemployment instead because OBR produces a forecast of it, which we can use in our scenario modelling research (see section 3.1.1). Further, the graduate unemployment rate is highly correlated with the overall unemployment rate, suggesting that the findings would be similar in any case.

Figure 3 shows the trend of the UK unemployment rate in the period 2000-2020. The level of unemployment in the UK economy was relatively low and stable in the 2000s, until 2009 when it increase by 2 percentage points during the 2008 recession. It remained high for the following years and started receding in 2014, dropping below the levels seen in the 2000s by 2017. After a further downward trend to a low of 3.8 per cent, the unemployment rate increased in 2020 due to the effects of the Covid-19 pandemic. However, the figure for 2020 understates the true weakness of the labour market, due to the furlough scheme introduced by the UK Government. Therefore, we exclude the 2020 unemployment rate data point from our analysis.

Figure 3 The UK unemployment rate rose considerably during the 2008 recession

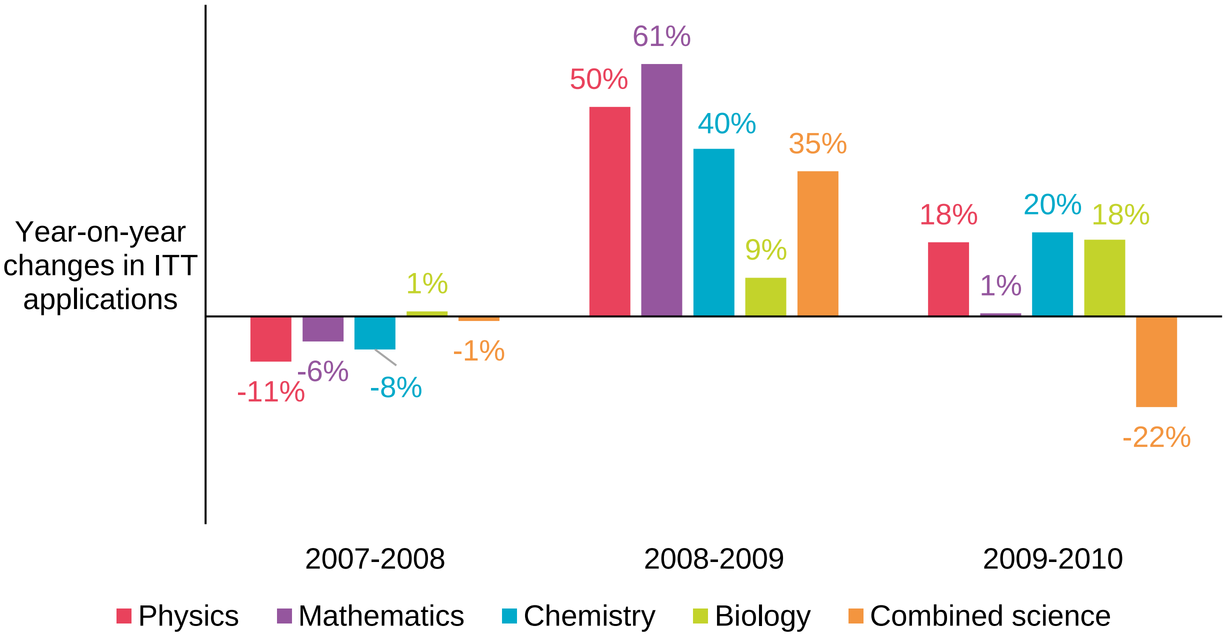


Source: Office for National Statistics.

Figure 4 shows the year-on-year changes in applicant numbers to the five STEM subjects around the time of the 2008 recession to illustrate the impact of labour market uncertainty on applicant behaviour, which we estimate formally – independently taking account of other factors that were also changing at the time – through the econometric modelling. Between 2007 and 2008, when the unemployment rate rose by 0.4 percentage points, applicant numbers did not change very much.

Between 2008 and 2009, when the unemployment rate increased suddenly, from 5.7 per cent to 7.6 per cent, ITT applicant numbers also increased. The number of applicants for chemistry, physics and mathematics ITT increased by more than 40 per cent at the beginning of the recession. The increase in applicant numbers in each subject between 2009 and 2010 were more modest, in line with the modest change in the unemployment rate over the same time period.

Figure 4 The number of applicants for chemistry, physics and mathematics ITT increased by more than 40 per cent at the beginning of the 2008 recession



Source: NFER analysis of GTTR ITT applications data.

2.1.1.3 Teacher and subject-specific ‘outside’ pay

We use data on teacher starting salaries from the School Teachers' Pay and Conditions Documents (STPCDs) published each year by the DfE. The teacher starting salary for this analysis relates to local authority maintained schools in England in the rest of England (i.e. excluding the uplifts applicable to Inner and Outer London and the London Fringe area). While academies have freedom to deviate from this minimum, in practice most maintained alignment to the national scales (Sharp *et al.*, 2017).

The teaching starting salary has been the same for each subject throughout the period 2000-2021. However, the ‘outside option’ (i.e. what a graduate might expect to earn outside of teaching) differed considerably between subjects, and also over time. To measure the ‘outside option’ for teachers in each ITT subject, we use data from the Destinations of Leavers of Higher Education

(DLHE) survey to estimate the average starting salary of graduates. We link each degree subject to one or more of the ITT subjects by using the DLHE information coded with the Joint Academic Coding System (JACS) that is used by higher education institutions. We mapped each JACS subject code to the ITT curriculum subjects of teacher training using DfE's School Workforce Census (SWC) qualification subject mapping.

We map each JACS code to up to two ITT subjects e.g. someone with a degree in molecular biology is linked to both biology and chemistry. We exclude medicine, nursing, engineering, veterinary and dentistry (which are nominally linked to subjects including biology, chemistry, physics and design & technology) because graduates from these degrees are likely to have separate vocational tracks and are therefore much less likely to consider teaching as a career option.

Although we have ITT applications data for the period 2000-2021, the DLHE data is available only from 2003 to 2016[7], which limits our analysis that uses the graduate pay data to that period.

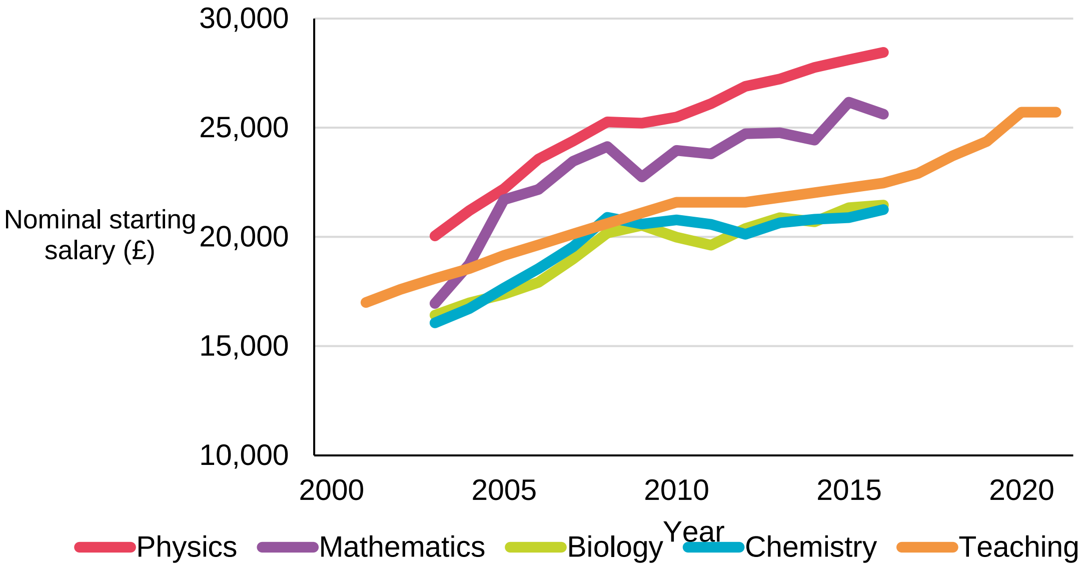
The salary data in the DLHE survey corresponds to what graduates reported as their income in the year after graduating, coded in twenty salary bands in ranges of £5,000, from "under £10,000" to "£100,000 or more". We exclude graduates who are employed as teachers and use the mid-point of each salary band to estimate the average salary across all graduates by ITT subject. The DLHE data includes graduates from providers in all UK countries so we used the Higher Education Statistics Agency (HESA) provider metadata to map the institutions to each country and analyse only graduates from providers in England.

Figure 5 shows the average starting salary for graduates from biology, chemistry, physics and mathematics degrees, who were in full-time, non-teaching jobs from 2003 to 2016. For comparison, the orange line shows the teaching starting salary during the period 2000-2021.

---

[7] The survey was replaced in 2018 by the Graduate Outcomes survey.

Figure 5 Starting salaries for graduates in physics and mathematics were considerably higher than in teaching throughout the period 2003-2016



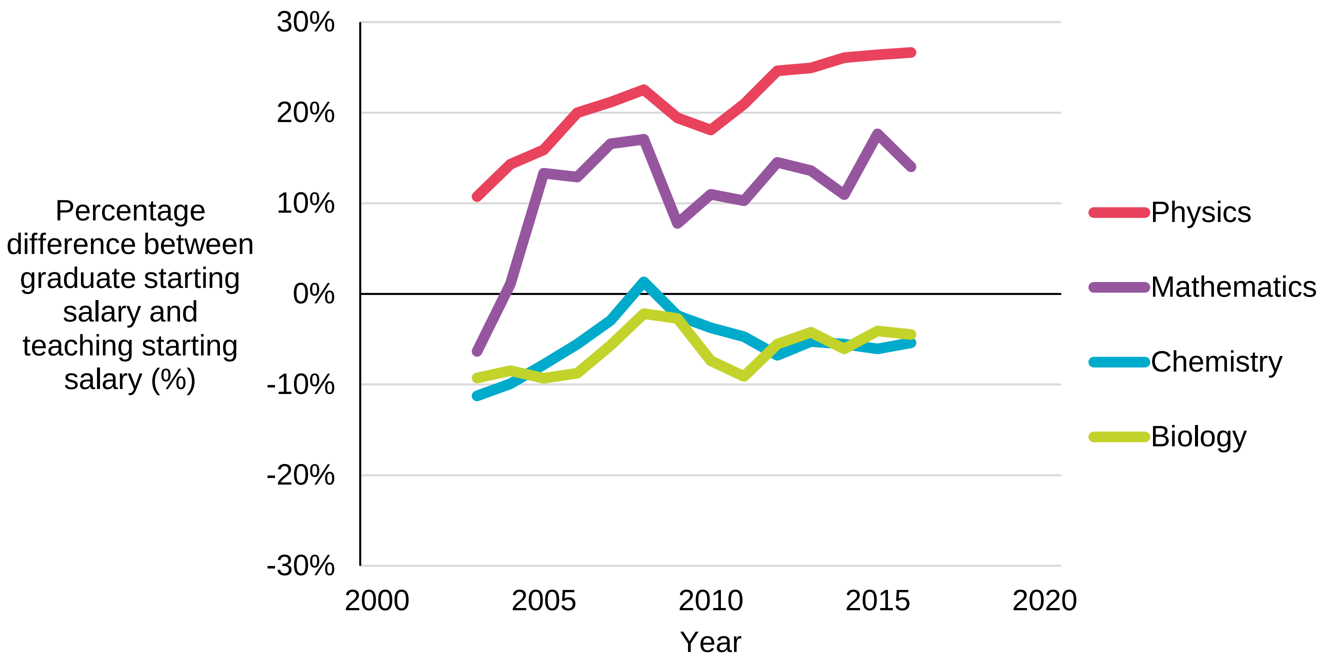
Source: NFER analysis of DLHE (subjects) and STPCD data (teaching).

The data shows that the average starting salaries for physics and mathematics graduates were considerably higher than the teaching starting salary throughout the period. In contrast, the average starting salaries for chemistry and biology graduates were slightly lower than the teaching starting salary throughout the period.

The average starting salary for all four subjects rose more rapidly than the teaching starting salary between 2003 and 2016: mathematics by 51 per cent, physics by 42 per cent, chemistry by 32 per cent and biology by 31 per cent, compared to the teaching starting salary rising by 24 per cent over the same period. This implies that the competitiveness of teacher pay for graduates in these subjects fell during this time period.

Figure 6 shows the percentage difference between the starting salary that graduates of physics, mathematics, chemistry and biology were earning compared to teaching. Values above the zero line indicate that the salary for the subject is higher than the teaching salary, while values below the zero line correspond to subjects for which the teaching starting salary was higher. In 2016, the average starting salary for a physics graduate in a full-time job was 27 per cent higher than in teaching, while the average starting salary for chemistry graduates was five per cent less than the starting salary for teaching.

Figure 6 The average starting salary for physics graduates outside of teaching was 27 per cent higher than the salary in teaching in 2016



Source: NFER analysis of DLHE and STPCD data.

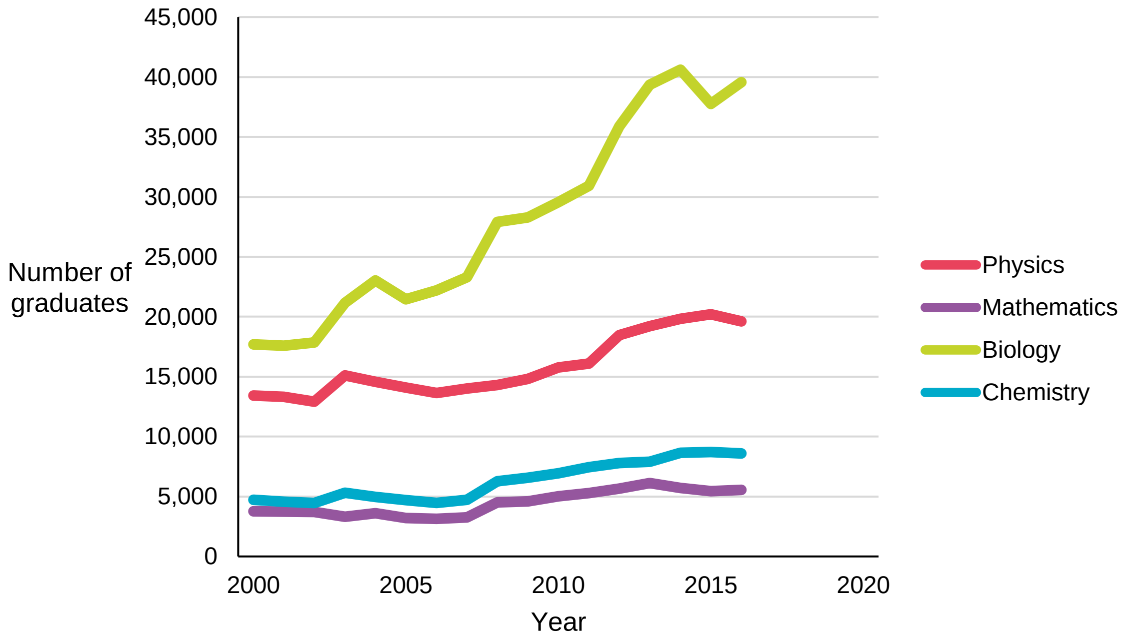
2.1.1.4 Pool of available graduates

We also use DLHE survey data to estimate the number of graduates holding relevant degrees in each ITT subject, as a proxy for the size of the available pool of potential trainees. Unlike the starting salary data, we can estimate the number of graduates from 2000 onwards, although we are again limited to 2016 as the last year of available data.

For combined science, we estimate the number of graduates and the average outside-teaching salary as the average across graduates of all science subjects. Similarly for primary, we estimate the number of graduates and average outside-teaching salaries as the averages across all subjects, since there is no set of particular undergraduate degree subjects that are direct preconditions for entering primary postgraduate teacher training.

Figure 7 shows the trends in the number of graduates from HE providers in England from bachelor degrees in mathematics, physics, chemistry and biology during the period 2000 to 2016. As mentioned above, we exclude medicine, nursing, engineering, veterinary and dentistry (nominally linked to subjects including biology, chemistry, physics and design & technology) because graduates from these degrees are likely to have separate vocational tracks and less likely to consider teaching as a career option. Biology has historically had more graduates than the other three subjects and also had the largest increase during the period from 2000 to 2016, with the number of graduates more than doubling in 16 years. Physics and mathematics had a smaller number of graduates throughout the period and an increase of less than 50 per cent over the same period.

Figure 7 There were six times more graduates of subjects associated with biology than associated with mathematics in 2016



Source: NFER analysis of DLHE data.

2.1.1.5 Bursaries and other financial incentives

In addition to the teaching starting salary, we use data on subject-specific bursaries and other financial incentives to measure the subject-specific financial attractiveness of teaching. Specifically, we gather data on the tuition grants, early career payments and Golden Hellos that were available to teacher trainees of each subject in each year from 2000 to 2021. This data was gathered from the DfE website and the web archive of the Training and Development Agency for Schools (TDA).

Table 2 gives further information about each type of financial incentive.

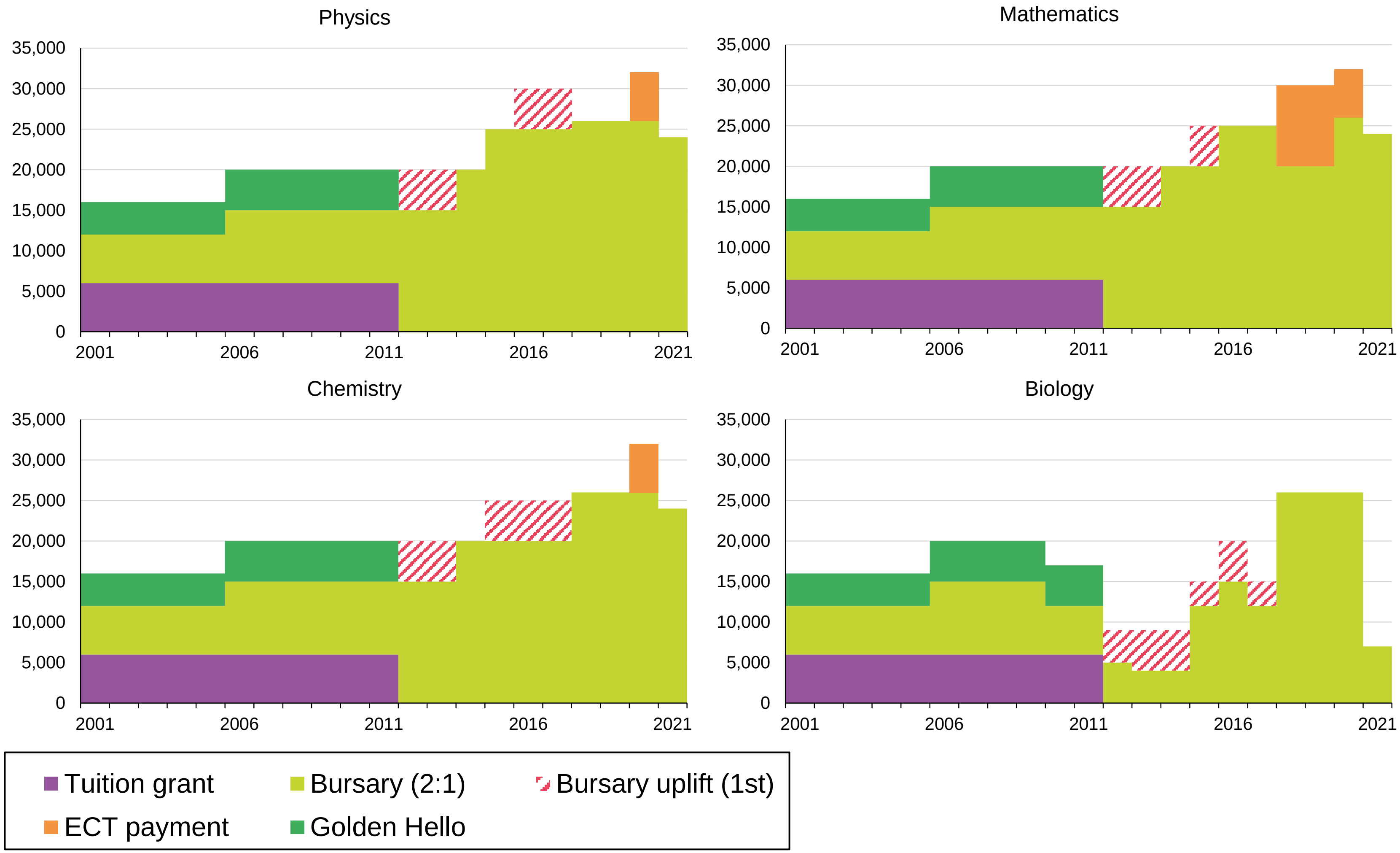
Table 2 Financial incentives included in the analysis

Incentive	Description
Bursaries	Students with a first, 2:1, 2:2 degree or a PhD or master's are eligible to tax-free bursaries to train to teach in certain subjects. Since the value of the bursaries varied by degree class from 2012 to 2018, for those years we focused on the bursary associated with a 2:1 degree. We included the bursary differential between a first degree and a 2:1 degree as an additional variable, as part of the sensitivity analysis.
Tuition grants	Tuition grants of around £6,000 were paid directly to ITT providers up to 2011, and replaced with higher tuition fees from 2012 onwards.
Golden Hello	The Golden Hello was a payment between £2,500 and £5,000, available to teachers who successfully completed a postgraduate ITT course in one of the priority subjects and successfully completed their induction year. Cohorts from 2001 to 2011 were eligible.
Early Career Payments	The early career payment (or phased bursary) scheme was introduced in the 2018 application cycle for maths trainees, and extended to physics, chemistry and modern foreign languages in the 2020 cycle. The payments aimed to encourage teachers to stay in the profession after qualifying. In the 2020 application cohort, graduates enrolling in ITT for one of the four subjects could receive payments in £2,000 instalments in their second, third, and fourth year of teaching in the state-funded sector.

Figure 8 shows the financial incentives offered by the government from 2001 to 2021 associated with training to teach in physics, mathematics, biology and chemistry. These incentives vary by subject and by year, with some large year-to-year changes. For example, the bursary for biology ITT increased from £12,000 in the 2016/17 application cycle to £26,000 in the 2017/18 cycle. The red shaded area corresponds to the bursary uplift associated with the applicant having a first class degree, as opposed to a 2:1 degree.

The data shows that the total value of financial incentives for these four subjects rose in the last decade, after the financial crisis (when bursaries were scaled back due to large numbers of applications) and as the teacher supply challenges intensified. The removal of tuition grants (which effectively lowered the tuition fee students faced) in 2011 was replaced with a like-for-like increase in bursary for mathematics, physics and chemistry. However, the same was not true for biology, where the bursary was reduced from £6,000 to £5,000 at the same time as the tuition grant was discontinued.

Figure 8 The total value of financial recruitment incentives available for STEM subjects rose over the last decade



2.1.2 Econometric method

We combine the data described above into a statistical model to measure how responsive teacher recruitment is to changes in teacher pay (relative to the pay in alternative graduate careers for each subject), training incentives, and the state of the wider labour market.

We model the graduate occupational choice, which includes information that may influence graduates' decisions about whether or not to pursue a teaching career. Our econometric regression model measures the elasticities (i.e. responsiveness) of teacher recruitment to changes in a set of explanatory variables.

The outcome variable is the number of applicants to postgraduate ITT in each subject in a particular year. We include the natural logarithm of the number of applicants as the dependent variable in the regression model, which is a common transformation that means each elasticity is measured in terms of the percentage increase in ITT applicants as a result of a particular change.

The explanatory variables are:

- Financial attractiveness of the teaching salary relative to the (subject-specific) outside option. This is defined as the difference between the teaching starting salary and the average starting salary of graduates from each ITT subject (as explained above). We include this variable in the regression model as the difference in natural logarithms of the two variables, which means the estimated elasticity is measured in terms of the percentage change in teacher salary, over and above the change in outside starting salary.
- The subject-specific financial incentives offered by the government to take postgraduate teacher training. We separately include, each in nominal value terms: bursaries, Golden Hellos, early career payments and tuition grants.
- The UK unemployment rate, as a proxy measure of the strength and security of the wider labour market and employment opportunities outside teaching.
- The size of the graduate pool in each subject since an important determinant of the numbers recruited into teaching for each subject is the number of graduates holding relevant degrees in those subjects. We include this variable in the regression model in natural logarithms, which means the estimated elasticity is measured in terms of the percentage change in the size of the graduate pool.

We estimate these models using econometric methods for analysing panel data (i.e. data on subjects over time), to account for subject-specific and year-specific variation in the data. These add to the robustness of the analysis by controlling for unobserved variation by subject and over time. The structure of the data allowed us to include:

- **Subject fixed effects** (FEs) in all models to account for subject-related factors that are fixed over time, for example long-standing preferences for entering ITT in some subjects over others.
- **Year fixed effects** to account for all factors (both observed and unobserved) that vary over time and that affect all subjects equally, such as changes in policy and macroeconomic fluctuations. Since the unemployment rate is a macroeconomic factor that only varies across years but is constant across subjects, we do not include year FEs when estimating the unemployment elasticity of ITT recruitment. Likewise, because teacher pay varies only by year

and not by subject, we are careful in interpreting estimates of the pay elasticity from regression models that include year FEs.

We include subject weights in the statistical model to give greater statistical importance to subjects that have more applicants.

Depending on the nature of each explanatory variable, we use different econometric modelling approaches to estimate the elasticities.

- We estimate the model in **levels** by including the natural logarithm of the *number* of applicants as the outcome variable. This modelling approach is particularly useful for analysing elasticities where we expect the impact of the explanatory variable to be most noticeable over the longer term, i.e. variables that do not change drastically from year to year, or where year-to-year change is likely to contain a large amount of statistical 'noise'.
- We estimate the model in **first differences** by including the *change* in the natural logarithm of the number of applicants between one year and the next as the outcome variable. These estimates give us the association between year-to-year changes in the explanatory variable and the year-to-year change in ITT applications. This modelling approach is particularly useful for analysing elasticities where we expect the impact of the explanatory variable to be most noticeable in the short term.

2.1.3 Caveats and limitations

There are a number of important caveats with the data that affect the robustness and interpretation of the various elasticity estimates.

Due to the availability of DLHE data to measure graduate non-teaching pay, many of the models we estimate are limited to the period 2003 to 2016. This reduces the sample size available for the analysis. However, the period includes a significant economic recession (in 2008), several large changes to bursaries and other financial incentives and periods of both fast and slow growth in teacher pay. The period therefore still contains a significant amount of variation in the key variables with which to estimate the elasticities of interest. Since the data on graduate salary comes from a survey, it contains sampling error, which introduces statistical 'noise'.

However, the 2003 to 2016 period precedes the introduction of the early career payment regime. We therefore estimate specific models for exploring the association between these payments and numbers of ITT applicants. Further, we have a small sample size of data on early career payments because the scheme was only operational for three years (2018 to 2020) and affected a small number of subjects.

The models estimate elasticities that are based on linear associations between each variable and the outcome variable. This means that, for example, an additional £1,000 of bursary increase is interpreted to be associated with a percentage increase in ITT applications, independent of what value the existing bursary is (i.e. whether from £0 to £1,000 or from £24,000 to £25,000). Simplifying the relationship in some way is necessary for estimating a statistical model and linear associations are very commonly used. There was too little variation in the data to explore further variation in the elasticities, and alternative ways of expressing the relationship would also involve making strong assumptions.

We also assume that applications to a subject are only influenced by factors relating to that subject, and are unrelated to factors associated with factors affecting other subjects. For example, we do not model the relationship between applications to physics and chemistry and the value of the biology bursary. There may be some small relationship, driven by applicants with, for example, biochemistry degrees, being willing to switch between biology and chemistry and the likelihood depending on the relative bursaries. There was too little variation in the data to explore this possibility, but it remains a relationship that could potentially have some influence. Nonetheless, we believe any such second-order effects would have only small influences.

Finally, we include unemployment rate data from 2000 until 2019 because the UK unemployment rate measure for 2020 underestimates the true effect of the 2020 recession in the labour market, due to the Government’s furlough scheme.

2.2 Findings

2.2.1 Main estimates

Table 3 shows the estimated elasticities from our six main econometric models. Each model is set up differently to estimate different elasticities, according to the nature of the data and the expected type of effect.

In all models, the outcome variable is ITT applications measured in natural logarithms, which allows the regression coefficient to be interpreted in percentage terms, i.e. the percentage change in ITT applications associated with a change in each explanatory factor.

We interpret the coefficients of each estimated coefficients in turn, and assess and justify which model we believe provides the most robust elasticity in each case.

Teacher pay elasticity of recruitment

We estimate four models that include estimates of the pay elasticity of recruitment, but have reasons why we think some estimates are more robust than others for estimating this specific elasticity.

First, the year-to-year variation in this variable contains some statistical noise, which comes from the sampling error in the survey data we use to calculate the average graduate starting salary by subject. We therefore put more weight on the estimates in levels (models 1 and 2) than the estimates in first differences (models 4 and 5) because they are likely to be more robust. Second, the relative competitiveness of teacher pay does not change drastically from year to year, so potential teachers’ perception of what the teaching salary is when they apply may be informed by longer-term assessments of competitiveness. Finally, teacher starting salary does not vary by subject, so including year FEs (as in models 2 and 5) reduces the useful remaining variation in this variable for estimating the elasticity.

It is for these reasons that we believe model 1 provides the most robust estimate of the pay elasticity of recruitment.

Our preferred estimate from model 1 suggests that a one per cent increase in the teaching starting salary (over and above the change in the outside-teaching graduate starting salary) is associated with a 2 per cent increase in applicants to ITT

Graduate pool elasticity of recruitment

We also estimate four models that include estimates of the size of the graduate pool elasticity of recruitment. For similar reasons to the above for the pay elasticity, we believe that model 1 provides the most robust estimate of this elasticity.

Model 1 suggests that a 10 per cent increase in the number of graduates in a subject is associated with a 6.5 per cent increase in applications to ITT.

Unemployment elasticity of recruitment

The unemployment rate elasticity of recruitment is challenging to estimate robustly as it cannot be estimated alongside year FEs. This is because it only varies over time and not by subject. Therefore, we only estimate two models that include estimates of the unemployment elasticity of recruitment (models 1 and 4).

As shown in Figure 4, the number of applicants increased rapidly in 2009 just as the unemployment rate rose rapidly due to the 2008 recession. This suggests that ITT recruitment is sensitive to short-run changes in the unemployment rate, which has also been the case during the 2020 recession. Therefore, we believe model 4 provides the most robust estimate of the unemployment elasticity of recruitment because it exploits short-term variation in both the unemployment rate and the number of applicants. The first differences model allows us to estimate the short-run effect of sudden changes, such as the jump in unemployment due to the financial crisis in 2008.

Our preferred estimate from model 4 suggests that an increase of one percentage point in the UK unemployment rate is associated with a 6 per cent increase in applicants to ITT.

The estimated unemployment elasticity from model 1 is also positive, but is a smaller magnitude that is not statistically significant. It may suggest that the association between the unemployment rate and the number of applicants is less strong over the longer-term (i.e. the impact is short-lived and washes out fairly quickly).

Bursary elasticity of recruitment

The bursary elasticity of recruitment has been the focus of a number of previous studies, and consistently estimated to be 2.9 per cent per £1,000 of bursary (NAO, 2016; Worth and Hollis, 2021).

We estimate the bursary elasticity using a range of models. The models in first differences (models 4-6) are appealing to estimate the bursary elasticity, since there have been several occasions when the incentives have changed sharply from one year to the next. This means the model can exploit the short-term variation in both the bursary and the number of applicants to estimate the association.

All our estimates of the bursary elasticity are positive and statistically significant. The estimates range from a 2.3 per cent increase in applicants per £1,000 increase in bursary (model 5) to 3.9 per cent per £1,000 (model 2), which are largely consistent with the previous estimates of 2.9 per cent.

The estimates from the first differences models are consistently lower than the estimates from the models in levels, suggesting that the short-term response of applicant numbers to bursaries is lower than the longer-term association. This may indicate that while applicant behaviour responds quickly to changes in the value of financial incentives, some adjustment to these changes takes a little longer to feed through.

Tuition grant elasticity of recruitment

We also estimate the tuition grant elasticity to recruitment using the full range of models. Since the value of the tuition grant was very stable over time, the models in first differences and the models including year FEs are not as appealing to robustly estimate the tuition grant elasticity. However, apart from the outlier estimate from model 4, all the estimates are positive and statistically significant, ranging from a 3.0 per cent increase in applicants per £1,000 increase in bursary (model 2) to 7.1 per cent per £1,000 (model 6).

Our preferred estimate from model 1 suggests that the tuition grant elasticity of recruitment is a 3.3 per cent increase in applicants per £1,000. This estimate, and most of the other estimates for the tuition grant elasticity of recruitment, are in a similar range to the bursary elasticity of recruitment. Indeed, the estimates do not provide compelling evidence of the tuition grant elasticity of recruitment being any higher or lower than the bursary elasticity of recruitment.

Golden Hello elasticity of recruitment

We also use the full range of models to estimate the Golden Hello elasticity of recruitment. The value and eligible subjects of the Golden Hello were relatively stable over time. However, there were changes in value and eligibility that provide some variation to exploit in order to estimate the elasticity using year FEs and first differences models. None of the estimates of the Golden Hello elasticity of recruitment are statistically significant, suggesting that they had limited success in attracting additional applicants.

However, the point estimate in models 1-3 is around a five per cent increase in ITT applications per £1,000 of Golden Hello, suggesting that it may have had an impact commensurate with a bursary, but there was too little variation in the data to identify the association with high enough precision. Despite this, the estimates from first differences models (models 4-6) suggest that the Golden Hello had no impact on applicant numbers.

Early career payment (phased bursary) elasticity of recruitment

We are limited in our ability to estimate the early career payment elasticity of recruitment because of the timespan of DLHE data on pay, one of our key explanatory variables, being limited to before the early career payment was first introduced in 2017/18. We estimate the early career payment elasticity of recruitment using two models that extend the timescale of data used to 2002-2021 and exclude teacher pay as an explanatory variable. These models include year FEs, explaining at least some of the variation in relative pay (since it tends to vary more by year than it does between subject, after also including subject FEs).

Both our estimates of the early career payment elasticity of recruitment (models 3 and 6) are statistically insignificant, suggesting that graduates may be far less responsive to early career payments compared to bursaries.

The level of precision with which these are estimated is low, due to the small number of subjects and years that the policy was active. Since the payoff from an early career payment comes later than a bursary, this is perhaps to be expected. Indeed, the main objective of early career payments is to incentivise retention rather than recruitment. However, for the purposes of the scenario modelling in section 3, assuming an early career payment elasticity of recruitment equal to zero would be an extreme assumption, when both elasticity estimates are positive. We therefore use the elasticity of 0.7 from model 1 in the scenario modelling.

Table 3 Econometric regression analysis results

Factor	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
1% in teacher pay (over and above outside pay increase)	2.0 ** (0.4)	1.6 (0.9)	-	1.0 ** (0.2)	0.3 (0.4)	-
10% increase in number of graduates	6.5 ** (1.4)	6.8 ** (1.8)	-	-1.2 (1.6)	-1.6 (1.8)	-
1pp increase in unemployment	1.5 (1.2)	-	-	6.0 ** (1.3)	-	-
£1k increase in bursary	3.8 ** (0.9)	3.9 ** (1.0)	2.6 ** (0.5)	2.6 ** (0.6)	2.3 ** (0.7)	2.5 ** (0.4)
£1k increase in tuition grant (i.e. reduced tuition fee)	3.3 ** (0.8)	3.0 (2.1)	-8.5 ** (0.2)	4.1 ** (0.6)	4.2 ** (0.9)	7.1 ** (0.6)
£1k increase in Golden Hello	5.0 (2.8)	5.6 (2.9)	4.6 (2.7)	-0.7 (0.9)	-0.5 (0.9)	-0.7 (1.0)
£1k increase in early career payment	-	-	0.7 (1.0)	-	-	0.2 (0.4)
R-squared (within)	0.33	0.42	0.37	0.18	0.33	0.43
Model type	Levels	Levels	Levels	Differences	Differences	Differences
Subject FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	Yes	Yes	No	Yes	Yes
Years included	2004-2016	2004-2016	2001-2021	2005-2016	2005-2016	2002-2021

Robust standard errors in parentheses ** p<0.01, * p<0.05,

Note: The early career payment variable is not included in models 1, 2, 4 and 5 because it does not vary during the time period of the analysis. The unemployment variable is not included in models 2, 3 6 and 6 because it cannot be estimated alongside year FEs. The teacher pay and number of graduates variables were not included in models 3 and 6 so that they can include data from 2017-2021, and thus estimate the early career payment elasticity.

2.2.2 Sensitivity analysis

We perform some sensitivity analysis to test key assumptions that were necessary to make in the analysis, which may have had an arbitrary impact on the findings from the final models. These are particularly in cases where we have uncertainty over nuances of how different factors may have influenced graduates' decision making about entering teaching.

Timing of salary information

We model the pay differential variable based on the assumption that when graduates make the decision of whether or not to apply for postgraduate ITT they would have access to information on the teaching starting salary announced the year before and the non-teaching salaries of people that graduated the year before. For this reason, the pay differential variable used in our analysis has lagged teacher-starting salary and lagged outside-teaching salaries.

However, some graduates may have had access to more up-to-date information about teaching and non-teaching salaries (or had pay expectations that aligned well with the level of pay that prevailed at the time when they considered applying to ITT). In order to assess the extent to which our results may change were we to change this underlying assumption, we estimate model 1 with two different pay differential variables:

- Concurrent teaching starting salary and concurrent outside-teaching salaries
- Concurrent teaching starting salary and lagged outside-teaching salaries

In both cases, we find that the coefficient is significant and very similar in size to that of model 1 (an increase of 1 per cent in teacher pay, over and above outside pay, is associated with a 1.9 per cent increase in ITT applications). These findings suggest that our main teacher pay elasticity of recruitment is robust to the timing of pay information being available to graduates. The regression results are presented in Appendix A.

Bursary differential

From 2012 to 2018, the government introduced a higher bursary in some subjects for graduates holding a first class degree, as compared with a 2:1 degree. This bursary differential ranged from £3,000 to £5,000 and varied across years and across subjects. We estimate the six models with an additional variable that captures this bursary differential and find very similar coefficients for all the main elasticities.

Our results suggest that the bursary uplift associated with the applicant having a first class degree does not have a significant short-term effect in applications to ITT and does not affect the elasticity of applications to bursaries. However, since the bursary uplift applied to fewer subjects in fewer years and was not large, we are estimating it with far lower precision than other elasticities. We find that many of the point estimates for the bursary uplift elasticity of recruitment are roughly in the same range as the overall bursary elasticity, suggesting it may have attracted additional applicants. The regression results are presented in Appendix A.

2.2.3 Consolidated estimates of elasticities

2.2.3.1 Consolidated elasticity estimates and their collective predictive validity

The analysis presented above yields a number of elasticities of recruitment, each drawn from different models and/or a range of models. In order to further use these elasticities in scenarios modelling (see section 3) we draw together the evidence to establish a consolidated elasticity estimate. These consolidated estimates are summarised in Table 4 below.

Table 4 Consolidated estimates of elasticities

Elasticity	Consolidated estimate
Teacher pay	2.0 per cent increase in applicants for every one per cent increase in teacher pay (over and above outside pay)
Unemployment	6.0 per cent increase in applicants for every one percentage point increase in the unemployment rate
Graduate pool	6.5 per cent increase in applicants for every one per cent increase in the number of graduates
Bursaries	2.9 per cent increase in applicants for every £1,000 increase in bursary
Tuition grants	3.3 per cent increase in applicants for every £1,000 increase in tuition grant
Golden Hello	No significant impact
Early career payments	No significant impact (0.7 per cent increase in applicants for every £1,000 increase in early career payment for scenario-modelling purposes)

However, there is a question about whether it would be legitimate to use these estimates in forecasting, given that they have been estimated using slightly different models, explanatory variables and time periods underpinning the analysis.

To test the predictive validity of the elasticity estimates, we conduct some forecasting using historical data and assess the extent to which the forecast performs well. First, we take the number of applicants for each subject in a particular year (e.g. 2004). Second, we create a forecast for subsequent years by combining data on how the explanatory variables changed over time with the elasticities, which estimate what impact they are expected to have on applicant numbers. Finally, we compare the forecast of applicant numbers with the actual data from those years, and assess which combination of elasticities performs best.

We perform this assessment using a summary measure of statistical fit called the mean squared error. Lower values of the mean squared error equate to better prediction and a more accurate forecast. We compare the set of elasticities estimated from model 1 and model 4 with the consolidated elasticity estimates summarised in Table 4. The mean squared error values are presented in Table 5.

None of the models produce a perfectly accurate forecast, as shown by the values of mean squared error being greater than zero. However, each model performs similarly. There is therefore no clear evidence that using a consolidated set of elasticities from different models would not be valid for forecasting. Indeed, on the longer-term forecasts (from 2011 onwards) the consolidated elasticity estimates perform well compared to the other models.

Table 5 A test of predictive validity suggests that using a consolidated set of elasticities from different models would be valid for forecasting

Year	Model 1	Model 4	Consolidated estimates
2005	145	**143**	145
2006	**208**	238	234
2007	**366**	420	429
2008	**427**	521	549
2009	**231**	444	474
2010	438	**301**	327
2011	714	452	**448**
2012	512	417	**380**
2013	646	609	**553**
2014	829	790	**689**
2015	686	692	**574**
2016	621	651	**533**

Note: the cells show the mean squared errors from forecasting the number of applicants in a given year based on the baseline values in 2004, explanatory variable data in later years and the particular set of elasticities being tested. Lower values indicate a better statistical fit and cells highlighted bold are the lowest out of the three sets of elasticity estimates.

2.3 Conclusions

The findings from the econometric analysis presented in this section highlight the importance of some key economic factors as influences on the level of recruitment to ITT in England. In particular, it shows that the relative level of teacher pay matters for recruitment, as does the level of bursary available to train in each subject. The findings also show that the state of the wider labour market has an important influence on ITT recruitment, finding that interest in entering teaching is greater during recessions (when there are fewer and less secure job opportunities available in the labour market and the unemployment rate tends to rise). However, we find no evidence of early career payments having a significant association with increases in recruitment. This may in part be due to their design to incentivise retention rather than recruitment, *per se*, but could also be because of the limited sample sizes available in our analysis.

Our further analysis has demonstrated that these elasticities are robust to alternative assumptions and have predictive validity for use in forecasting. The latter in particular is an important conclusion underpinning the scenario forecasting analysis presented in section 3.

3 Modelling teacher supply under different pay and incentive scenarios

In section 2 we establish robust estimates of a number of key elasticities of economic and financial factors affecting recruitment to postgraduate ITT in England. In this section we present findings based on using those insights, and insights from other research, to forecast future teacher supply.

We describe the key features of how the integrated model of teacher recruitment and retention we use works to produce forecasts. We then present findings from using the forecasting model to assess the likely implications for teacher supply of a range of different financial policy options for attracting and retaining teachers.

3.1 Data and modelling approach

The forecasting model combines a range of input data and elasticities (i.e. how responsive teacher recruitment and retention behaviour is to changes in economic and financial factors) to estimate outputs of interest. The input data includes for example, the number of ITT enrolments in 2019, the number of teachers and pay structure of the existing teacher workforce in England, rates of teacher retention and existing values of subject bursaries. The inputs also include forecasts of the availability of job opportunities and pay prospects in the wider labour market, and pupil numbers. The inputs and elasticities are combined with policy variables, which allows us to input different pay and financial incentive policy options, and assess their implications for teacher supply in future years.

The key outputs of the model are forecasts of:

- the number of enrolments to ITT in each subject in each year 2022-2025
- the target number of enrolments to ITT in each subject in each year 2022-2025 that is sufficient to meet future teacher demand
- the total cost of the pay and financial incentive policy options under consideration.

The next sub-sections explain the function of each part of the model in more detail.

3.1.1 Modelling ITT enrolments

The first stage of the forecasting model is to forecast the expected number of enrolments to postgraduate ITT in England in each subject in 2022-2025. The year 2019 is taken as the baseline year, since it was the last year unaffected by the Covid-19 pandemic. We then construct a forecast based on:

- the expected path of the unemployment rate from the Office for Budget Responsibility's (OBR) Economic and Fiscal Outlook forecasts, relative to its level in 2019
- the expected path of teacher pay relative to outside pay, based on the forecasted evolution of each series relative to its level prior to the pandemic. The forecast of outside pay is from the

OBR forecasts of average earnings, while the evolution of teacher pay is a policy variable that we alter to test different policy options on pay.[8]

- the expected path of subject-specific bursaries and early career payments, relative to their level in 2019. Both are also policy variables that we alter to test different policy options.
- associated elasticities of how the number of enrolments responds to changes in these factors (as presented in section 2).

These elements are combined into a forecast of the number of enrolments expected in future years for each subject. We assume that ITT recruitment in each subject responds only to changes in its own financial incentives (e.g. bursary, early career payment), but is independent of financial incentives for other subjects. As discussed in section 2.1.3, there may be some such second-order effects (such as some switching between biology and chemistry, depending on the relative values of the subjects' respective bursaries) but that these are likely to be small.

We can use early data from the 2021/22 ITT application cycle to test the how well the model forecasts the number of ITT enrolments in the 2022/23 academic year. Both data sources are estimates rather than definitive, but one is a forecast based on known factors of policy and elasticities, while the other is closely linked to what level of recruitment is likely based on the early application data. Figure 9 below plots the change in the number of placed applications between the year up to May 2022 and the year up to May 2019 (vertical axis) against the model forecast of the change in enrolments between the corresponding 2019/20 and 2022/23 academic years[9]. Each point on the chart represents a subject.

The green line shows the equality line, which means that the model forecast exactly aligns with the trends in the application data. Three key points are evident from this chart. First, the two variables are correlated (correlation coefficient = 0.75), which suggests that subjects that the model forecasts to have fewer enrolments are seeing fewer applications in the current data, and vice versa. This is reassuring for the validity of the forecasts.

Second, many of the data points are clustered around the equality line, suggesting not only that it predicts differences between subjects fairly well, but that it is also likely to predict the *level* of enrolments in each subject fairly well too.

Finally, however, it is clear that not all the data points are clustered close to the equality line. This suggests that the forecasts are not perfect, and involve a considerable degree of uncertainty.

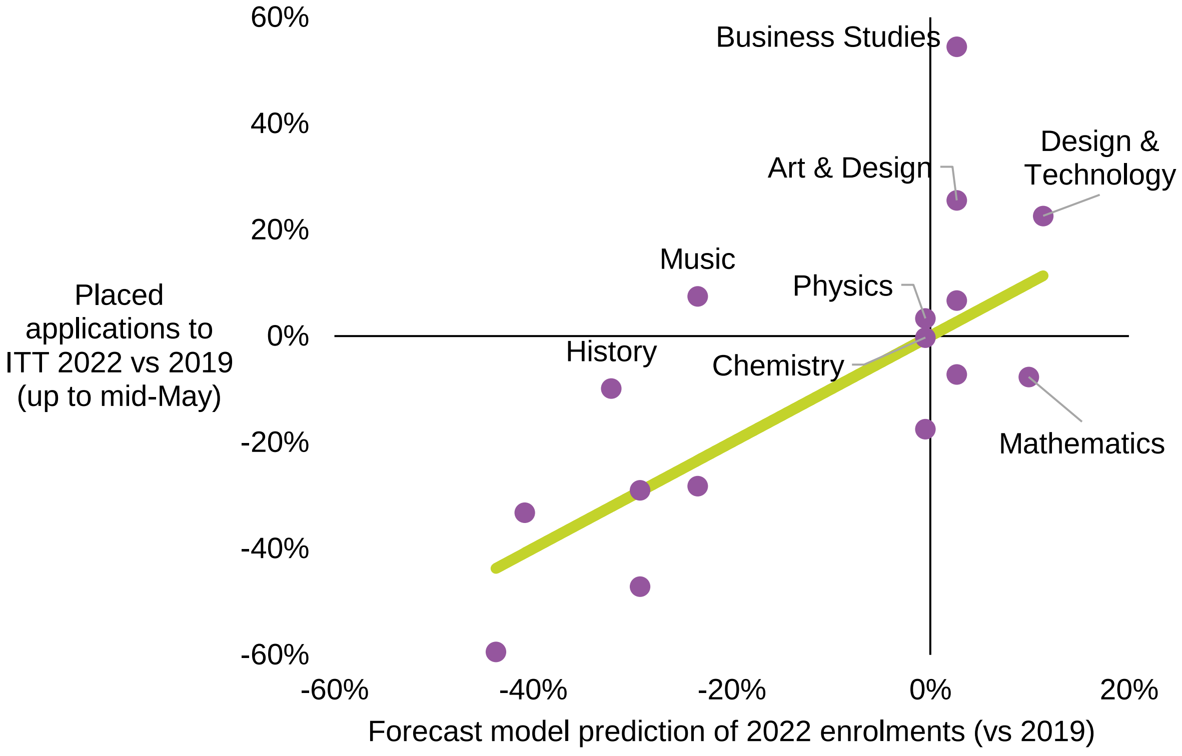
---

[8] We assume that the number of ITT enrolments responds to changes in the average level of the main pay scale rather than starting salary. The pay elasticity is estimated base on starting salary (see section 2), but the main pay scale has not changed at a different rate to the starting salary during the period of analysis. It is more reasonable to assume teachers take account of future pay rather than a myopic focus only on starting salary. However, we also explore the sensitivity to assuming that recruitment behaviour responds to the starting salary (see Appendix B). Given the discussion about the uncertainty over the timing of pay information available to potential trainees in section 2.2.2, we also assume ITT recruitment responds partly to teacher pay relative to outside pay in the *current* year and partly to teacher pay relative to outside pay in the *previous* year. Again, we test the sensitivity of this assumption in Appendix B.
[9] The forecast used is based on the closest to current policy, which is based on DfE's pay proposals to STRB, as presented in scenario 3 in section 3.2 below.

Therefore, the numbers presented in the findings should not be considered to be precise forecasts, but indicative forecasts of the overall trend for each subject.

A notable example is mathematics. The forecast model predicts that, under current policy (see scenario 3 in section 3.2 below) 2,200 mathematics trainees may be recruited, which would exceed the subject's target of 2,040. However, the ITT applications data up to May suggests that the number of placed applications for mathematics is around eight per cent *below* the same point in 2019, when mathematics enrolled 2,159 trainees. When combined, this would imply that mathematics recruitment could be less under 2,000, and therefore below its target. This emphasises the importance, particularly for policymakers, of using a range of data sources to build a picture of the evolving recruitment and retention landscape, rather than relying only on predictions from a forecasting model.

Figure 9 The model forecasts for 2022 align reasonably well with application data for 2022, but not perfectly, which indicates a degree of forecasting uncertainty



Source: NFER analysis of UCAS and DfE Apply data and model forecasts.

3.1.2 Modelling policy costs

The second stage of the forecasting model is to estimate the cost of the policies under consideration, including the teacher pay bill and the cost of bursaries and early career payments.

We base our estimate of the pay bill on the number of teachers at each pay scale point (M1-M6, U1-U3, as well as the average pay of centrally employed, unqualified teachers and the leadership group), which is calculated using data from the School Workforce Census (SWC). We calculate the costs associated with the teacher pay policy under consideration in each scenario. The costs are estimated separately for primary, secondary and special schools.

The model's inputs for pay enable scenarios to be explored that vary the rate of pay growth according to the scale point (e.g. flattening the main pay scale by increasing M1 by more than M6) and amending the pay premium associated with different pay regions (i.e. Inner London, Outer London and London Fringe, relative to the rest of England). It also allows differences in the rate of pay growth for primary and secondary teachers, as we explore in some of our scenarios in section 3.2.

3.1.3 Modelling retention

The third stage of the forecasting model is to forecast changes in the rate of teacher retention in the workforce that result from changes in pay and early career payments. Again, the year 2019 is taken as the baseline year, since it was unaffected by the Covid-19 pandemic. We estimate the attrition rate of teachers at each pay scale point using data from the SWC. Using the salary information for each pay point derived from the second stage, we then estimate the implied pay growth for each point on the teacher pay scale relative to the growth in outside pay. The latter is derived from the same OBR forecast of average earnings used in the first stage.

Early career payments for each subject are modelled as a direct pay uplift to the relevant cohorts of early career teachers. We assume the early career payments have a uniform uplift effect on pay that is spread across the first four years of each cohort's teaching career. We also model the on-going impacts of previous early career payment regimes (i.e. the uplift provided by the 2020 phased bursary payments for maths, physics, chemistry and MFL).

We estimate the implications for teacher attrition by using elasticities estimated in the wider literature. The DfE's recent evidence to the STRB suggests, based on a review of the literature, uses an elasticity of -1.5. In other words, it assumes an increase in teacher pay relative to outside pay of 1 per cent leads to a 1.5 per cent decrease in the teacher attrition rate (DfE, 2022a). However, US-based evidence in the literature suggests that early career teachers are likely to be more responsive to changes in pay, so may have a higher elasticity than the average teacher, and more experienced teachers have a lower elasticity. Indeed, recent UK-based evidence suggests that early career teachers in shortage subjects have an elasticity of -3 (Sims and Benhenda, 2022). We take a balanced approach based on these estimates, and assume that teachers for all phases and subjects on the M1-M5 pay scale points have an elasticity of -2.5 and teachers on the M6 pay scale point and above have an elasticity of -1. This averages out across the teacher workforce to be around -1.5, consistent with DfE's average. However, we test the sensitivity of our findings to different assumptions, including taking DfE's approach.

We choose not to model the implications of the strength of the labour market (e.g. through the unemployment rate) for teacher attrition. While the research evidence suggests it is an important factor, we choose not to model it for two reasons. First, while the relationship between the strength of the labour market and teacher retention is established, there is little evidence on the unemployment elasticity of teacher retention to use in the forecasting (Hutchings, 2011). Second, the difference between the unemployment rate in 2022 and the rate in 2019 is fairly small, which means any modelling of the impact for 2022-2025 would have little influence under current forecasts.

3.1.4 Modelling recruitment targets

The final stage of the forecasting model is to forecast the evolution of the postgraduate ITT target for each subject. We take the published 2022 ITT targets as our baseline. The Department for Education has not published its new Teacher Workforce Model (TWM), which underpins its calculation of the 2022 targets and estimates of future targets, which were previously published in the predecessor Teacher Supply Model (TSM).

We therefore take a simplistic approach to estimating forecasts of each subject's target in 2023-2025 by combining data on projected pupil numbers (which are a key contributory driver of teacher demand) and teacher attrition rates (based on estimates outlined in section 3.1.3). Given the full TWM has not been published, it is uncertain how pupil numbers and teacher attrition rates affect target calculations in the DfE's new model. We estimate how the targets are likely to evolve in response to changes in these factors using insights from how these factors were associated with the evolution of postgraduate ITT targets in the predecessor TSM. This may not reflect DfE's current thinking on target evolution, but no better information is publicly available to the contrary.

A key new feature of the DfE's TWM that was not present in the previous TSM, is that it takes into account previous under- or over-recruitment in a subject over the last two recruitment cycles in the setting of the next targets. However, no information is given on how this is calculated, so we are not able to include this dynamic adjustment to recruitment performance in our model. We strongly recommend that the DfE publishes the full TWM, to improve understanding of the target-setting method and rationale within the education sector.

3.1.5 Limitations

There are several key limitations of any forecasting model and which are relevant to this model. First, forecasting models are a simplistic representation of the key features of the problem being modelled, but do not capture absolutely everything of importance or relevance. This model of teacher supply focuses on the financial attractiveness of teaching and does not account for changes in the non-financial attractiveness of teaching and its impact on recruitment and retention. For example, if teacher workload reduced in future then it may have an impact on retention, but the model assumes no factors outside of those it models have any influence on recruitment or retention. Other factors could include the impact of media campaigns, changes in the image of the teaching profession, availability of part-time and flexible working in teaching and/or the wider economy. While these are significant and important factors in their own right, the model abstracts from any potential future impact they may have. This seems reasonable given there is little data or reliable forecast of how any of these factors may change on the future.

Second, the model uses elasticities and other data that are estimated with a degree of imprecision. Therefore any modelled impact could in fact be higher or lower, depending on the true value of the elasticity. We have used a range of approaches to deal with this limitation, including using sensitivity analysis to check whether certain findings are driven by plausibly different and potentially arbitrary assumptions. If they are not, then we can have greater confidence that, while the data or parameters remain imprecise, the imprecision is not so great that it wholly determines the nature of the findings.

Third, the impact of some second-order factors have not been modelled, to retain model simplicity and because the second-order effects are expected to have a limited impact on the overall findings. For example, for the purposes of cost and retention forecasting we assume that the number of teachers at each pay scale point remains the same over time. Differential teacher attrition is likely to affect this to some very small degree, but we do not attempt to incorporate this into the model as the benefit of doing so for model accuracy is outweighed by the complexity and intractability it introduces. This is also a simplification that the DfE's evidence to STRB assumes.

3.2 Findings

This sub-section presents the forecasts estimated from a range of different pay and financial incentive options. Scenarios 1 and 2 assess the claims about improved teacher supply made by the DfE in its evidence to the STRB of the benefits of its 2022 and 2023 pay proposals (DfE 2022a). Scenario 3 explores the impact of the latest economic forecasts, which were published after the DfE's evidence to STRB was published.

Subsequent scenarios explore the implications for teacher supply of a range of other financial policies available to policymakers, with a focus on STEM subjects such as physics, chemistry, biology (and 'all science' – the combination of all three sciences), maths and computing. All of these subsequent scenarios are compared relative to scenario 3, which is the closest known approximation to future policy.

3.2.1 Scenarios 1 & 2: Assessing the DfE's proposals for flattening the pay scale

In its evidence to the STRB (DfE, 2022a), the DfE proposed pay increases that would enable the government to achieve the 2019 Conservative election manifesto commitment of achieving a teacher starting salary of £30,000 (DfE and Williamson, 2019) by 2023/24 (albeit delayed a year by the pandemic). The proposals achieve this within a restricted financial envelope by increasing the lower points on the main pay scale at a higher rate than higher spine points, flattening the main pay scale.

DfE proposes to increase M1 – the starting pay scale point for teachers – by 8.9 per cent in 2022/23 and then 7.1 per cent in 2023/24. The top pay point on the main pay scale, M6, is proposed to increase at a lower rate of four per cent then three per cent, respectively. Pay increases for each point between the minimum and maximum are proposed to change proportionally. Under the DfE proposals, all other pay scales (unqualified teachers, upper pay scale and leadership group) are proposed to increase at three per cent in 2022/23 and then two per cent in 2023/24. This is scenario 2.

The recruitment outcomes under scenario 2 are compared to scenario 1, which allocates the same total pay increase for each year evenly across all the pay points (within and across different scales). Allocating the total pay envelope for the academic year uniformly across all pay points leads to an increase of 3.9 per cent in 2022/23 and 2.6 per cent in 2023/24.

No pay proposals have been made by DfE for 2024/25 onwards. We assume under both scenarios 1 and 2 that pay increases by 2.5 per cent per year across all pay points. This is based on the expected increase in the overall Schools Budget, as announced in the 2021 Spending Review (HMT, 2021). The DfE pay proposals increase teaching starting salaries (M1) in London at a lower rate than the rest of England, although actual salaries remain considerably higher as can be seen in Table 6 below. An implication of this is to reduce the London pay areas' premium relative to the rest of England, which may have implications for recruitment and retention to schools in the London area.

Table 6 DfE has proposed to increase the London pay scales at a lower rate than the rest of the country

	Percentage pay increase for M1 (actual salary in brackets)	
	2022/23	**2023/24**
Inner London	6.5% (£34,247)	3.7% (£35,500)
Outer London	8.0% (£32,308)	4.3% (£33,700)
London Fringe	8.5% (£29,239)	6.0% (£31,000)
Rest of England	8.9% (£28,000)	7.1% (£30,000)

As described in section 3.1, the economic forecast is an important input into the model as it provides an estimate of the unemployment rate and outside pay levels, which in turn affects recruitment and retention. The development of the DfE pay proposals took place under the OBR October 2021 forecasts (OBR, 2021), which we use for assessing the teacher supply implications of scenarios 1 and 2. The OBR October 2021 forecasts assumed average earnings would increase by 3.9 per cent in 2022 and 3.0 per cent in 2023, and the unemployment rate would be 4.5 per cent in 2022 and 4.2 per cent in 2023.

In this scenario, bursaries are assumed to remain at their current values[10] and the predicted impact on retention of the withdrawal of early career payments for the 2020/21 ITT cohort is also included. The Schools White Paper – Opportunity for All (DfE, 2022c) outlines a 'Levelling up' premium for teachers in subjects facing the greatest supply challenges, namely mathematics, physics, chemistry and computing in eligible schools. A school is eligible if it is in the top half of the most deprived schools in England (as measured by the proportion of the pupil body who are eligible for pupil premium) or the school is in the top 70 per cent of deprivation levels and in an Education Investment Area (EIA) (DfE, 2022d). These pay premiums are an additional £1,500 to £3,000 per year for three of the first five years of a teacher's career, depending on the level of deprivation of the school and whether it is in an EIA[11]. The total value of the premium for an eligible teacher

---

[10] Postgraduate trainee teachers of mathematics, chemistry, physics and computing who have a 2:2 degree class or above receive the maximum available bursary (£24,000) in their training years. Biology ITT trainees receive £10,000. See DfE (2022b).

[11] In order to model this we have calculated the average amount an eligible teacher would receive on average across all secondary schools and assumed that eligible teachers are split across the groups of schools in the same proportions as the number of schools in each premium group. For example, 12 per cent

would be between £4,500 and £9,000. We model this as being equivalent to £3,775, reflecting the fact that 42 per cent of secondary schools are not eligible for any premium. It is worth noting that there are likely to be proportionally fewer teachers in shortage subjects in the EIAs and more deprived schools, as recruitment challenges are often greater in these areas and thus our total value may be an over-estimate (Sibieta, 2018; Sibieta, 2020). More generally, our modelling does not take into account regional variation in teacher shortages, but rather considers the implications for total teacher supply across England.

Table 7 compares the outcomes of the two scenarios in terms of predicted recruitment as a percentage of the recruitment target for selected subjects. The 'all science' measure combines teachers of physics, chemistry and biology. The 'capped measure of overall recruitment' provides a measure of ITT recruitment against target for all subjects, but does not allow over-recruitment (i.e. greater than 100 per cent) in some subjects to be counted against under-recruitment (i.e. less than 100 per cent) in other subjects[12]. The capped measure of overall recruitment has a maximum value of 100 per cent, which would represent every subject meeting or exceeding its target.

For each subject in the table we report two numbers for each year: the forecast number of ITT enrolments as a percentage of the target under the scenario considered (first row – represents scenario 2 in Table 7), and the percentage point difference between the predicted percentage of target when compared to the comparison scenario (second row – represents scenario 1 in Table 7).

Our analysis shows that the proposals put forward by DfE have a positive impact on supply in all subjects of interest, compared to a uniform pay award. There are year-on-year increases in the number of ITT enrolments as a percentage of the target from 2022/23 onwards for all the subject in Table 7. This is in contrast to the uniform pay award scenario, under which there are year-on-year decreases in the number of ITT enrolments as a percentage of the target from 2022/23 onwards.

Overall under the DfE proposals, some progress is made towards meeting targets in chemistry, all science and computing by 2025/26. The model estimates that mathematics achieves its target from 2022/23 onwards. However, physics supply remains challenging with only around 23 per cent of target expected to be achieved in 2025/26, which is only four percentage points higher than under a uniform pay award.

The positive impact on overall supply is primarily driven by increased recruitment from increasing pay on the main pay scale faster than pay in the rest of the labour market. This same pattern is also associated with an increase in early career teacher retention. The overall expected impact on retention is to reduce attrition rates, which is for two reasons. First, we assume that early career teachers are more responsive to changes in pay, based on the wider research literature. Second, early career teachers have higher attrition rates, so any increase in their pay leads to a greater effect than among more experienced teachers.

---

of secondary schools are eligible for the highest premium (£3,000 per year) and we assume that 12 per cent of teachers teach in these schools.

[12] For science subjects, 'All science' is capped at 100% rather than the individual sciences.

Table 7 The DfE’s pay proposals, which include flattening the main pay scale, are likely to improve teacher supply relative to a uniform award to all teachers

Comparison scenario:	**Scenario 1**: Uniform pay increase of 3.9% in 2022/23, 2.6% in 2023/24 and 2.5% in 2024/25 and 2025/26. Assumes OBR October 2021 forecasts of pay in the economy and unemployment			
Scenario considered:	**Scenario 2**: DfE’s proposals to: • move starting salary to £30,000 by 2023/24, • flatten the main pay scale (M1 increases by 8.9% in 2022/23 and then 7.1% in 2023/24, while M6 increases at a slower rate of 4% then 3%, all other scales increase at 3% in 2022/23 then 2% in 2023/24), and • reduce the London area pay premium for M1 compared to the rest of England. We assume uniform increases to all scales by 2.5% in 2024/25 and 2025/26.			
	2022/23	**2023/24**	**2024/25**	**2025/26**
Mathematics	116%	118%	121%	122%
	+2	+10	+16	+20
Physics	20%	21%	22%	23%
	0	+2	+3	+4
Chemistry	86%	89%	94%	97%
	+2	+8	+13	+17
All science	55%	58%	61%	63%
	+2	+6	+10	+12
Computing	41%	43%	45%	48%
	+1	+4	+6	+8
Capped measure of overall recruitment	78%	78%	79%	80%
	+1	+2	+4	+4

However, comparing the two scenarios, the expected retention impacts are not uniform across all types of teacher. Table 8 shows the forecast of attrition rates, split by school phase (primary/secondary) and teacher experience[13]. Under scenario 2, attrition rates for early career teachers compared to scenario 1 fall the most, due to the increase in pay competitiveness relative to outside pay and the high responsiveness. However, the model also predicts a small increase in attrition rates for more experienced teachers. The structure of the teacher workforce changing in this way means that the overall teacher body would have less experience under scenario 2 compared to scenario 1, and this could have implications for future leadership capacity and support for teachers starting out in their career through mentoring.

Table 8 Flattening the main pay scale at the expense of increases to experienced teachers' pay is expected to impact on the attrition of different groups of teachers in different ways

Teacher group	**Attrition rates under scenario 2 (first rows) and percentage point difference in attrition rates compared to scenario 1 (second rows)**			
	2022/23	**2023/24**	**2024/25**	**2025/26**
Primary early career teachers (%)	10.9	10.1	10.0	10.1
	-1.2	-2.2	-2.2	-2.2
Primary main pay scale teachers (%)	9.9	9.5	9.4	9.5
	-0.5	-1.0	-1.0	-1.0
Primary upper pay scale teachers and leaders (%)	6.8	6.9	6.9	6.9
	+0.1	+0.1	+0.1	+0.1
Secondary early career teachers (%)	12.2	11.3	11.2	11.3
	-1.3	-2.4	-2.4	-2.4
Secondary main pay scale teachers (%)	10.8	10.4	10.3	10.4
	-0.6	-1.2	-1.2	-1.2
Secondary upper pay scale teachers and leaders (%)	7.4	7.5	7.5	7.5
	+0.1	+0.1	+0.1	+0.1

---

[13] The experience categories are defined by whether a teacher is an early career teacher (ECT), on the main pay scale, or on the upper pay scale or leadership group. ECTs are teachers in their induction period which is the first two years of their teaching career.

3.2.2 Scenario 3: DfE's proposals in the light of new economic forecasts

In March 2022, the OBR published revised economic forecasts, providing an updated prediction of the unemployment rate and average earnings in the wider labour market (OBR, 2022). The post-pandemic economic recovery has proved challenging to accurately forecast and the revised numbers present a much healthier picture of the state of wider labour market conditions. In particular, average pay in the wider economy is expected to increase by 5.3 per cent in 2022 rather than the 3.9 per cent predicted in the October 2021 forecasts. The 2022 unemployment rate is also expected to be lower than previously forecast: 4.1 per cent compared to 4.5 per cent predicted in the October 2021 forecasts.

In scenario 3, we assess the same DfE pay proposals as we modelled in scenario 2, but use the updated economic forecasts reflecting the healthier wider labour market. Table 9 compares the outcomes from scenario 3 with those from scenario 2, where the only change made is to the economic forecast used. The table shows that the latest forecasts have a negative impact on predicted teacher supply, as a healthier employment market outside of teaching means greater competitiveness of the outside option for graduates considering entering teaching. The decrease in the competitiveness of teacher pay as a result also has a negative impact on teacher retention, further impacting on teacher supply.

Table 9 shows that the impact of the latest forecasts is to reduce the predicted number of ITT enrolments as a percentage of the target in all subjects. The overall impact is to imply that the DfE pay proposals are likely to lead to very little improvement in recruitment against targets over time. This is in contrast to scenario 2, which suggested that the DfE proposals would lead to steady improvement in supply over time in all these subjects.

The negative impact on overall supply of scenario 3 compared to scenario 2 is driven both by lower recruitment (because job opportunities and outside pay prospects are stronger than previously assumed) and lower retention (because outside pay prospects are stronger than previously assumed).

Table 9 The latest economic forecasts suggest that the wider labour market is healthier, and the DfE pay proposals therefore less competitive, than previously thought

Comparison scenario:	**Scenario 2**: DfE's pay proposals under October 2021 economic forecasts, as modelled above.			
Change considered:	**Scenario 3**: DfE's pay proposals, using OBR March 2022 forecasts instead of OBR October 2021 forecasts.			
	2022/23	**2023/24**	**2024/25**	**2025/26**
Mathematics	108%	110%	110%	109%
	-8	-9	-11	-14
Physics	18%	19%	20%	20%
	-1	-2	-2	-3
Chemistry	80%	82%	85%	86%
	-6	-7	-9	-12
All science	50%	52%	54%	54%
	-5	-6	-7	-9
Computing	38%	39%	41%	42%
	-3	-3	-4	-6
Capped measure of overall recruitment	75%	76%	77%	77%
	-2	-2	-3	-3

3.2.3 Scenario 4: Achieving a £30,000 starting salary more slowly with less pay scale flattening

The 2019 Conservative party election manifesto included a commitment to increasing teacher starting salaries to £30,000 by 2022/23 (Conservative Party, 2019). Under the current pay proposals, this objective will be met by 2023/24.

However, when a plan to implement a £30,000 starting salary was first proposed to STRB in 2020, the pay review body recommended not flattening the pay scale so aggressively (STRB, 2020). An implication of STRB's recommendations was that the £30,000 starting salary could be implemented over four years rather than three. Anticipating that STRB might again consider recommending a slower pace for achieving the £30,000 starting salary in its 2022 recommendations, we consider in scenario 4 the implications for teacher supply of implementing a slower move towards £30,000. We model the implications of M1 not reaching £30,000 in the rest of England until a year later (2024/25). We use the same total pay envelope of 3.9 per cent in 2022/23 and 2.6 per cent in 2023/24, but flatten the pay scale by less during those years.

As shown in Table 10, the impact of this, when compared to scenario 3, is a reduction in overall teacher supply. Similar to the logic behind the comparisons in Table 7, less flattening of the pay scale means relatively more resource is targeted at increasing experienced teacher pay and less at increasing early career teacher pay. Given the high attrition rates and greater sensitivity to pay changes among early career teachers, the overall impact of these is therefore to reduce recruitment and overall retention. However, all else equal, this scenario slightly increases the retention rate of experienced teachers and school leaders, compared to scenario 3.

Table 10 A slower rise in starting salary, and a lesser degree of pay scale flattening, means the system makes slower progress than otherwise towards meeting supply targets

Comparison scenario:	**Scenario 3**: DfE's pay proposals.			
Change considered:	**Scenario 4:** Change the pay increase for M1 to 6.4% for 2022/23, 5.5% for 2023/24 and 4% for 2024/25.			
	2022/23	**2023/24**	**2024/25**	**2025/26**
Mathematics	107%	105%	104%	102%
	-1	-5	-6	-7
Physics	18%	18%	19%	19%
	0	-1	-1	-1
Chemistry	79%	78%	80%	80%
	-1	-4	-5	-6
All science	49%	49%	50%	50%
	-1	-3	-4	-4
Computing	37%	37%	38%	39%
	0	-2	-2	-3
Capped measure of overall recruitment	74%	75%	75%	75%
	-1	-1	-1	-1

3.2.4 Scenario 5: Using training bursaries to boost teacher supply

3.2.4.1 Scenario 5a: raising bursaries up to a maximum of £24,000

Our modelling of DfE's pay proposals predicts that while mathematics teacher recruitment achieves its target over the next four years, physics, chemistry, computing and all science remain some way off their targets. We now consider a range of additional scenarios that could inform a policy approach to possibly achieving the targets in these subjects.

Bursaries are a tool that can be used to boost recruitment. Thus far in the modelling we have kept subject training bursaries at the values they are for the 2022/23 academic year.

Under scenario 5a, we explore the expected impact of increasing bursaries up to a maximum of £24,000 (the current maximum for any subject) by the necessary amount to reach the target for each subject. For example, we model the impact of the English bursary increasing from no current bursary to having a £6,000 in 2023/24, which is sufficient (in our forecasting model) to meet its estimated target. Since mathematics, chemistry, physics and computing already attract the maximum bursary, there is no change in the recruitment for these subjects. Indeed, the expected bursary needed to exactly meet the mathematics target in the model is only £21,000.

However, as shown in Table 11, there is an impact on all science supply from these changes as the biology bursary increases from £10,000 to £24,000, supporting overall science teacher recruitment. This increased biology bursary improves science recruitment by 19 percentage points compared to the DfE proposals (scenario 3). However, ITT recruitment for all science remains below target, at around 70 per cent. Furthermore, expected overall capped recruitment increases by six percentage points, as a range of other subjects also reach, or get closer to, their respective targets. As shown in the last row of Table 11, the cost of this policy change is estimated to be around £80-90m per year, on top of the existing bursary expenditure by the DfE.

Table 11 Increasing bursaries to a maximum of £24,000 could boost science teacher supply by increasing biology teacher numbers

Comparison scenario:	**Scenario 3**: DfE’s pay proposals.			
Change considered:	**Scenario 5a**: Scenario 3, plus increases in bursaries to a maximum of £24,000, where needed, to reach recruitment target. Of the subjects of interest in this report, all reach the cap of £24,000 other than mathematics (which is £23,000).			
	2022/23	**2023/24**	**2024/25**	**2025/26**
All science	50%	70%	73%	73%
	0	+19	+19	+19
Capped measure of overall recruitment	75%	82%	82%	82%
	0	+6	+5	+5
Total cost increase (£m)	0	87	83	84

3.2.4.2 Scenario 5b: raising bursaries up to a maximum of £30,000

In order to use bursaries to boost supply in shortage subjects such as physics, chemistry and computing, the bursaries in these subjects would need to be increased beyond the current £24,000 maximum. In scenario 5b we raise the maximum possible bursary to £30,000. The bursaries for all subjects included here increase to £30,000, other than mathematics which drops to £21,000.

As shown in Table 12, this level of bursary boosts ITT recruitment as a percentage of target for chemistry by 15 percentage points, achieving 98 per cent of target in 2023/24. Recruitment for all science sees an improvement of 32 percentage points under scenario 5b, largely driven by further increased numbers of biology teachers, as well as more chemistry and physics teachers. Despite recruitment increasing under this scenario, computing and physics remain considerably below their respective targets. We estimate that the additional cost of this policy change could be around £150m per year.

Table 12 Increasing bursaries to a maximum of £30,000 could further boost science teacher supply and support chemistry recruitment to approach its target

Comparison scenario:	**Scenario 3:** DfE’s pay proposals.			
Change considered:	**Scenario 5b**: Scenario 3, plus increase bursaries to a maximum of £30,000, where needed, to reach recruitment target. Of the subjects of interest in this report, all reach the cap of £30,000 other than mathematics (which is £23,000).			
	2022/23	**2023/24**	**2024/25**	**2025/26**
Mathematics	108%	100%	100%	100%
	0	-10	-10	-9
Physics	18%	23%	23%	23%
	0	+4	+4	+4
Chemistry	80%	98%	100%	100%
	0	+15	+15	+14
All science	50%	84%	86%	86%
	0	+32	+32	+32
Computing	38%	47%	48%	50%
	0	+7	+7	+8
Capped measure of overall recruitment	75%	84%	84%	84%
	0	+8	+8	+8
Total cost increase (£m)	0	153	148	148

3.2.5 Scenario 6: Using early career payments to boost retention

Early career payments (or phased bursaries) are another pay mechanism that could be utilised to boost teacher supply. The Government has introduced a set of payments (the ‘levelling up premium’) of £1,500 to £3,000 for mathematics, physics, chemistry and computing teachers in schools with a higher level of deprivation for three of their first five years of teaching. Our model assumes that just under 60 per cent of each cohort of teachers starting their careers in these shortage subjects will be eligible, based on our estimate that around a 60 per cent of secondary schools are eligible. The average per teacher payment across all secondary schools is estimated to be £3,775 in total.

One policy approach to early career payments having a greater impact on teacher supply could be to expand these payments to the whole of England at a uniform rate. We estimate that if the levelling up premium was rolled out to all teachers across the country (and increased to three instalments of £3,000 regardless of which school teachers were teaching in), it could improve overall teacher supply in eligible shortage subjects with a relatively modest additional cost.

Table 13 shows the overall implications for teacher supply of extending the levelling up premium nationwide from 2022/23. The model predicts that maths ITT recruitment as a percentage of target could increase by nine percentage points by 2025/26, chemistry by eight percentage points, all science by three percentage points, computing by four percentage points and physics by two percentage points. There are two mechanisms for these expected impacts. First they increase early career retention rates, which in turn reduces future recruitment targets. Second, the early career payment has an impact on recruitment, although, as explained in section 2.2.1, there is considerable uncertainty around how responsive teacher recruitment could be to the prospect of early career payments. We estimate the additional cost of these changes to be around £14m per year.

Table 13 A nationwide rollout of the levelling up premium could increase teacher supply in the targeted subjects at a relatively modest cost

Comparison scenario:	**Scenario 3**: DfE's pay proposals.			
Change considered:	**Scenario 6**: Increase early career payments to £9,000, paid over the first five years of teaching.			
	2022/23	**2023/24**	**2024/25**	**2025/26**
Mathematics	112% +4	115% +5	117% +7	118% +9
Physics	19% +1	20% +1	21% +1	22% +2
Chemistry	83% +3	86% +4	91% +6	93% +8
All science	51% +1	53% +2	56% +2	57% +3
Computing	39% +2	41% +2	44% +3	46% +4
Capped measure of overall recruitment	75% 0	76% 0	77% +1	77% +1
Total cost increase (£m)	14	14	14	14

3.2.6 Scenario 7: Separating the primary and secondary teacher pay scales

3.2.6.1 Scenario 7a: separating the primary and secondary pay scales from 2022/23

Currently in England, primary and secondary teacher pay are determined on the same pay scale. However, this does not reflect the relative supply and demand, since primary ITT generally recruits and enrols more trainees than its target, whereas many secondary subjects under-recruit compared to their targets.

Given the mismatch in supply across subjects, varying pay by subject would make economic sense in terms of maximising value for money. Similar arguments have previously been made about varying pay for shortage subjects, given the mismatches between supply and demand (Sibieta, 2018). Such a policy change could be complex to implement, introducing fairness issues about different pay scales for teachers of the same experience level. However, the option of splitting primary and secondary pay scales potentially balances these concerns better than by subject, since it would not introduce multiple pay scales within the same schools.

Implementing such a policy could still be challenging, particularly in the short term since school funding allocations have already been published. The change could also have a negative impact on primary teacher morale, add complexity to the teacher pay structure and may have implications for teacher quality. It could also add complexity to the teacher pay structure. However, these factors should be considered in the round alongside the potential net benefits for teacher supply.

Under scenarios 7a and b we model two options for splitting the primary and secondary pay scales: first splitting the scales in 2022/23 and second in 2024/25. As for scenarios 3-6 above, they are each compared to scenario 3, which is DfE's pay proposals to STRB.

In scenario 7a we reduce the primary teacher pay settlement for 2022/23 and 2023/24 as much as possible while still meeting the primary recruitment target (a 7.2% pay increase for M1 in 2022/23 and 4.9% in 2023/24). We then reallocate the overall cost savings made from doing this to increase pay in secondary, by additionally boosting the secondary main pay scale. The policy change is thus cost neutral, compared to the DfE pay proposals that the supply implications are compared against (scenario 3).

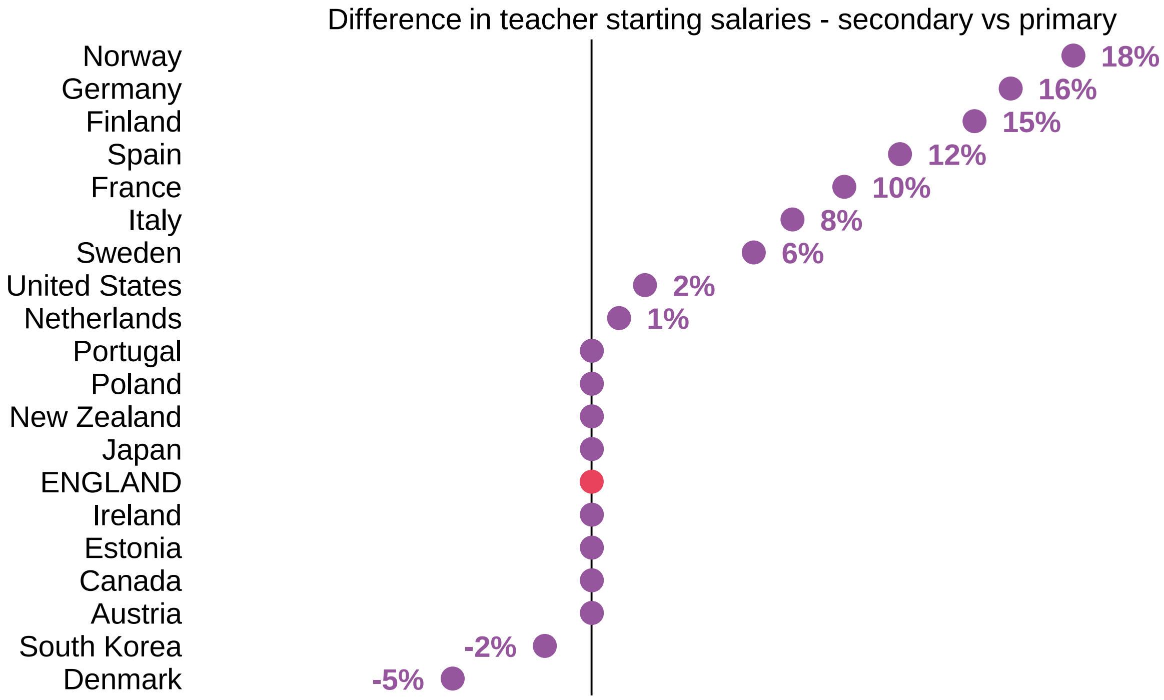
Table 14 shows the outcomes of one scenario modelled on this basis, with an increase of M1 for secondary teachers of 13 per cent in 2022/23 and seven per cent in 2023/24. The result of this policy change is for the capped measure of overall recruitment to increase by four percentage points more by 2025/26 than under scenario 3 (DfE proposals). There are also large improvements in teacher supply in mathematics, chemistry and science and also smaller increases for computing and physics. As also shown in Table 14, while primary teacher supply is lower under this scenario, the number of primary ITT enrolments remains at around 100 per cent of its target.

Table 14 Splitting the primary and secondary pay scales could improve secondary teacher supply, while still meeting the primary target, at no additional cost

Comparison scenario:	**Scenario 3**: DfE's pay proposals.			
Change considered:	**Scenario 7a:** Split the primary and secondary pay scales in 2022/23. Percentage increases from scenario 3 are retained except: • M1 for primary reduces to 7.2% for 2022/23 and 4.9% for 2023/24 • M1 for secondary increases to 13.0% for 2022/23 and 7.0% for 2023/24			
	2022/23	**2023/24**	**2024/25**	**2025/26**
Mathematics	110%	115%	118%	119%
	+2	+6	+8	+10
Physics	19%	20%	21%	22%
	0	+1	+2	+2
Chemistry	81%	87%	91%	94%
	+2	+5	+6	+8
All science	51%	56%	59%	60%
	+1	+4	+5	+6
Computing	38%	42%	44%	46%
	+1	+2	+3	+4
Primary	99%	100%	102%	102%
	-1	-6	-10	-14
Capped measure of overall recruitment	75%	78%	79%	80%
	0	+2	+3	+4

There are plenty of international precedents for this split in primary and secondary teacher pay. Figure 10 shows data on differences in starting salaries between primary and secondary teachers from a range of OECD countries. Countries such as Finland and Sweden pay secondary teachers more than primary teachers. In Finland, starting salaries are 15 per cent higher in secondary and in Sweden they are 6 per cent higher. The proposals modelled in scenario 7a result in secondary starting pay being 7.5 per cent higher than primary starting pay, from 2023/24 onwards, which is reasonably modest by international standards.

Figure 10 A range of countries have higher starting salaries for secondary teachers



Source: OECD.

3.2.6.2 Scenario 7b: separating the primary and secondary pay scales from 2024/25

However, a key practical difficulty of implementing scenario 7a in schools is that schools' funding allocations, and therefore the affordability envelope for teacher pay increases, have already been determined for the 2022/23 academic year. Such a policy being introduced in 2022/23 would mean secondary schools may be unlikely to be able to afford the large increase in pay.

Therefore, it is more practical to consider a possible longer-term implementation of this structural change. For scenario 7b, we model the expected impact of splitting the primary and secondary pay scales from 2024/25, thus giving the government the opportunity to reflect this in schools' future funding allocations. The modelled pay increases remain the same for 2022/23 and 2023/24 as under scenario 3 (DfE proposals). However, in both 2024/25 and 2025/26 we set primary teacher pay to increase by 0.8 per cent, and for secondary pay to increase by 4.2 per cent in 2024/25 and 3.9 per cent in 2025/26. By 2025/26 secondary school teachers starting salaries would then be 6.6 per cent higher than in primary.

As shown in Table 15, under this scenario, there is no change to the teacher supply implications in the first two years. However, the capped measure of overall recruitment is four percentage points higher in 2025/26 than under scenario 3, with significant improvements in some shortage subjects such as maths (11 percentage points), chemistry (ten percentage points) and all science (seven percentage points).

Again, this policy is cost neutral relative to the originally modelled pay proposals. The overall increase in teacher supply is achieved by allocating more resource to pay increases in secondary subjects that tend to under-recruit compared to target, and less to primary, which recruits at its target rather than above the target as a result.

Table 15 Splitting the primary and secondary pay scales from 2024/25 improves secondary teacher supply, while maintain primary recruitment at its target

Comparison scenario:	**Scenario 3**: DfE’s pay proposals.			
Change considered:	**Scenario 7b:** Split the primary and secondary pay scales in 2024/25. Percentage increases from scenario 3 are retained except: • All primary pay scales for 2024/25 and 2025/26 have a 0.8% increase. • All secondary pay scales for 2024/25 have a 4.2% increase and for 2025/26 have a 3.9% increase.			
	2022/23	**2023/24**	**2024/25**	**2025/26**
Mathematics	108%	110%	114%	120%
	0	0	+4	+11
Physics	18%	19%	20%	22%
	0	0	+1	+2
Chemistry	80%	82%	88%	95%
	0	0	+3	+10
All science	50%	52%	56%	61%
	0	0	+2	+7
Computing	38%	39%	43%	47%
	0	0	+2	+5
Primary	99%	106%	107%	100%
	0	0	-5	-16
Capped measure of overall recruitment	75%	76%	78%	80%
	0	0	+1	+4

3.2.7 Packages of measures to achieve adequate supply in shortage subjects

Under the scenarios modelled so far, mathematics has been predicted to reach its recruitment target (under all scenarios) and the chemistry recruitment target is met by increasing bursaries to £30,000. The analysis shows that some measures have greater impacts on shortage subject teacher supply than others, but no measures on their own would be enough to meet supply needs for physics and computing. We next consider packages of pay proposals and financial incentives that may help achieve adequate supply in these subjects.

Achieving an adequate supply of physics teachers has been a persistent challenge and the measures modelled previously have made little headway at improving supply. This has been compounded by the physics ITT target estimated in the TWM being substantially higher than it was under the predecessor TSM.

In scenario 8, we model the teacher supply implications for computing and physics of a package of financial measures, which includes increasing bursaries to £30,000, increasing early career payments to £3,000 per year for five years nationwide (a total of £15,000) and splitting the primary and secondary pay scales in 2024/25 as modelled in scenario 7b.

Table 16 summarises the teacher supply implications for physics and computing. The model predicts that this package of measures could boost the number of physics ITT enrolments as a percentage of the target by 11 percentage points by 2025/26, compared to the DfE pay proposals (scenario 3). Under the same package of measures, computing teacher supply achieves an increase of 23 percentage points by 2025/26.

Table 16 A package of measures could increase physics and computing teacher supply

Comparison scenario:	**Scenario 3**: DfE's pay proposals.			
Change considered:	**Scenario 8**: Increase bursary to £30,000, raise early career payments to £15,000 and split the primary and secondary pay scales in 2024/25 follow the same percentage increases as in the previous scenario: 4.2% (2024/25), 3.9% (2025/26) secondary and 0.8% (both years) for primary.			
	2022/23	**2023/24**	**2024/25**	**2025/26**
Physics	20%	25%	27%	31%
	+2	+6	+8	+11
Computing	41%	51%	57%	64%
	+3	+12	+16	+23

However, even with these packages of financial measures in place, both subjects remain below their respective recruitment targets, with physics predicted to achieve 31 per cent of its target in 2025/26 and computing 64 per cent. These findings highlight the challenge of ensuring sufficient teacher supply in some of the most hard-to-recruit subjects.

3.2.8 Increasing teacher pay beyond the current affordability envelope

All the scenarios for teacher pay increases that we have considered above have been confined to options that are consistent with an overall pay envelope constrained by affordability to schools, as assessed by DfE in its STRB proposals to be 3.9 per cent in 2022/23 and 2.6 per cent in 2023/24.[14] Pay increases above that affordability envelope risk being unaffordable to schools within their budgets, leading to unintended consequences such as reducing staffing ratios. However, commentators such as Luke Sibieta have suggested that schools may be able to afford a larger teacher pay increase than 3.9 per cent within their existing budgets (Sibieta, 2022). Furthermore, Government has mechanisms for injecting additional funding into school budgets to support teacher pay increases, such as it did through the teachers' pay grant in 2018 (DfE and Hinds, 2018).

We therefore explore the implications for teacher supply of increasing teacher pay by more than the current affordability envelope. In scenario 9, we model the teacher supply implications of retaining the 8.9 per cent and 7.1 per cent increases in M1 in 2022/23 and 2023/24, respectively, but increasing M6 by five per cent in 2022/23 and four per cent in 2023/24. We also model an increase in the pay of upper pay scale, leadership group and unqualified teachers of four per cent in 2022/23 and three per cent in 2023/24. The pay increases in this scenario are weighted more towards experienced teachers.

We also model constant London weightings, rather than reducing them as in scenario 3. The overall cost of this scenario is a 4.9 per cent increase in the pay bill in 2022/23 and a 3.8 per cent increase in 2023/24. This represents a cost increase of £178m in 2022/23 and £427m overall increase in 2023/24, relative to scenario 3.

Table 17 summarises the teacher supply implications for the key STEM subjects and the caped measure of overall recruitment. The model predicts that increasing teacher pay by more than the current affordability envelope is likely to increase supply across all subjects. The positive impact on overall supply is driven by a combination of increased recruitment from increasing pay on the main pay scale and reducing attrition rates.

However, the predicted increases in recruitment and retention are fairly modest, particularly in the short term, compared to other policy options considered above. Moreover, the cost of this policy option is high compared to the other policy options considered above. For example, we predict that the implications of increasing bursaries up to a maximum of £30,000 in order to increase recruitment in any subject that is below target (scenario 5b in Table 12) would cost less than scenario 9, but is predicted to have a greater impact on teacher supply.

This suggests that while maintaining teacher pay competitiveness is an important component of achieving overall teacher supply, general increases in teacher pay may not always be the most cost effective policy approach to achieving adequate supply, particularly when issues are concentrated in shortage subjects. As explored in scenarios 7a and b above, targeting pay increases at secondary teachers rather than primary teachers would be more cost effective, although there are implementation challenges that are likely to prevent this being feasible in the short-term. Despite the limitations of using a general pay increase to support teacher supply, particularly when concentrated towards less responsive groups such as experienced teachers, it

---

[14] We have assessed scenarios that imply additional government expenditure on bursaries and early career payments, but these come out of departmental expenditure rather than delegated school budgets.

remains an important tool for supporting teacher supply, especially when used in combination with other policy measures targeted at specific shortage subjects.

Table 17 Increasing teacher pay above the current affordability envelope could improve teacher supply, but at relatively high cost

Comparison scenario:	**Scenario 3**: DfE's pay proposals.			
Change considered:	**Scenario 9:** M1 increases as in DfE proposals; 5 per cent in 2022/23 and 4 per cent in 2023/24 increases for M6; 4 per cent in 2022/23 and 3 per cent in 2023/24 increases for UPS, leadership and unqualified; and London weightings retained.			
	2022/23	**2023/24**	**2024/25**	**2025/26**
Mathematics	109%	114%	118%	119%
	+1	+4	+8	+10
Physics	19%	20%	21%	22%
	+1	+1	+1	+1
Chemistry	80%	86%	91%	94%
	0	+4	+6	+8
All science	50%	55%	59%	60%
	0	+3	+5	+6
Computing	38%	41%	44%	46%
	0	+2	+3	+4
Capped measure of overall recruitment	76%	77%	78%	79%
	+1	+1	+1	+2
Total cost increase (£m)	178	427	442	452

3.2.9 Sensitivity analysis

To test the sensitivity of our analysis to the model inputs and parameters, we assess the implications of changing the values of different elasticities and other inputs to the model. This analysis tests the extent to which the findings are driven by plausibly different and potentially arbitrary assumptions. In each case we re-run scenario 3 (DfE proposals), varying different elasticities, assumptions or inputs to the model. The different assumptions that we analyse are described in Appendix B.

Varying the pay elasticity of recruitment, the weight attached to concurrent pay, or the unemployment elasticity do not have large impacts on the teacher supply implications arising from the model. Varying the pay elasticity of wastage has a comparatively larger impact, although the magnitude of differences is modest compared to some of the modelled impact from policy changes.

Basing the recruitment response to teacher salary changes on teacher starting salary as opposed to the average pay on the main pay scale has the greatest impact, as starting salaries grow at a faster rate than other pay spine points under scenario 3. However, for the reasons stated in section 3.1, we have a preference for assuming that teachers do not myopically respond only to starting salary, and expectations about future pay also form a key part of potential teachers' perceptions of the financial attractiveness of teaching.

Overall, the sensitivity analysis reinforces the importance of interpreting the results cautiously and not attributing high levels of precision to the model outputs. The numbers presented in the scenarios should be treated as indicative estimates of the rough magnitudes of expected impacts, but not as precise estimates of the expected impact. However, the sensitivity analysis findings also reassuringly suggest that the broad conclusions we draw from the analysis would be supported under other reasonable sets of assumptions.

4 Conclusions and policy recommendations

The insights from our econometric and forecasting analyses presented in this report highlight the importance of economic and financial factors for teacher recruitment and retention, and draw attention to the powerful role policy change can potentially play in ensuring the education system achieves adequate levels of teacher supply in shortage subjects.

The econometric analysis strengthens, and helps to quantify more precisely, some important and well-known stylised facts about how recruitment to teacher training responds to economic and financial factors (Hutchings, 2011). The analysis demonstrates the important role the strength of the wider labour market plays in teacher recruitment, as shown recently during the pandemic and associated recession. The findings also highlight the importance of teacher pay and bursaries as significant levers that policymakers have for increasing recruitment.

The forecasting analysis builds on these insights to display the significant implications of policymakers' choices and decisions for overall teacher supply. Indeed, several specific conclusions for policymakers arise from the scenario modelling findings:

- While the DfE's pay proposals to STRB are likely to improve teacher supply in shortage subjects relative to a uniform award, overall they do not improve the relative competitiveness of teacher pay enough to support the achievement of targets in key subjects. The latest economic forecasts suggest that the wider labour market environment is even more challenging for teacher supply than previously thought, meaning the teacher supply implications of DfE's pay proposals are neutral at best.
- However, additional financial incentives could be implemented to improve teacher supply, especially those that are targeted at shortage subjects. These could include increasing bursaries beyond their current £24,000 maximum and applying the 'levelling up premium' to the whole of England.
- Splitting the primary and secondary teacher pay scales could be effective at targeting resource where it can have greater gain in terms of overall teacher supply, in a way that is cost neutral within an existing spending envelope. While it has potential implementation challenges, the policy of separating the primary and secondary pay structures also has international precedents.
- Combinations of additional financial measures could support the improvement of teacher supply in some particularly challenging shortage subjects, e.g. physics and computing. However, the finding that physics is highly unlikely to meet its recruitment target under any package of measures should prompt debate about how the education system can realistically and sustainably staff science departments in schools with a range of specialists. This could include considering the range of ITT courses offered, additional subject specialism training in physics, for trainees and teachers in the classroom, ensuring physics teachers are deployed to teach physics rather than other subjects, targeting recruitment of graduates with engineering degrees into physics teaching, and addressing the relatively low numbers of students studying physics at A level and as an undergraduate degree (Sims, 2019).

We recommend that:

1. In light of new economic forecasts, which show that the wider labour market is stronger than was thought when the DfE pay proposals were developed, the STRB should consider recommending that teacher pay should increase by more than 3.9 per cent overall in 2022/23, to maintain teacher pay competitiveness and support teacher supply. This should be done in a way that is affordable for schools.
2. The DfE and STRB should explore the feasibility of implementing separate pay scales for primary and secondary teachers from 2024/25 onwards, and develop plans to use the flexibility to increase teacher supply in secondary.
3. The DfE should consider increasing bursaries in shortage subjects up to a maximum of £30,000 and expanding the ‘levelling up premium’ to apply to teachers working in schools across England, to further improve recruitment and early career teacher retention.
4. The DfE should publish the full Teacher Workforce Model, to improve stakeholder, researcher and public understanding of the postgraduate ITT target-setting process, methods and rationale.
5. As part of its future evidence to STRB, the DfE should publish full impact assessments of the overall teacher supply impact of its pay and financial incentive proposals. Where an impact assessment suggests supply is unlikely to be met, the DfE should set out the financial and non-financial actions being taken to improve teacher supply, particularly in subjects not expected to reach their respective targets

References

Conservative Party (2019). *The Conservative and Unionist Party Manifesto 2019* [online]. Available: https://www.conservatives.com/our-plan/conservative-party-manifesto-2019 [9 May 2022].

Department for Education (2022a). *Government Evidence to the STRB* [online]. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1060707/Government_evidence_to_the_STRB_2022.pdf [9 May, 2022].

Department for Education (2022b). *Initial teacher training bursaries funding manual: 2022 to 2023 academic year* [online]. Available: https://www.gov.uk/government/publications/initial-teacher-training-itt-bursary-funding-manual/initial-teacher-training-bursaries-funding-manual-2022-to-2023-academic-year [9 May, 2022].

Department for Education (2022c). *Opportunity for all: strong schools with great teachers for your child* [online]. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1063602/Opportunity_for_all_strong_schools_with_great_teachers_for_your_child__print_version_.pdf [9 May, 2022].

Department for Education (2022d). *Levelling up premium: methodology* [online]. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1074856/Levelling_up_premium_methodology.pdf [16 May, 2022].

Department for Education and Hinds, D. (2018). 'Government to fund pay rise for teachers', 24 July [online]. Available: https://www.gov.uk/government/news/government-to-fund-pay-rise-for-teachers [9 May, 2022].

Department for Education and Williamson, G. (2019). '£30,000 starting salaries proposed for teachers', 2 September [online]. Available: https://www.gov.uk/government/news/30000-starting-salaries-proposed-for-teachers [9 May, 2022].

Department for Education and Zahawi, N. (2022). 'Teacher bonuses and funding for schools to level up education', 13 May [online]. Available: https://www.gov.uk/government/news/teacher-bonuses-and-funding-for-schools-to-level-up-education [16 May, 2022].

HM Treasury (2021). *Autumn budget and Spending review 2021: A stronger economy for the British people* [online]. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1043688/Budget_AB2021_Print.pdf [9 May, 2022].

Hutchings, M. (2011). What impact does the wider economic situation have on teachers' career decisions? A literature review [online]. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/181566/DFE-RR136.pdf [9 May, 2022].

Migration Advisory Committee (2017). *Partial review of the Shortage Occupation List: Review of teachers* [online]. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/585998/2017_01_26_MAC_report_teachers_SOL.pdf [9 May, 2022].

National Audit Office (2016). *Training new teachers* [online]. Available: https://www.nao.org.uk/wp-content/uploads/2016/02/Training-new-teachers.pdf [9 May, 2022].

Office of Budget Responsibility (2021). *Economic and fiscal outlook – October 2021* [online]. Available: https://obr.uk//docs/dlm_uploads/CCS1021486854-001_OBR-EFO-October-2021_CS_Web-Accessible_v2.pdf [9 May 2022].

Office of Budget Responsibility (2022). *Economic and fiscal outlook – March 2022* [online]. Available: https://obr.uk//docs/dlm_uploads/CCS0222366764-001_OBR-EFO-March-2022_Web-Accessible-2.pdf [9 May 2022].

School Teachers' Review Body. (2020). *School Teachers' Review Body 30th report: 2020*. [online]. Available: https://www.gov.uk/government/publications/school-teachers-review-body-30th-report-2020 [9 May, 2022].

Sharp, C., Walker, M., Lynch, S., Worth, J., Greaves, E., Bernardinelli, D., Puntan, L., Burgess, S. and Murphy, R. (2017). *Evaluation of Teachers' Pay Reform: Final Report* [online]. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/652763/Evaluation_of_Teachers__Pay_Reform-Final_Report.pdf [9 May, 2022].

Sibieta, L. (2018). *The teacher labour market in England: shortages, subject expertise and incentives* [online]. Available: https://epi.org.uk/wp-content/uploads/2018/08/EPI-Teacher-Labour-Market_2018.pdf [9 May, 2022].

Sibieta, L. (2020). *Teacher shortages in England: analysis and pay options* [online]. Available: https://epi.org.uk/wp-content/uploads/2020/02/Teacher-shortages-and-pay_2020_EPI.pdf [9 May, 2022].

Sibieta, L. (2022). *The even longer squeeze on teacher pay* [online]. Available: https://ifs.org.uk/publications/15989 [9 May, 2022].

Sims, S. (2019). *Increasing the quantity and quality of science teachers in schools: eight evidence-based principles*. [online]. Available: https://www.gatsby.org.uk/uploads/education/increasingscienceteachers-web.pdf [9 May, 2022].

Sims, S. and Benhenda, A. (2022). *The effect of financial incentives on the retention of shortage-subject teachers: evidence from England* [online]. Available: https://www.gatsby.org.uk/uploads/education/reports/pdf/the-effect-of-financial-incentives-on-the-retention-of-shortage-subject-teachers-evidence-from-england.pdf [9 May, 2022].

Worth, J. and Faulkner-Ellis, H. (2021). *Teacher Labour Market in England: Annual Report 2021* [online]. Available: https://www.nfer.ac.uk/media/4382/teacher_labour_market_in_england_annual_report_2021.pdf [9 May, 2022]

Worth, J. and Faulkner-Ellis, H. (2022). *Teacher Labour Market in England: Annual Report 2022* [online]. Available: https://www.nfer.ac.uk/media/4885/teacher_labour_market_in_england_annual_report_2022.pdf [9 May, 2022].

Worth, J. and Hollis, E. (2021). ‘Do bursaries change who applies to teacher training?’, NFER Blog, 24 November [online]. Available: https://www.nfer.ac.uk/news-events/nfer-blogs/do-bursaries-change-who-applies-to-teacher-training/ [9 May, 2022].

Worth, J. and Van den Brande, J. (2019). *Retaining Science, Mathematics and Computing teachers* [online]. Available: https://www.nfer.ac.uk/retaining-science-mathematics-and-computing-teachers/ [9 May, 2022].

Appendix A: Sensitivity analysis for the econometric analysis

Table 18 Regression analysis results using different pay differential variables

Outcome variable: percentage change in ITT applications **Factor**	**Model 1A (concurrent graduate and teacher salaries)**		**Model 1B (concurrent teacher salary, lagged graduate salary)**	
1% in teacher pay (over and above outside pay increase)	1.9 (0.5)	**	1.9 (0.4)	**
10% increase in number of graduates	6.3 (1.4)	**	6.6 (1.3)	**
1pp increase in unemployment	0.5 (1.2)		2.0 (1.2)	
£1K increase in bursary	3.5 (0.8)	**	3.6 (0.9)	**
£1K increase in tuition grant (i.e. reduced tuition fee)	3.0 (0.9)	**	2.9 (0.8)	**
£1K increase in Golden Hello	4.5 (2.6)		5.0 (2.8)	
£1K increase in ECT payment^{+}	-		-	
R-squared (within)	0.34		0.32	
Model type	Levels		Levels	
Subject FE	Yes		Yes	
Year FE	No		No	
Years included	2003-2016		2004-2016	

Robust standard errors in parentheses ** $p<0.01$, * $p<0.05$,

Table 19 Regression analysis results (including bursary differential)

Outcome variable: percentage change in ITT applications **Factor**	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
1% in teacher pay (over and above outside pay increase)	1.8 ** (0.3)	1.5 (0.8)	-	1.0 ** (0.2)	0.3 (0.4)	-
10% increase in number of graduates	6.9 ** (1.4)	7.5 ** (1.6)	-	-1.2 (1.6)	-1.9 (1.8)	-
1pp increase in unemployment	0.6 (1.2)	-	-	6.0 ** (1.5)	-	-
£1K increase in bursary	3.6 ** (0.8)	3.7 ** (0.8)	2.6 ** (0.5)	2.6 ** (0.6)	2.4 ** (0.7)	2.7 ** (0.4)
£1K increase in tuition grant (i.e. reduced tuition fee)	4.8 ** (1.4)	4.5 * (1.8)	-8.5 ** (1.6)	4.0 ** (0.9)	4.8 ** (1.0)	8.3 ** (0.9)
£1K increase in Golden Hello	5.0 (2.6)	5.4 * (2.5)	4.6 (2.6)	-0.7 (0.9)	-0.5 (0.9)	-0.6 (1.0)
£1K increase in ECT payment^{+}	- -	-	0.7 (1.0)	-	-	0.1 (0.4)
£1K increase in bursary degree differential	2.2 (1.3)	4.1 * (1.6)	2.7 (2.0)	-0.1 (0.9)	0.9 (0.6)	1.7 * (0.7)
R-squared (within)	0.35	0.46	0.39	0.18	0.34	0.45
Model type	Levels	Levels	Levels	Differences	Differences	Differences
Subject FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	Yes	Yes	No	Yes	Yes
Years included	2004-2016	2004-2016	2001-2021	2005-2016	2005-2016	2002-2021

Robust standard errors in parentheses ** p<0.01, * p<0.05,

$^{+}$ECT not included in models 1, 2, 4 and 5 because it did not vary during the time period of the analysis.

Appendix B: Sensitivity analysis for the scenario modelling

Table 20 The different assumptions varied under scenario 3 for sensitivity analysis

	Varying assumptions for model
ai	Pay elasticity of recruitment = 1.5
aii	Pay elasticity of recruitment = 2.5
bi	Weight attached to concurrent pay = 0%
bii	Weight attached to concurrent pay = 100%
ci	Unemployment elasticity = 3.0
cii	Unemployment elasticity = 8.0
di	Bursary elasticity = 2.5
dii	Bursary elasticity = 3.5
ei	Pay elasticity of wastage = -1.0
eii	Pay elasticity of wastage = -1.5
eiii	Pay elasticity of wastage = -2.0
eiv	Pay elasticity of wastage = -2.5
f	Basis of teacher salary changes = starting salary
g	Optimistic basket: • Pay elasticity of recruitment = 2.5 • Unemployment elasticity = 8.0 • Bursary elasticity = 3.5 • Pay elasticity of wastage = -2.5 • Basis of teacher salary changes = starting salary
h	Pessimistic basket: • Pay elasticity of recruitment = 1.5 • Unemployment elasticity = 3.0 • Bursary elasticity = 2.5 • Pay elasticity of wastage = -1 • Basis of teacher salary changes = main scale average

Table 21 Recruitment outcomes for 2025/26 for scenario 3 under varying assumptions and inputs

	2025/26 outcomes for scenario 3 after varying different model inputs														
Comparison:	**Assumptions as in the standard model (see section 3.1)**														
Changes made:	**ai**	**aii**	**bi**	**bii**	**ci**	**cii**	**di**	**dii**	**ei**	**eii**	**eiii**	**eiv**	**f**	**g**	**h**
Mathematics	110	108	109	108	108	109	107	111	107	105	104	103	120	118	105
	+1	-1	+0	-0	-1	+1	-2	+2	-2	-3	-5	-6	+11	+9	-3
Physics	20	20	20	20	20	20	20	20	19	19	19	19	22	21	19
	+0	-0	+0	-0	-0	+0	+0	-0	-1	-1	-1	-1	+2	+1	-1
Chemistry	86	85	86	85	85	86	86	84	81	81	81	81	95	91	82
	+1	-1	+0	-0	-1	+1	+1	-1	-4	-5	-5	-5	+10	+5	-4
All science	55	53	54	54	53	55	57	49	51	51	51	51	63	56	54
	+1	-1	+0	-0	-1	+0	+3	-5	-3	-3	-3	-3	+8	+2	+0
Computing	42	41	42	42	41	42	42	41	39	39	39	39	47	44	39
	+0	-0	+0	-0	-0	+0	+0	-1	-3	-3	-3	-2	+5	+3	-3
Capped measure of overall recruitment	77	76	77	76	6	77	78	75	76	76	75	75	80	78	77
	+0	-0	+0	-0	-0	+0	+1	-2	-1	-1	-1	-1	+3	+1	+0
Total cost increase (£m)	2	-2	1	-1	-2	1	2	-4	0	0	0	0	18	19	2

NFER
National Foundation for
Educational Research

Evidence for excellence in education

Restricted

The Mere, Upton Park, Slough, Berks SL1 2DQ
T: +44 (0)1753 574123 • **F:** +44 (0)1753 691632 • enquiries@nfer.ac.uk

www.nfer.ac.uk

NFER ref. GATT