Department for Education

Evaluation of the phased maths bursaries pilot: Final report

Research report

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Glossary

DfE	Department for Education.
ECP	Early career payment.
GIAS	Get Information About Schools dataset.
GiT website	Get into Teaching website. A government website where people can register their interest in a teaching career and initial teacher training.
ITT	Initial teacher training.
ITTC	Initial Teacher Training Census. An administrative dataset which counts the number of people registered on initial teacher training courses between the start of the academic year and the second Wednesday of October of each year.
PGCE	Postgraduate certificate in education. An academic qualification acquired through initial teacher training.
PMB Pilot	Phased maths bursary pilot. A financial incentive design that combined an initial teacher training bursary with subsequent early year payments to teachers in their third and fifth year of teaching.
SCITT	School-Centred Initial Teacher Training.
SWC	School workforce census. The School Workforce Census, which runs each November, collects information from schools and local authorities on the school workforce in state-funded schools in England. A national statistic on the school workforce, predominantly using the SWC, is published annually.
Uplift area	Locations where the value of early career payments is higher. These are areas identified with a high need for new teachers, as determined by DfE data on education standards and capacity to improve (DfE, 2016[1]).
UCAS	Universities and Colleges Admissions Service.

[1] Department for Education, (2016), Defining Achieving Excellence Areas: Methodology guidance note. DfE. London. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/508392/Methodology_guidance_note_-_defining_achieving_excellence_areas.pdf

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Executive Summary

Background

The Department for Education (DfE) commissioned CFE Research to evaluate the pilot phased maths bursary scheme (the PMB pilot). Prior to the PMB pilot, maths teacher trainees received a bursary of £25,000 or scholarship of £27,500 to support them through initial teacher training (ITT). The PMB pilot increased the total value of the financial incentives offered to maths teachers and restructured when the incentives were paid. The PMB pilot design was introduced in the 2018/19 academic year and offered a £20,000 bursary or a scholarship of £22,000.[2] Early Career Payments (ECPs) of £5,000 each were then paid in the third and fifth years of teaching, increasing to £7,500 in uplift areas (39 locations identified as having a high need for new teachers, as determined by DfE (DfE, 2016[3]).

DfE recognised that reducing the value of the ITT bursary or scholarship would reduce initial recruitment. The introduction of ECPs was designed to increase retention enough to more than offset this decline in recruitment, thus leading to more maths teachers in the workforce overall.

Evaluation aims

The evaluation was designed to meet two aims:

1. To assess whether the phased approach to maths bursaries secures an increase in teacher years.

2. To learn how the PMB pilot has been delivered and perceived.

Methods

To address the aims of the evaluation, a mixed methods evaluation was undertaken, including quasi-experimental impact analyses using administrative data from the Initial Teacher Training Census and the School Workforce Census. The analyses assessed the impact of the PMB pilot on 1) maths ITT recruitment, and 2) the retention of maths teachers three years after their ITT, following the first PMB payment.

To address the second aim, a combination of surveys and qualitative methods (focus groups and in-depth interviews) were undertaken with prospective teachers, teacher

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[2] See the Get into Teaching website for an explanation of the difference between bursaries and scholarships. https://getintoteaching.education.gov.uk/funding-and-support/scholarships-and-bursaries

[3] Department for Education, (2016), Defining Achieving Excellence Areas: Methodology guidance note. DfE. London. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/508392/Methodology_guidance_note_-_defining_achieving_excellence_areas.pdf

trainees and qualified teachers in four phases between June 2018 and April 2022. This element of the evaluation assessed perceptions of the PMB pilot and sought to understand from trainees and teachers whether the pilot influenced choices to apply for maths ITT and to stay in maths teaching.

Two main surveys were conducted: one with individuals considering teacher training (prospective teachers); and one with initial teacher trainees (ITTs) during their training year. Background data describing the population of prospective teachers was limited which means it was not possible to assess whether the achieved sample was representative of all prospective teachers. The survey of maths trainees was broadly representative by gender and degree-class but over-represented trainees undertaking School Centred Initial Teacher Training (SCITT) compared to those training through a higher education institution. DfE's Initial teacher training (ITT) census: 2018 to 2019 – data does not break other data down by subject. These are important caveats when comparing data between the two surveys.

Awareness of the PMB pilot and the claims process

In 2018, three-quarters of prospective trainees surveyed (75%) said they had heard of bursaries for ITT. This was twice the amount who had heard of ECPs (36%). By the time teacher trainees were surveyed in 2019, awareness of bursaries increased to 89% and ECPs to 71%. Trainee awareness of ECPs was on a par with that of maintenance loans (75%).

Prospective trainees were more likely to learn about bursaries (80%) than ECPs (55%) when first considering their career options. A quarter of trainees who knew about ECPs said they learned about them after they applied for their ITT. Government sources of information were the most important sources of information in 2018, notably the Get Into Teaching, DfE and gov.uk websites.

All third-year teacher interviewees who made a claim (n=15 interviews conducted in 2022) found the application easy and offered no suggestions to improve the application process.

Most second-year teachers did not know how to make a claim at that point; however, they were much more informed by their third year. All but one third-year teacher participant applied for an ECP.

Several third-year interviewees felt post-application communication about the progress of a claim could be improved a little, especially regarding when payments would be made and the reason for any delays. A couple of teachers said information about eligibility could be clearer.

The impact of the PMB pilot on recruitment

The impact of the PMB pilot on recruitment was estimated by comparing the change in recruitment of maths teachers after the PMB pilot was introduced to the change in recruitment of non-maths teachers at the same point in time (See Appendix B). The results suggest that moving from a maths bursary of £25,000 to a smaller £20,000 bursary reduced recruitment onto maths initial teacher training by 10-15%. This is an estimated 275 fewer maths teachers entering state schools in the 2019/20 academic year. Most of this reduction was associated with deferring (or phasing) some of the bursary payment. There was no consistent statistical evidence that introducing additional funds for maths teachers later in their career (through ECPs) influenced recruitment. These impact estimates rely on certain assumptions, which are outlined and tested in Appendix B. Overall, bursary payments influenced recruitment to ITT whereas ECPs did not.

In common with other self-reported evidence (Menzies et al, 2015[4], Gorard, et al, 2021[5]), trainees cited altruistic or personal reasons for becoming a teacher; financial factors influenced far fewer trainees. In the trainee 2019 survey, 87% said they entered teacher training because they felt they could make a difference to peoples' lives as a teacher. Around seven in ten believed they would enjoy a teaching career (72%), loved maths as a subject (71%) and thought teaching would offer different challenges and rewards each day (69%). One in six (16%) agreed that they were motivated by the financial incentives on offer to encourage people to stay in teaching.

The prospective teacher trainee survey in 2018 found the absence of financial incentives (especially bursaries) influenced choices about pursuing teacher training.

- Nearly half (48%) of those who had applied for maths ITT and knew about bursaries (see the awareness section above) said they would not have applied without one; 22% who knew about ECPs would not have applied without one.
- In 2019, four in five (79%) surveyed trainees said bursaries were influential in their overall decision to pursue ITT; ECPs influenced half (50%) of trainees.

Throughout the study, bursaries were always viewed more favourably than ECPs and exerted a stronger influence on the decision to become a teacher. Regarding bursaries, the 2018 undergraduate focus group participants said maths graduates could command higher starting salaries than the £20,000 bursary in other industrial sectors. During the same year, older prospective trainees felt the value of ECPs was too small to recompense lost income available through other careers.

[4] Menzies, L, Parameshwaran, M., Shaw, B., and Chiong, C (2015) Why Teach? Pearson. DOI: 10.13140/RG.2.2.12227.8656

[5] Stephen Gorard, Ourania Maria Ventista, Rebecca Morris & Beng Huat See (2021) Who wants to be a teacher? Findings from a survey of undergraduates in England, Educational Studies, DOI: 10.1080/03055698.2021.1915751

The impact on teacher retention

Linked Initial Teacher Training Census and School Workforce Census data was used to estimate whether the PMB pilot reduced the number of teachers leaving the profession in their third year. Attrition was defined as the point when an individual qualified to teach maths was no longer working in a state funded school in England. The results suggest that the PMB pilot reduced the probability of attrition by 37% in the year the first ECP payment of £5,000 was made (2021/22). This equates to 47 maths teachers retained who would otherwise have left teaching in state schools.

The impact of higher retention payments in uplift areas was greater. Here, the £7,500 ECP payment reduced attrition by 58%, although the sample used to estimate this value is small, so caution is needed interpreting the results. The relationship between the different ECP payment amounts and the impact on attrition was broadly linear. That is, increasing the payment value by 50% increased the effect on retention by approximately 50%.

The PMB pilot includes a second ECP payable in the 2023/24 academic year. The data necessary to evaluate the impact of this second payment is not yet available. Even if we assume that the payments will have the same effect for teachers later in their career, the number of additional teachers retained by this second payment will be less than 275 due to the eligible cohort of maths teachers being smaller by this point. The two ECPs are therefore likely to retain at most 94 (=47x2) teachers. Since this is lower than the 275 fewer teachers entering the profession in the 2019/20 academic year, the PMB pilot is therefore likely to result in a net reduction of teachers within the 2018/19 cohort by the end of the policy period.

As with the models used to assess the impact on recruitment, the impact estimates for retention also rely on assumptions (See Appendix C). The triple difference model used assumes that retention in the treatment and comparison groups would have followed a common trajectory in the absence of the policy. Indirect tests on data two years prior to the first PMB ECP found reasonably good support for the assumption. However, a placebo effect[6] was observed for chemistry teachers, who were ineligible for the policy. This suggests that the triple-difference model may not have perfectly isolated the effect of the PMB pilot and that caution should be exercised when interpreting our main findings.

The qualitative evidence from teachers interviewed in their second-year (in 2021) and third-year after receiving their first ECP (in 2022) finds ECPs exerted some influence on retention. In the 2022 fieldwork, a few teachers said they were deferring a decision about their future career until they had received their fifth year ECP, however, in both sets of interviews, ECPs were usually perceived as a welcome reward for their commitment to teaching rather than an incentive that kept them in teaching. Most believed the value of the ECP was insufficient to keep teachers who wanted to leave in the profession. Most interviewees said the push factors of teacher workload and its association with long

[6] Placebo tests is to look for an ‘effect’ in years or subjects where (logically speaking) the PMB pilot should not have had an effect.

working hours were stronger than the pull of ECPs. Those who planned to remain a teacher cited non-financial benefits like fulfilment in the role as a reason to stay.

Several interviewees suggested strategies to address workload, either alone or coupled with ECPs, would more effectively improve retention compared to ECPs alone. They advocated extra finances for schools to introduce professional development to manage workload, reduce administration associated with teaching and resource workload interventions.

Policy developments since the introduction of the PMB pilot

All research participants in this evaluation were eligible for the PMB pilot payments, which were subsequently superseded. In academic year 2020/21 maths, physics, chemistry and languages teachers were offered a higher value £26,000 bursary followed by £2,000 ECPs in their second, third and fourth years; the ECP increases to £3,000 for those eligible for uplift. Maths bursaries will be £28,000 per annum, and a scholarship is £30,000[7] for trainees starting their training course between September 2024 and July 2025. In addition, the Department has introduced a Levelling Up Premium worth up to £3,000 annually for maths, physics, chemistry and computing teachers in the first five years of their careers.

In the prospective trainee (2018) and teacher trainee (2019) surveys, the preference for different hypothetical ECP designs were tested. This test found a stronger attraction to larger bursaries and/or ECPs for which most of the total value was paid earlier in a teacher's nascent career. The current policy retention model for maths teachers is more closely aligned to this preference.

As suggested by the recruitment evidence, lower bursaries had a negative impact on recruitment; ECPs had some impact on retention, albeit the final net gain in teaching years remains unknown because eligible teachers need to receive their final ECP before the true impact can be measured. There is no quasi-experimental evidence to show ECPs influence recruitment. The qualitative evidence suggests an ECP is a useful retention tool for some. Overall, the findings suggest DfE was right to return to a higher maths bursary to improve recruitment, and provide some evidence in support of using ECPs to increase maths teacher retention. However, this evaluation only tested the recruitment and retention impacts of the PMB pilot, so it is not possible to fully understand what impact other configurations of bursaries and ECPs would have on teacher retention and recruitment.

[7] From DfE's Get into Teaching website. Accessed 25/102023: https://getintoteaching.education.gov.uk/funding-and-support/scholarships-and-bursaries

Introduction

The Department for Education (DfE) commissioned CFE Research to evaluate the pilot phased maths bursary scheme (the PMB pilot), which was announced in Autumn 2017 with the aim of improving maths teacher retention and the overall number of teacher years. The scheme was introduced because maths is one of the priority subjects for which it is challenging to recruit and retain a sufficient number of trainee and qualified teachers. It is important that the DfE recruits and retains a sufficient number of trainee and qualified maths teachers to ensure the highest quality teaching provision is in place in schools.

The pilot increased the total value of the financial incentives, with phased Early Career Payments (ECPs) over a five-year period. The ITT bursary or scholarship offered was reduced. DfE recognised a smaller ITT bursary or scholarship would reduce initial recruitment. The PMB pilot was designed to increase retention enough that more maths teachers would be working in their fifth year to more than offset lower recruitment.

Background

Teacher recruitment and retention prior to the PMB pilot

Official statistics on the school workforce in England highlighted challenges in teacher recruitment prior to the introduction of the PMB pilot. While the number of schools and pupils increased, the number of teachers fell: Between 2010-11 and 2017-18, the number of schools grew by 3% while the number FTE secondary classroom teachers fell by 8%.[8] Retention was a problem as the proportion of teachers leaving the profession rose slightly between 2012 and 2017 and retaining early career teachers was especially challenging (DfE, 2019[9]). Research by the National Foundation for Educational Research (NFER) revealed that many non-retiree leavers were driven by non-financial factors including workload, working hours and job satisfaction rather than the draw of higher pay in another identified profession.[10]

Through consultation with 44,000 teachers, the DfE's 2014 Workload Challenge identified many factors contributing to teacher workload. Teachers reported the most burdensome tasks were lesson planning and data management, and expressed the level of detail, duplication or bureaucracy in these tasks were high.[11] In response, the DfE provided

[8] https://explore-education-statistics.service.gov.uk/find-statistics/school-workforce-in-england#explore-data-and-files
[9] DfE (2019) Teacher Recruitment and Retention Strategy. DfE. London. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/786856/DFE_Teacher_Retention_Strategy_Report.pdf
[10] Bamford, S. and Worth, J. (2017). *Teacher Retention and Turnover Research. Research Update 3: Is the Grass Greener Beyond Teaching?* Slough: NFER https://www.nfer.ac.uk/publications/teacher-retention-and-turnover-research-research-update-3-is-the-grass-greener-beyond-teaching/
[11] Gibson, S., Oliver, L & Dennison, M. (2015). *Workload Challenge: Analysis of teacher consultation responses*. https://www.gov.uk/government/publications/workload-challenge-analysis-of-teacher-responses

resources to help schools tackle some of these issues,[12] including advice for reducing workload in initial teacher education.[13] Yet analysis of school workforce data by the Education Policy Institute has identified persistent issues with teacher retention prior to the introduction of the PMB pilot[14].

A summary of financial incentives for teacher recruitment

Since 2000, teachers have been incentivised to take fee-paying ITT routes. In 2000, the government introduced a £6,000 tax-free payment to all full-time postgraduate trainees, which was increased to £9,000 in 2007.

In 2010, the coalition government reduced the bursary back down to £6,000 for subjects such as music and RE. In 2012, the same year that the current shortage of maths and science teachers began to appear (Sims, 2018), the government increased the bursary to £15,000 in maths, physics and chemistry, while simultaneously dropping the value of the bursary in many other subjects to £5,000. Bursary values also became conditional on the class of undergraduate degree held by an applicant. This represented an important shift in the objective of bursary payments: away from providing financial support for trainees, toward incentivising recruitment in specific shortage subjects.

In recent years, the government has continued to adjust the subject-specific bursary rates in an attempt to tackle shortages in specific areas. By 2017, bursary values for trainees with an upper second (2:1) degree ranged from £25,000 in severe-shortage subjects such as maths and physics, to £4,000 in minor-shortage subjects such as music, down to £0 in business. Indeed, by 2017, there was substantial variation in bursary value even within STEM subjects, with maths and physics attracting £25,000 training incentives, chemistry £20,000 and biology just £12,000. Given that trainees with a science degree can choose to train in any of the three main science subjects (via a subject knowledge enhancement course), and most trainees will go on to teach all three sciences anyway, these bursary disparities may well have resulted in biology graduates choosing to train as physics teachers in order to benefit from the £13,000 additional tax-free payments.

As shortages and bursary values have increased, so has government spending on bursaries. Indeed, a 2016 report by the National Audit Office noted that government spending on bursaries had risen to around £167m per year (NAO, 2016). The auditors recommended that this level of spending required government to conduct an evaluation of bursaries effect on recruitment and retention.

[12] https://www.gov.uk/government/collections/reducing-school-workload
[13] DfE (2018). *Addressing teacher workload in Initial Teacher Education (ITE): Advice for ITE providers*. https://www.gov.uk/government/publications/addressing-workload-in-initial-teacher-education-ite
[14] EPI (2018). *Blog: Number of teachers in state schools continues to decline*. 28 June 2018. https://epi.org.uk/publications-and-research/teachers-continue-to-decline/

Around this time, research began to identify a clear downward trend in teacher retention rates (Lynch et al., 2016; Sims, 2017). This prompted the NAO and Public Accounts Committee to recommend that a greater emphasis be placed on improving retention, as opposed to recruitment (NAO, 2017; PAC, 2017). That same year, a study for the Gatsby Foundation found that retention incentives paid to early-career teachers in shortage subjects would be a cost-effective way of increasing the supply of experienced teachers (Sims, 2017).

The PMB pilot rationale and offer

Following the announcement of the PMB pilot in Autumn 2017, the Department for Education (DfE) introduced the *Teacher Recruitment and Retention Strategy*[15] in 2019. The strategy included a wider package of policies designed to address teacher shortages. The strategy changed emphasis from recruitment to retention.

> "Once these reforms have taken place, we expect that around 40% of bursary spend in phased subjects will be on retention, marking a fundamental shift in bursary policy to support both recruitment and retention." (p.22)

The PMB pilot[16] was one policy included in the strategy which split the prior payment of an ITT bursary into stages: a smaller ITT bursary or scholarship, followed by two ECPs made in the third and fifth years of teaching. Combined, the bursary and ECPs were a higher value than the ITT bursary or scholarship on offer before the PMB pilot.

Some locations in the country were designated as uplift areas where the value of early career payments was higher (n=39). These were areas with a high need for new teachers, as determined by DfE data on education standards and capacity to improve (DfE, 2016[17]).

This evaluation began at the start of the PMB pilot (the 2018/19 academic year) when the value of an ITT bursary was £20,000 and an ITT scholarship £22,000[18]. These were paid in 10 equal monthly instalments in the training year. ECPs of £5,000 each were then paid in the third and fifth years of teaching, increasing to £7,500 in uplift areas. In 2020/21, the amounts paid via bursaries, scholarships and ECPs changed, as per Table 1. During this year, the amounts for which maths teachers were eligible was aligned to that of physics, chemistry, and modern languages teacher trainees.

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[15] https://www.gov.uk/government/publications/teacher-recruitment-and-retention-strategy

[16] The term 'phased maths bursary' refers to the combination of two component incentives: the ITT bursary/scholarship and early career payments. The term is not used publicly because those components were presented as separate initiatives and because they are not restricted to maths only.

[17] Department for Education, (2016), Defining Achieving Excellence Areas: Methodology guidance note. DfE. London. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/508392/Methodology_guidance_note_-_defining_achieving_excellence_areas.pdf

[18] See the Get into Teaching website for an explanation of the difference between bursaries and scholarships. https://getintoteaching.education.gov.uk/funding-and-support/scholarships-and-bursaries

Table 1: Early career payments for maths by year

ITT year	Bursary	Scholarship	ECP years	ECP Amount
2018 to 2019	£20,000	£22,000	2021 and 2023	£5,000
2019 to 2020	£20,000	£22,000	2022 and 2024	£5,000
2020 to 2021	£26,000	£28,000	2022, 2023 and 2024	£2,000

Sources: Gov.uk – ITT manuals 2018 to 2020; and Early Career Payments for Teachers[19]

These changes between years have implications for this evaluation, especially the impact analyses, because the evaluators track changes to recruitment over time. Changing the value of bursaries and ECPs influences choice and hence recruitment and retention.

The PMB pilot eligibility and conditions

This evaluation tracks maths ITT postgraduates who trained in the 2018/19 academic year. As now, the postgraduate ITT bursary then was available to applicants with a 1st, 2:1, 2:2 class undergraduate degree, master's degree or PhD; scholarships were not typically offered to those with a 2:2 class undergraduate degree.

There are numerous routes into ITT. When the PMB pilot was conceived, only teachers trained via the main three postgraduate fee-funded routes were eligible. These were training through higher education institute (HEI) postgraduate courses (47% of the intake); School Direct (26%); and School-Centred Initial Teacher Training (SCITT, 14%)[20]. ECPs were extended to teachers on salaried routes before the first of these payments were made in the 2021/22 academic year.

Evaluation aims & objectives

The core aims of the phased maths bursaries pilot evaluation were to:

1. Assess whether the phased approach to maths bursaries secures an increase in teacher years and

2. Learn how the PMB pilot has been delivered and perceived.

As described earlier, the phased approach means offering two components to new teachers: a bursary and early career payments (ECPs). Five research objectives were agreed to evaluate how the PMB pilot was delivered and whether it was effective in

19 https://www.gov.uk/guidance/early-career-payments-guidance-for-teachers-and-schools

20 Department for Education (2018) Initial Teacher Training (ITT) Census for the academic year 2018 to 2019, England. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/759716/ITT_Census_2018_to_2019_main_text.pdf

increasing the number of teacher years (the number of teachers and the length of time they spend in the profession). These were to:

- Assess awareness and understanding of the bursary and ECPs amongst trainees.
- Identify any influence on the recruitment and retention of maths teachers in their early careers.
- Understand teachers' perceptions of the PMB pilot – what they think of the delivery, whether the change to payments encourages them to stay in maths teaching, and, if so, how and why does the PMB pilot achieve its aims.
- Understand the influence on choices to apply for maths ITT following registering interest and those who choose not to apply after registering interest.
- Capture insights from teachers as they progress through the PMB pilot.

These objectives were met through two lines of enquiry.

Methods

The evaluation design was mixed method, including quasi-experimental impact analyses of administrative data from the Initial Teacher Training Census and the School Workforce Census (to address aim 1) and a process evaluation based on primary research (to address aim 2).

Process evaluation and self-reported impacts

Primary research was undertaken across four stages to explore the PMB pilot's delivery and the experiences of prospective teacher trainees, teacher trainees, early career teachers and school leaders. Longitudinal aspects of the method followed individuals considering teacher training in 2018 who progressed into teacher training in the 2018/19 academic year. In contrast, cross-sectional methods collected data at a single point in time.

Table 2 summarises the primary research evaluation methods used. Further detail on each of the research phases is also provided in annex A.

The advent of the COVID-19 pandemic and changing departmental priorities meant primary research activity was redesigned to a solely qualitative approach from 2020 onwards.

Table 2: The primary research activities undertaken for the evaluation

Research phase	Methods and purpose	Dates	Number of respondents
	Potential teacher trainees		

Research phase	Methods and purpose	Dates	Number of respondents
Phase 1	**Online survey** and **Computer Aided Telephone Interviewing** boost of people registered on the Get into Teaching (GiT) website with the intention to start training in September 2018 and maths as a first or second subject preference. UCAS applicants for maths PGCE courses were also included in the sample. The survey gauged awareness and understanding of the bursary and ECPs, and their influence on decisions about teaching careers. The survey also included a preference test (using a max-diff method) on different configurations of bursary and ECP payments.	June – July 2018	551
Phase 1	**Focus groups** with final year undergraduate maths students. These groups explored views on awareness, knowledge and influence in more detail.	July 2018	3 groups, 14 undergraduates in total
Phase 1	**In-depth interviews** with GiT registrants aged >30. As with the focus groups, these interviews explored views on awareness, knowledge and influence on those moving into teaching after a period of employment.	July 2018	12
	Initial teacher trainees		
Phase 2	An **online survey** of maths trainees enrolled for the 2018/19 academic year. Respondents from the first survey were recontacted. A direct invite to the survey was also issued to students by ITT providers. This survey assessed changes in awareness and understanding of bursaries and ECPs, and their influence on decisions about teaching careers.	May – June 2019	820; 190 PMB eligible
	Early career teachers		
Phase 2	**In-depth interviews** with newly qualified teachers. Baseline interviews to explore views on their career at an early stage and how the promise of early career payments influences retention, especially in comparison to other aspects of teaching.	Sep – Nov 2019	30

Research phase	Methods and purpose	Dates	Number of respondents
Phase 3	**Longitudinal and cross-sectional interviews** with second year teachers. Follow-up interviews to update views expressed after qualification and identify the factors that lead to changes in opinion.	Nov 2020 – Feb 2021	22
	Teachers in their third year		
Phase 4	**In-depth longitudinal interviews** with teachers after receiving their first early career payment. Further follow-up interviews held after the first early career payment is made to consider the impact of early career payments on retention.	Mar – Apr 2022	15

Sampling and statistical significance

The two surveys in this study achieved PMB-eligible samples of 551 potential trainees and 190 teacher trainees. The sample frame for potential trainees was 3,780 people registered on the Get into Teaching (GiT) website selecting maths as their first or second training subject preference, plus UCAS applicants for maths PGCE courses. Two-stage sampling was used to survey teacher trainees. Firstly, all initial teacher training (ITT) providers who offered maths ITT were contacted and asked to disseminate a survey link to all maths trainees (195 providers at the time of the survey). The 190 responses came from 81 ITT providers.

A discussion on the challenges calculating response rates is provided in Appendix A. The best estimate for the response rate for potential trainees was 16%. It is not possible to calculate a response rate for teacher trainees as the number contacted via ITT providers is unknown.

In both cases, achieved samples were self-selecting. This means the samples are not necessarily representative of trainee maths teaches/prospective trainee maths teachers. Background data that describes the population characteristics of potential trainees was limited, so representation was not assessed, and the data has not been weighted. The achieved teacher trainee sample was broadly representative of all maths trainees by gender and degree class achieved (see Table 5, Appendix A). For type of ITT training, the survey overrepresented respondents who had completed a SCITT (38% in survey compared to 14% in population) and underrepresented those who had trained in higher education institutions (41% in survey compared to 50% in population). All age groups were represented in the achieved sample, older age categories were overrepresented, and younger age categories were underrepresented. It is also the case that these differences in sample representation are likely to be present in the qualitative interview sample because interviewees were identified following survey completion.

In the case of trainees, a sample size of 190 limited the potential for sub-groups analyses because of the confidence intervals associated with small base sizes. Confidence intervals describe the range in which a real value will fall based on a statistic derived from data (in this case, survey data). For example, Table 3 shows that if 50% of 551 potential teacher trainees agree with a statement, the true proportion who agree is ±4.2%, or between around 46% and 54%. The table uses the 95% level, which means the interval holds if repeating the survey 19 out of 20 times using the same sampling and methods. Smaller achieved samples have larger confidence intervals. While confidence intervals assume a simple random sample, which is not the case for the surveys reported here, they still provide a useful indication of the minimum range that the values reported are likely to fall within.

Table 3: Confidence intervals at the 95% confidence level for selected survey base sizes

Achieved samples	Interval: 50%	Interval: 30% / 70%	Interval: 10% / 90%
551 interviews	±4.2%	±3.8%	±2.5%
190 interviews	±7.1%	±6.5%	±4.3%
130 interviews	±8.6%	±7.9%	±5.2%

Impact evaluation

To assess whether the phased approach to maths bursaries increases the number of teaching years, quasi-experimental analysis was undertaken to assess the impact of the PMB on the recruitment of maths teachers before and after the PMB was introduced and the retention of maths teachers before and after the initial third year payment.

Separate analyses were undertaken to assess the impact of the PMB on recruitment and retention. The recruitment analysis used a panel of Initial Teacher Training Census (ITTC) data from 2014 to 2018.The retention analysis used this panel of (ITTC) data matched to data from the School Workforce Census (SWC). The (ITTC) is an administrative dataset which counts the number of people registered on initial teacher training courses between the start of the academic year and the second Wednesday of October of each year. The ITTC allowed us to count the number of individuals who began training to teach in each subject in each academic year. The SWC is an administrative dataset that collects information from schools and local authorities on the school workforce in state-funded schools in England. The SWC allowed us to count the number of teachers from each ITT cohort who remain in teaching in each academic year. Linking the two datasets enabled us to calculate teacher retention rates from the point of training.

For the recruitment analysis, the method used was a comparative interrupted time series model which looks at the deviation from trend in recruitment to maths ITT at the point the PMB pilot was introduced, relative to the deviation from trend in recruitment to other subjects that were not eligible for the PMB pilot. The ideal comparison group courses would have been subjects which had similar bursary values, require similar skills and for which teachers have similar earnings potential outside of teaching. No single subject fulfilled all these criteria, so a mixture of computing and science initial teacher training courses were used in the comparison groups. Appendix B describes the methods used to estimate the PMB policy impact on recruitment in full.

Analysis to assess the impact on retention at the first ECP payment point has also been undertaken using a triple-difference design. Difference in difference analysis relies on a parallel trend assumption: that differences between treatment and control groups would have remained constant over time in the absence of treatment. In this case, external changes outside of the PMB pilot (other economic draws and barriers facing those with relevant maths qualifications, changes to financial packages in other subjects, etc.) may violate the parallel trend assumption. The triple difference design uses multiple comparison groups to help address these difficulties (See Appendix C).

The three differences used in the attrition model are:

- Changes in retention of maths teachers in the eligible trainee cohort (those in initial teacher training in 2018/19 academic year) before and after the policy was introduced
- Net of changes in retention of maths teachers in ineligible cohorts (earlier ITT cohorts) before and after the policy was introduced *and*
- Net of the changes in the retention of non-maths teachers in eligible cohorts (ITT in other subjects in 2018/19) before and after the policy was introduced

Awareness of incentives and their influence on decision-making

The earlier stages of the evaluation explored how much those considering teaching (2018) and the trainees (2019) knew about the PMB pilot, and the influence exerted by bursaries and ECPs on decisions to teach maths.

Prospective trainees were more aware of bursaries than early career payments

The 2018 survey of prospective teacher trainees eligible for the PMB pilot found prompted awareness[21] of ITT bursaries was twice as high (75% awareness) compared to maths ECPs (36% awareness)[22]. Respondents who had already accepted an ITT place for maths were more aware of ECPs (49%) than those yet to make a firm decision (33%).

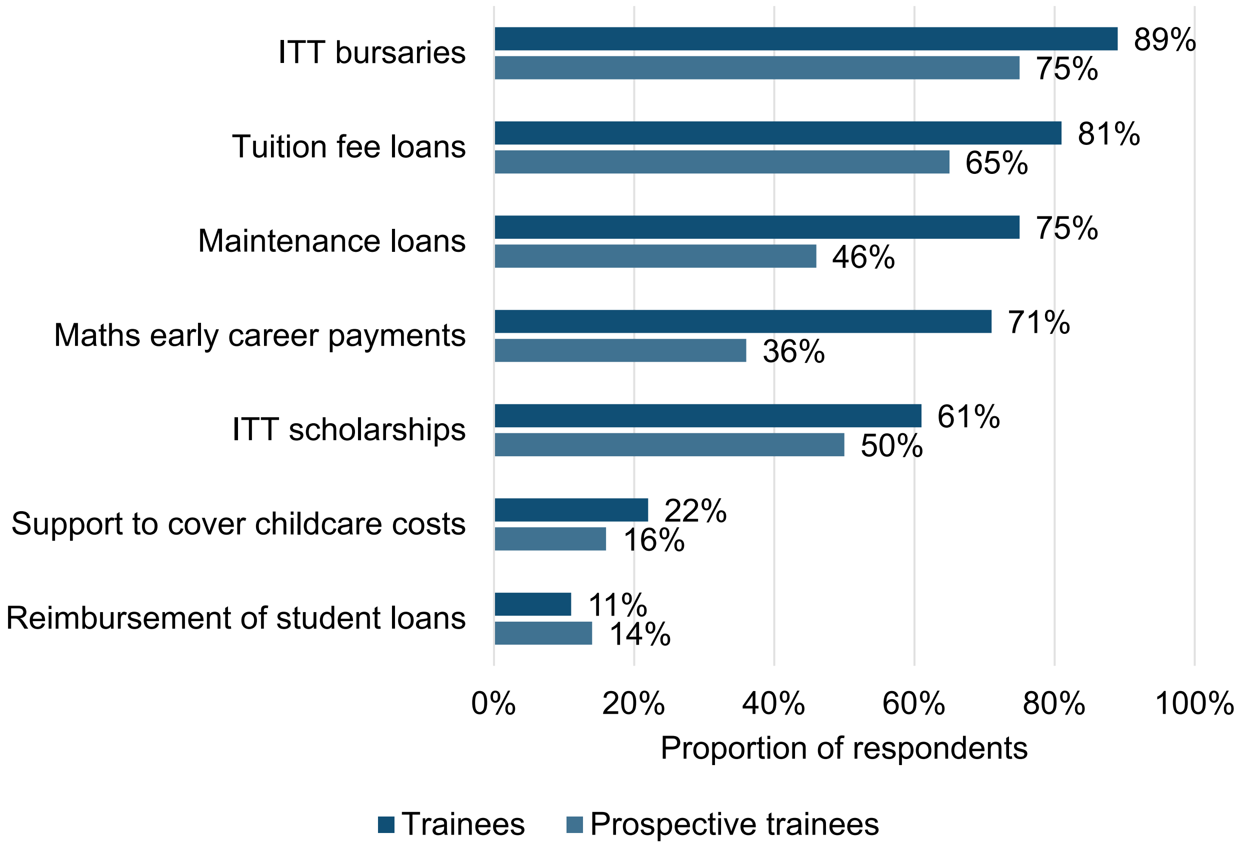
Bursaries were used to encourage teacher recruitment before the introduction of early career payments in 2018/19 (Roberts, Long and Danechi, 2023)[23]. Bursaries were better understood at that time compared to ECPs.

Teacher trainees remained more aware of bursaries

Teacher trainees eligible for bursaries and ECPs were surveyed in 2019, at which point nine in ten (89%) said they had heard of bursaries[24]. Awareness of ECPs amongst trainees was 71%, higher than prospective trainees (36%) (Figure 1).

[21] Meaning respondents selected the incentives they had heard of from a list.
[22] n=551 prospective trainees eligible for a bursary and an ECP.
[23] Roberts, N., Long, R. and Danechi, S (2023) Initial teacher training in England. House of Commons Briefing Paper, Number 6710, 24 April 2023. London. [Initial teacher training in England - House of Commons Library (parliament.uk)]
[24] n=190 maths teacher trainees eligible for a bursary and an ECP

Figure 1: Comparative awareness of ECPs, bursaries and other selected financial offers between prospective trainees and ITT trainees



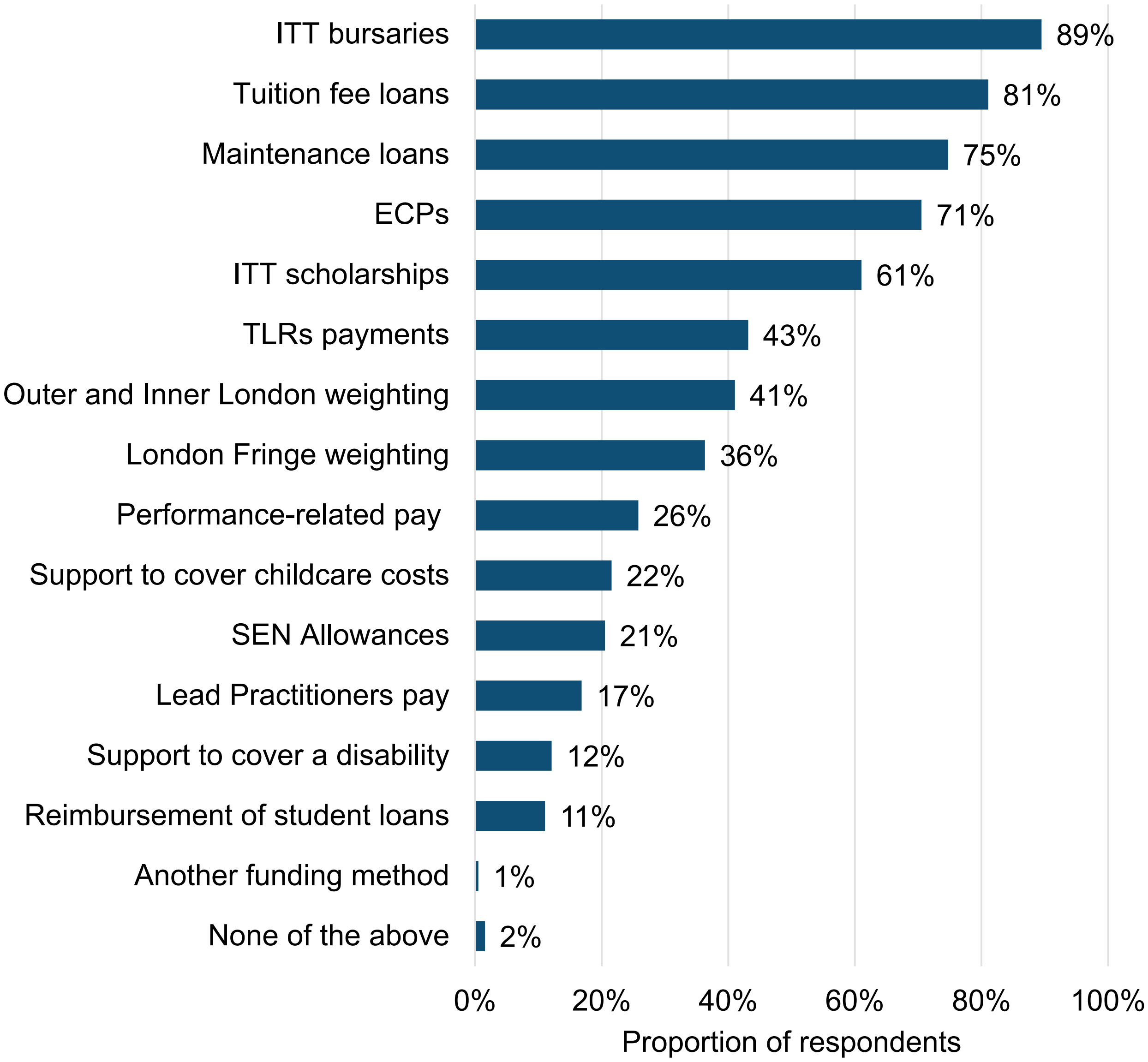
Sources: Survey of prospective maths teacher trainees, 2018, n=551; Survey of maths teacher trainees, 2019, n=190

Just over half of respondents said they first became aware of Maths ECPs (55%) when they were considering their career options. By comparison, most became aware of ITT bursaries (80%) at this point. A quarter of trainees who knew about ECPs said they learned about them after they applied for their ITT. This also helps account for their higher awareness compared to those considering a teaching career.

Government websites were important sources of information, especially about ECPs. The Get into Teaching website was where trainees most often first heard about ECPs (37%) and ITT bursaries (40%). The second most common source of information was the DfE or gov.uk website (ECP: 27%; ITT bursary 17%).

Figure 2 shows prompted awareness of ECPs amongst trainees was also higher than many other forms of financial offers such as London weightings (41%), Teaching & Learning Responsibility payments (43%) and reimbursement of student loans (11%).

Figure 2: Trainees' awareness of different funding offers[25]



Source: Survey of maths teacher trainees, 2019, n=190

Trainees said they entered teaching for non-financial reasons

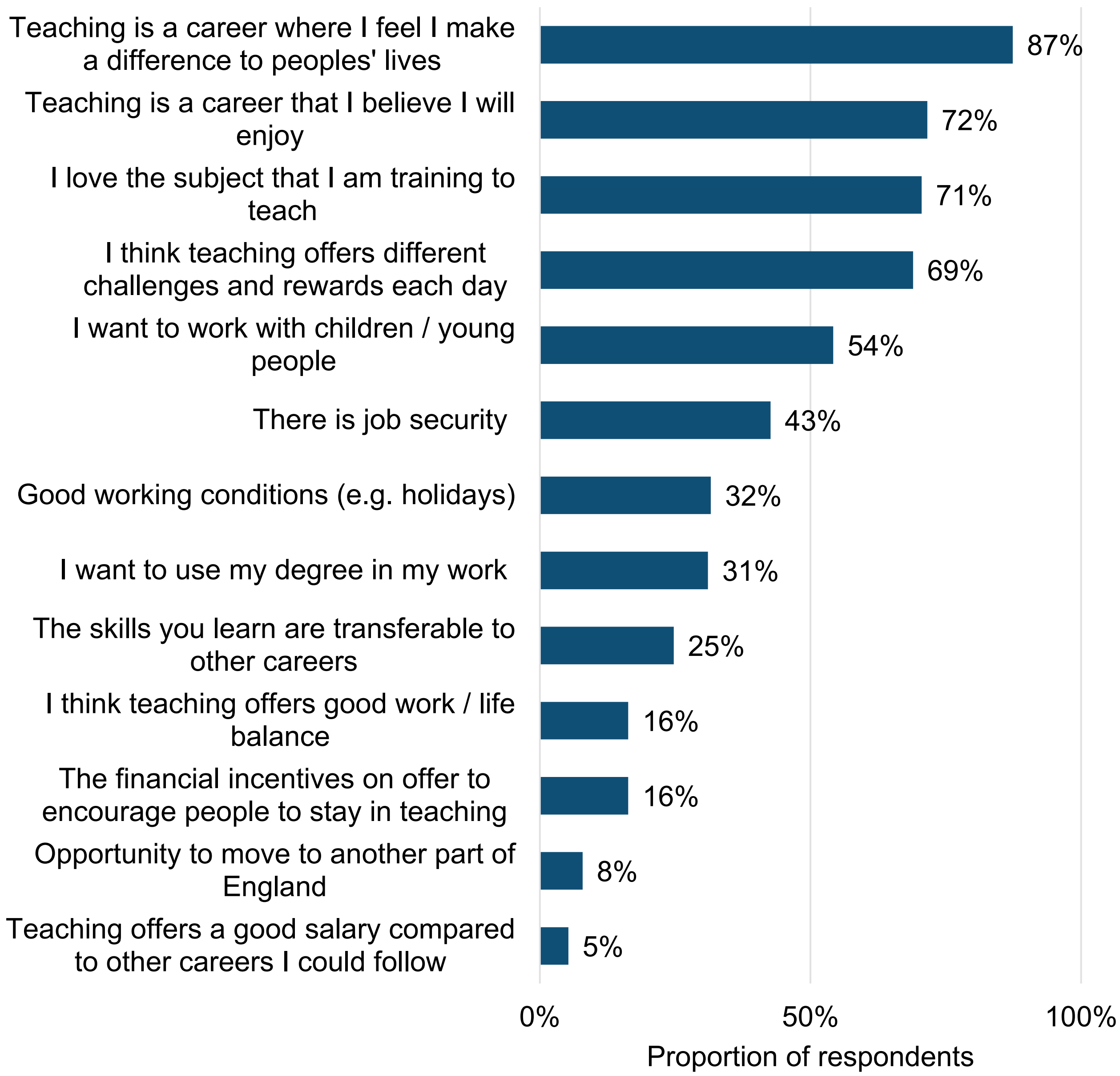
Figure 3 reflects much of the existing research exploring why teachers and trainees say they teach (Menzies et al, 2015[26]; Gorard, et al, 2021[27]).

[25] Question: What funding offers for those training to teach or for qualified teachers had you heard of before today?

[26] Menzies, L, Parameshwaran, M., Shaw, B., and Chiong, C (2015) Why Teach? Pearson. DOI: 10.13140/RG.2.2.12227.8656

[27] Stephen Gorard, Ourania Maria Ventista, Rebecca Morris & Beng Huat See (2021) Who wants to be a teacher? Findings from a survey of undergraduates in England, Educational Studies, DOI: 10.1080/03055698.2021.1915751

Figure 3: Motivations for entering initial teacher training[28]



Source: Maths teacher trainees eligible for early career payments, 2019. n=190

Those already in or entering the career typically cited altruistic or personal reasons for becoming a teacher; financial incentives typically feature lower on the list. Later qualitative interviews with early career teachers (in 2019) also found pay, pensions and financial recruitment incentives were not cited as reasons to enter teaching by interviewees. Many interviewees aged 30 or older who left careers in other industries said they took a substantial salary reduction to pursue teaching.

[28] Question: Which, if any, of the following were your original motivations for entering a career in teaching?

> “Outside of education, there’s an awful lot more money. Thirteen years ago, I earned more in bonus that year than I’ll earn in salary this year. It was an astonishing amount of money. However, I had a job that I hated, and I wanted to do something where I could come home every night and feel like I was achieving something positive in the world.”
>
> Newly qualified teacher, aged 30 or older, October 2019

However, Gorard *et al.*’s research also considered comparator views through a wider survey of all undergraduates, not just those considering or entering teaching. Here, financial factors are influential in rejecting teaching careers: “Issues like pay and career prospects are more important to the students who might otherwise have become teachers (according to their own reports)” (ibid, p.13).

The influence of financial incentives in choosing teaching was suggested in the 2018 survey of prospective teacher trainees for this evaluation. Nearly half of respondents who had already applied for maths initial training and who knew about bursaries (48%) would not have applied without one; more than one in five who knew about ECPs (22%) said the same about that incentive. Of applicants who knew about bursaries and ECPs, 59% would not have applied without a bursary and 19% would not have applied without an ECP. In 2019, two-thirds of trainees (67%) said the bursary influenced their choice to enter teacher training. A third (33%) said the same about ECPs.

Views on the claims processes of the PMB pilot

Ease of making a claim

Around three-quarters of second-year teachers interviewed said they did not know how to claim for an ECP at the time of their interview. The final claims process was not in place at the time this research was conducted. They were unsure whether they or the school that employed them would make a claim. Most said an email to their personal account to provide information on the claim process sent by their school or their ITT training provider would be the best way to explain the claims process.

However, third-year teachers were much more informed about the claims process, typically via an early email sent well before applications were due. Whilst a few interviewees still felt communication about their claim could be improved (principally about reasons for slight delays in payments), all who made an application said the process itself was straightforward and suggested no improvements. They especially welcomed regular communication before and after their application.

A few third-year teachers felt pre-application communication about eligibility criteria could have been clearer. One was unsure if School Direct trainees were eligible and the main improvements when suggested were clarifying who was eligible and when a payment would be received.

The impact of incentives on teacher recruitment

Impact on recruitment based on trends in ITT recruitment data

The first part of the analysis asked how moving from the old maths bursary to the PMB approach affected recruitment to maths ITT. This question considers the impact of reducing the *initial* bursary (from £25,000 to £20,000) and introducing two early career payments of £5,000 each. Comparative interrupted time series models were used to compare the change in recruitment in maths to the change in recruitment in other subjects, after the bursary value was changed.

The model estimated that moving from the old maths bursary to the PMB pilot was associated with a reduction in recruitment to maths ITT of 10-15%. This finding is robust to the use of different comparison group subjects and other sample restrictions. The model also shows the PMB pilot had the same impact on recruitment when compared to subjects or within regions which are not eligible for other contemporary pilots such as the Teacher Student Loan Reimbursement scheme.

Secondly, the model isolates the impact of the phased financial component of the PMB (ECPs) on recruitment to maths ITT. There was no consistent evidence that introducing ECPs affected recruitment to maths ITT.

Finally, the effect of phasing (delaying) some of the total bursary payment on recruitment to maths ITT was estimated. This question considers the timing of bursary payments, leaving aside total bursary value. The results associate phasing with a reduction in recruitment. Indeed, the evidence suggests that phasing the payments can account for most of the reduction in recruitment associated with the introduction of the PMB pilot.

Taken together, these findings suggest that ITT bursaries incentivise recruitment to maths teacher training but ECPs paid in the third year of the career do not. Potential explanations for these findings are discussed in the next section.

Self-reported impacts derived from primary research

The influence of incentives on recruitment

We noted earlier that bursaries exerted a stronger influence on the decision to apply for teacher training than early career payments. However, evidence showed the interplay between bursaries and ECPs was complex: trainees and those considering teacher training held nuanced opinions on the relative merits of different incentives.

Views on the monetary value of bursaries and ECPs

The evidence from in-depth interviews undertaken in 2018 highlighted the monetary values of the bursary and ECPs were influential. Bursaries were generally viewed positively, enabling trainees to earn a reasonable amount during their training year. However, undergraduate interviewees also highlighted the value of a bursary (£20,000 at the time) was lower than the salaries maths graduates could command in other sectors of the economy. Older prospective trainees felt that the value of each ECP (£5,000 in the third, then fifth year of teaching) were too small to recompense for the lost income available through other career paths.

> "If you're saying that the average salary is £26,000 per year and you have in the third and fifth year £5,000 one-off payments, that's still £31,000 which is still [much] lower than most other jobs."

Undergraduate focus group participant, July 2018

Bursaries were relatively more attractive than ECPs

A series of hypothetical bursary / ECP options were preference-tested with prospective trainees using a statistical ranking method called max-diff. When used in surveys, max-diff presents respondents with a series of choices from which they select their most and least preferred options. Table 4 (overleaf) shows the six options used in the question[29] and includes the net preference assigned to each option for: prospective trainees (2018) in the penultimate column; and trainees (2019) in the final column. The interesting aspect of this table is the relative attraction to option 6. When paired against all other options, there was an +11-percentage point preference for this option. Conversely, the PMB pilot's design had a 6-percentage point deficit for preference – on average, it was unattractive when presented alongside the other options.

The reason the attraction towards option 6 is interesting is the stated bursary is not the largest. However, this hypothetical shows the ECP tapering over several years, with most money received by the end of the second year in teaching. Most of the total value for the bursary and ECPs is paid by the end of year 1. Option 1 offered the largest bursary and was the second-choice option. Table 4 shows a general attraction towards larger bursaries and/or earlier career payments over shorter periods of deferral. In the case of the top three options, at least 80% of the total financial incentive is paid by the end of the first year of teaching.

[29] Here are several different ways the same amount of financial support might be delivered to those training to teach over a six-year period. Which is most attractive to you, and which is the least attractive?

Table 4: Hypothetical financial support structures

Paired options	ITT	Year 1	Year 2	Year 3	Year 4	Year 5	Net pref (2018)	Net pref (2019)
Option 6	£20,000	£4,000	£3,000	£2,000	£1,000	£0	+11%	+22%
Option 1	£26,000	£4,000	£0	£0	£0	£0	+7%	+13%
Option 4	£24,000	£0	£0	£2,000	£0	£4,000	-1%	+3%
Option 3	£15,000	£3,000	£3,000	£3,000	£3,000	£3,000	-1%	-7%
Option 2 (PMB)	£20,000	£0	£0	£5,000	£0	£5,000	-6%	-5%
Option 5	£10,000	£4,000	£4,000	£4,000	£4,000	£4,000	-11%	-7%

Sources: Survey of prospective maths teacher trainees, 2018, n=551; Survey of maths teacher trainees, 2019, n=190

By the time of the trainee survey (2019), attraction towards options 6 and 1 solidified. Interviewees would have begun receiving bursaries by the time they were surveyed, which may have strengthened attraction towards higher bursaries when answering the question, although option 6 (with a relatively modest bursary) was the strongest preference.

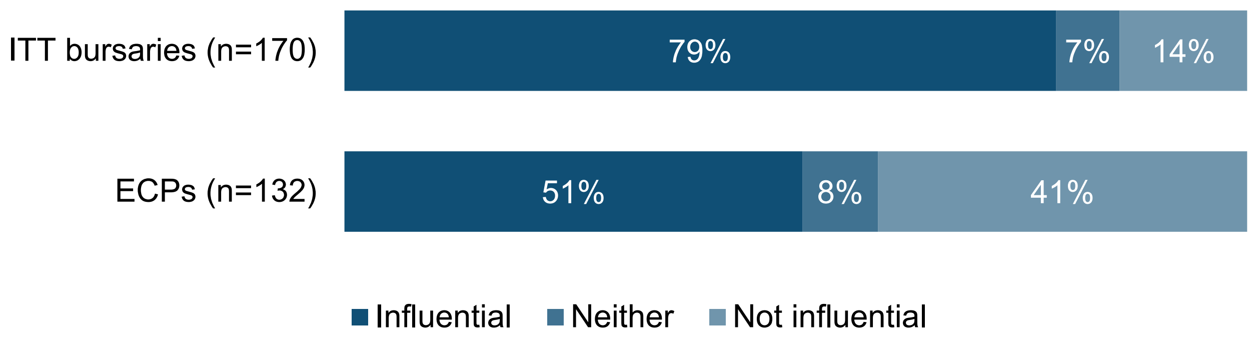
The influence of incentives on teaching career decisions

Bursaries were relatively more influential than ECPs

The stronger attraction of bursaries compared to ECPs amongst the trainee sample was also present when trainees were asked about the influence of financial incentives in a decision to pursue initial teacher training[30]. Four in five (79%) said bursaries exerted at least some influence on their decision; half (51%) said the same about ECPs (Figure 4).

[30] How influential, if at all, were the following in your decision to pursue the initial teacher training course you have selected?

Figure 4: Influence of incentives on a decision to pursue the initial teacher training



Source: Survey of maths initial teacher trainees who had heard of each incentive, 2019.

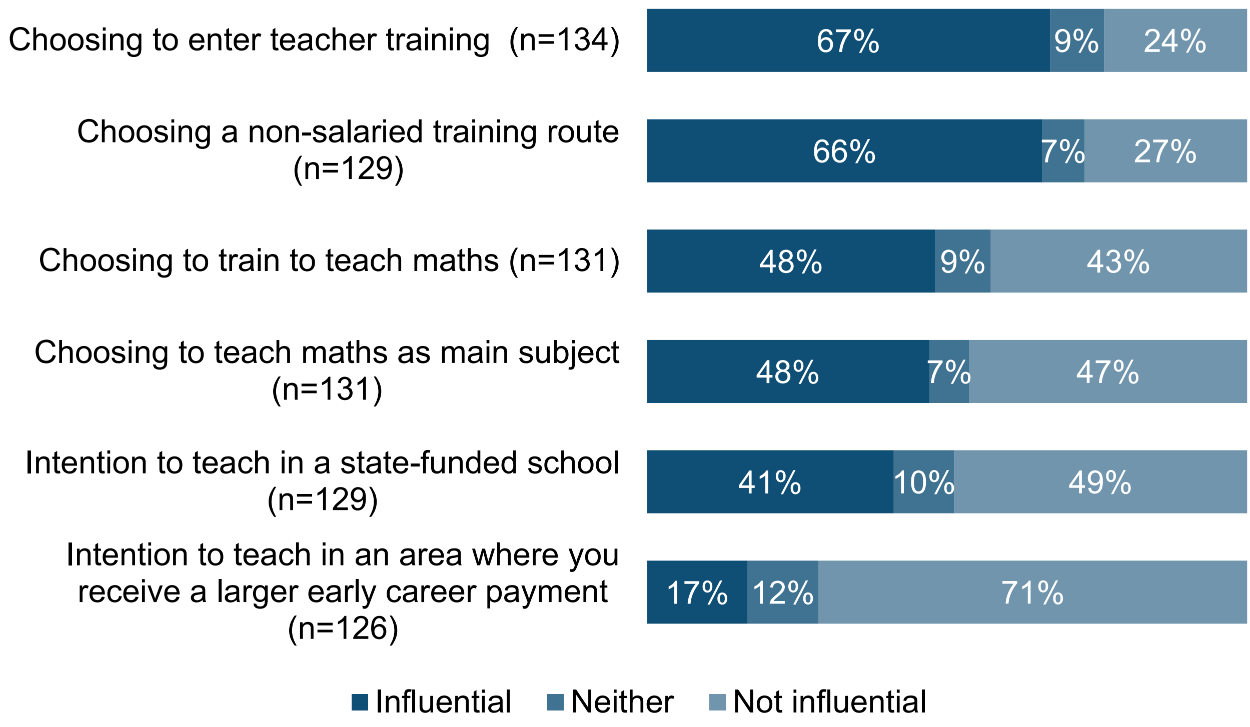
Trainees who were aware of bursaries or ECPs then answered follow-up questions to identify the extent the financial incentives influenced specific career decisions. Again, bursaries (Figure 5, overleaf) exerted stronger influence than ECPs (Figure 6) on all decisions, except the intention to teach in an area where they would receive a larger ECP (uplift areas). In both cases, one in six (17%) said the bursary or the ECP would influence such a decision.

Of the other options, bursaries were twice as influential as ECPs on decisions to enter initial teacher training (67% versus 33%) and choosing a non-salaried route (66% versus 33%). Bursaries were also almost twice as influential as ECPs on decisions to teach maths, and to do so as a main subject.

> "I probably wouldn't have [considered] teaching if it wasn't for the tax-free bursary. I always wanted to teach children, but I was following a finance [career because of the] money, so the bursary convinced me to [pursue teaching]."

Undergraduate focus group participant, July 2018

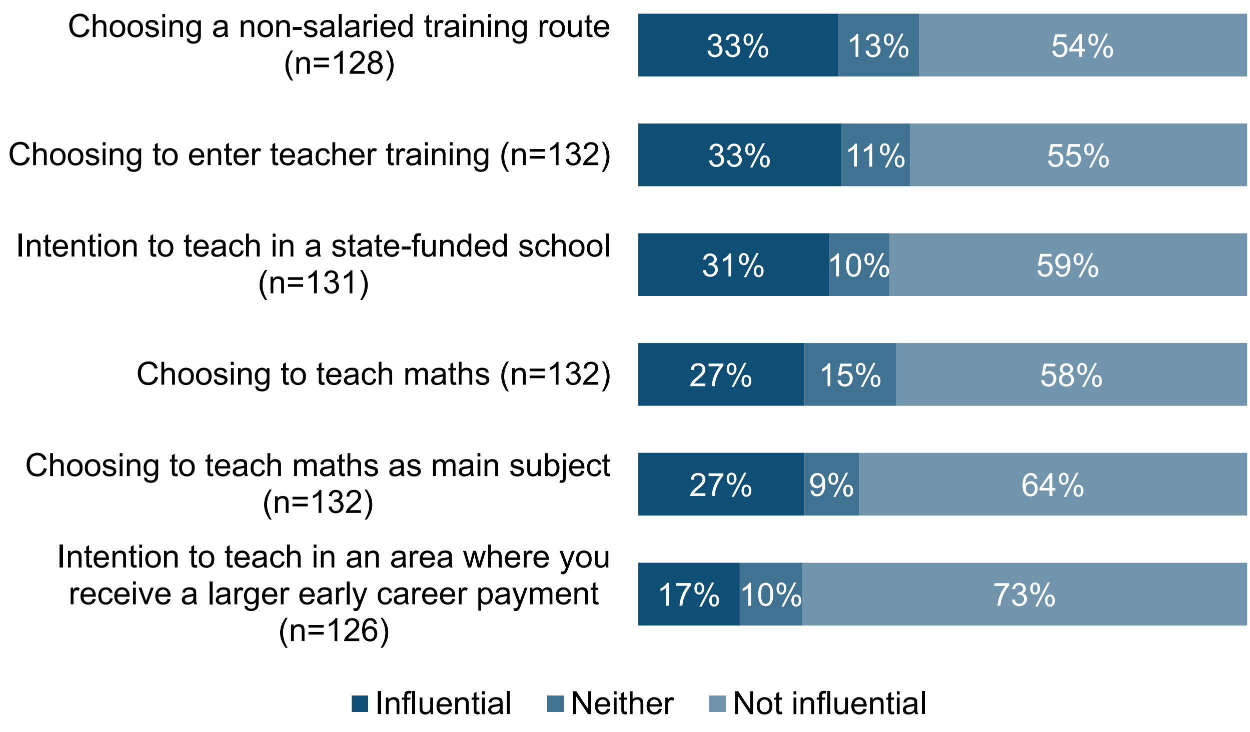
Figure 5: Stated influence of the bursary on different career decisions [31]



Source: Survey of maths teacher trainees, 2019. Respondents that had heard of bursaries or ECPs. Bases vary (in chart) as don't know excluded.

[31] Question: How influential, if at all, was the maths ITT bursary in the following decisions, on a scale of 1 to 7 where 1 is 'not at all influential' and 7 is 'very influential'? "Not influential" = aggregate score of 1 to 3; "Influential" = aggregate score of 5 to 7.

Figure 6: Stated influence of ECPs on different career decisions[32]



Source: Survey of maths teacher trainees, 2019. Respondents that had heard of ECPs. Bases vary (in chart) as don't know excluded.

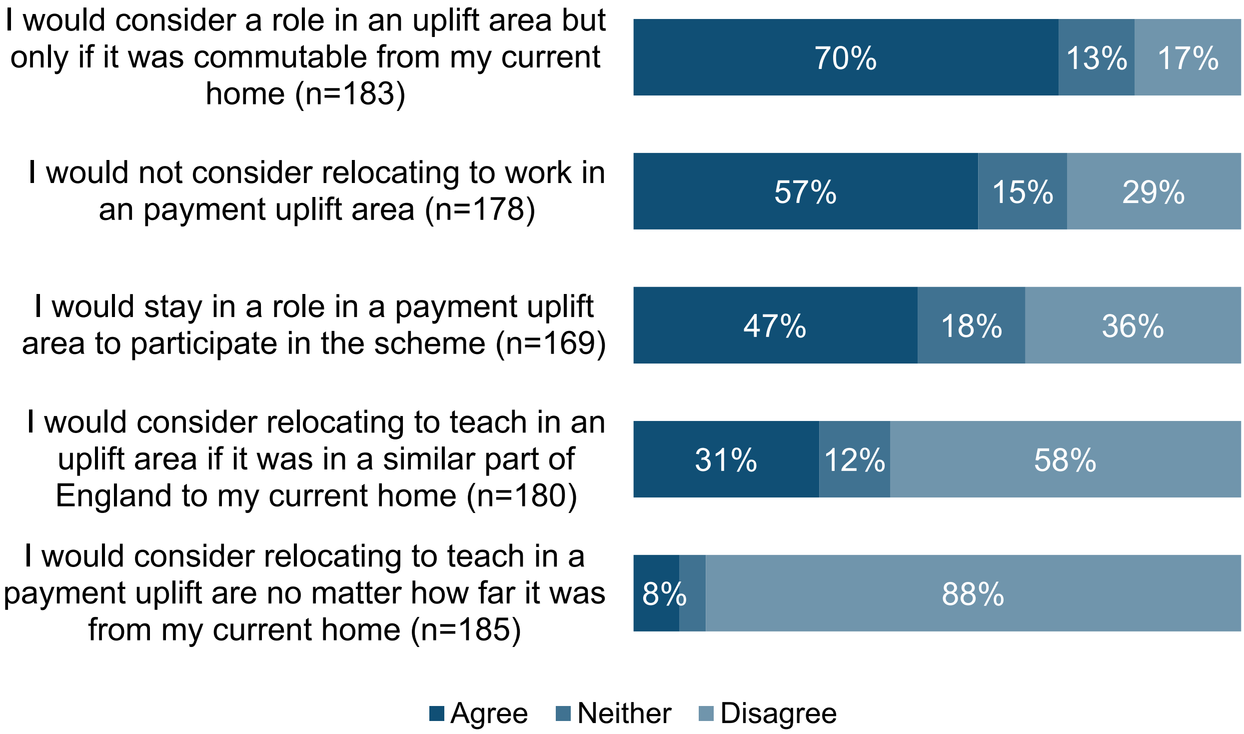
Influence on intentions to relocate to an uplift area

Earlier, we noted one in six trainees (17%) said a larger ECP would exert some influence on their intention to teach in an area (Figure 6); conversely, nearly three quarters (73%) said a higher ECP would not influence such a decision.

Maths teacher trainees were amenable to considering roles in uplift areas if they could commute from their current home (70% agreed with this statement); 57% agreed that they would not relocate to an uplift area (Figure 7). Statistics did not significantly vary by age or gender.

[32] Question: How influential, if at all, was the maths early career payment in the following decisions. Same influence scale and aggregation as before.

Figure 7: Level of agreement with statements about moving to uplift areas[33]



Source: Survey of maths teacher trainees, 2019. Bases vary (in chart) as don't know excluded.

> "[The uplift payments] certainly did persuade me that I wanted to work in [Area A] rather than [Area B]. I live on the border of, so I only looked at and applied for [Area A] schools because of that £2,500."
>
> Newly qualified teacher, under 30 years of age, September 2019

These questions were explored further during qualitative research with 22 second year teachers in 2020. Five of these teachers knew they were eligible for uplift ECPs.

All teachers were asked whether they thought uplifted ECPs (valued at £7,500 rather than £5,000 in other areas) would attract teachers into those locations. Most felt the increase was too little to be effective, although some interviewees aged 30 or older felt the uplift may attract younger teachers with fewer family and/or mortgage commitments, or looser geographical ties to an area. The subgroup sample sizes in the trainee survey were too small to test the hypothesis that age influences the willingness to teach in an uplift, nor the responses to any of the statements in Figure 7.

[33] Question: How much do you agree or disagree with the following? "Disagree" = aggregate score of 1 to 3; "Agree" = aggregate score of 5 to 7.

Interviewees aged 30 or older also said they were dissuaded from relocating to an uplift area for two reasons: they were concerned about the potential impact on their families and wanted stability during their early teaching career.

> “[I would not relocate] at the moment. I like the school I’m in. I'm happy here. I wouldn’t risk it to go to another school as maybe I wouldn’t enjoy that. With everything else I’m dealing with, the last thing I’m going to do is uproot to another school and have to learn the school system and that stuff. I’m happy. I have no intention of changing schools. If I was to leave, it would be because I was leaving teaching, not because of any other reason.”

Female, aged 30 or over and not in uplift area; Second-year teacher, January, 2021

Influence of the scheme on teacher retention

The main aim of the PMB pilot was to increase teacher retention through incentivising trainee and graduate maths teachers to stay in the profession. The following sections highlight the impact of the PMB pilot on these aims.

The estimated impact of the PMB pilot on retention

The second part of the impact evaluation estimated the effect of the PMB pilot on retention amongst the 2018/19 maths ITT cohort. If retained, these teachers would have entered their second teaching year in 2020/21 and their third in 2021/22. If still a teacher, they would have been eligible for their first ECP in 2021/22. The analysis evaluates the effect of the PMB on retention in the 2021/22 academic year, using data first published in the 2022/23 academic year.

The analysis estimated whether increased retention due to ECPs paid in 2021/22 outweighed the initial reduction in recruitment (275 first year maths teachers) associated with the PMB pilot's lower initial bursary payment.

The analysis estimated attrition which is defined as occurring when an individual who qualified to teach is no longer working in a state-funded school in England. Note that attrition here captures retention from the point of training, rather than the more commonly used retention from the point of entry to the school workforce. Values for attrition in this analysis will be higher than reports that use loss from the first teaching year as their measure of attrition.

The analysis estimates that the first ECP reduced the probability of attrition from the workforce by 37% in the year it was paid (2021/22). Assuming a third-year teacher would have been paid £29,664, the £5,000 payment was equivalent to a 17% increase in pay for that year. This 17% increase in pay resulted in a 37% reduction in the probability of leaving, which implies a pay-elasticity-of-exit (the ratio of the fall in attrition to the increase in pay) of -2.2[34].

The number of PMB eligible teachers who left the workforce between 2020/21 and 2021/22 was 80. The impact estimates imply that 127 teachers would have left the workforce without the PMB pilot ECP. Hence, the early career payment element of the overall PMB pilot increased the number of maths teachers retained in schools between 2020/21 and 2021/22 by 47.

In uplift areas, where eligible teachers received £7,500, the ECP reduced attrition by 58%. A 25% increase in pay resulted in a 58% reduction in the probability of leaving, which implies a pay-elasticity-of-exit of -2.3. This suggests that increasing bursary values from £5,000 to £7,500 had a broadly linear effect on retention. However, the impact

[34] Here, -37% (the fall in attrition) to 17% (the increase in pay for that year)

estimate for the uplift areas is based on a small sample and should be interpreted with caution.

Earlier, we noted that the PMB pilot's lower bursary payment led to 275 fewer newly qualified maths teachers beginning employment in state-funded schools in England in 2019/20. When paid in 2021/22, the ECP retained 47 maths teachers. A second phased payment will be made to this cohort in 2023/24. However, this is likely to retain fewer additional teachers than the 2021/22 payment as the cohort still teaching by this time will be smaller. Taken together, the two ECPs are likely to retain no more than 94 (=47x2) additional teachers. In sum, the PMB pilot will probably result in a net reduction in the number of maths teacher years (supply) among the 2018/19 maths trainee cohort.

Once received, early career payments exerted some influence on retention

The influence of ECPs on teacher retention was covered during depth interviews with second- and third-year teachers[35]. By the third year, eligible interviewees had received their first ECP by the time they were interviewed.

Awareness of ECPs grew over time and, by the second year of teaching, most interviewees could explain details such as the value and timing of ECPs with little or no prompting. However, most interviewees in their second teaching year believed ECPs were a modest amount and did little to counter the factors they felt were the main reasons teachers left the profession: workload and the associated long working hours.

> "The early career payment is really, really nice to have, and I think it certainly was a thing that we were looking at as a milestone ... I think it's a valuable thing to look forward to as a teacher, in terms of when you are having rough days, or when you are finding it quite hard. [However] For me to have stayed in the profession, [the ECP] would have had to have been a considerably larger sum."
>
> Male, aged 30 or over and left profession: Second-year teacher, December 2020

At the time of interview, many felt the introduction of online teaching in response to COVID-19 pandemic had exacerbated perceptions of high workload because teachers had to develop appropriate materials and adopt new teaching practices.

By the time teachers were interviewed again in 2022, all those eligible had received their first ECP. The idea that the payment was a reward for staying a teacher remained and the ECP did encourage a few teachers to stay in the profession until the payment was made. However, interviewees still perceived workload as the main reason teachers left the profession and most felt retention strategies to combat workload would be more effective than solely relying on financial incentives. Several teachers suggested increasing school budgets to improve support that alleviated workload pressure may

[35] Interviews with second-year teachers were conducted in between November 2020 to January 2021. Interviews with third-year teachers were conducted in March to April 2022.

positively influence retention. These teachers said financial support for schools to introduce more professional development to manage workload, reducing administration and resourcing workload interventions could be effective alongside financial incentives for teachers.

> “If teachers had more protected time whether that’s for developing skills or adjusting to quite how much marking that needs to be done, whatever it might be. I think that’s probably more likely [than ECPs] to keep them happy.”

Male, career changer aged 30 or over: Third-year teacher, March 2022

A few interviewees were waiting until their second ECP (after five years of teaching) before deciding their long-term future. However, ECPs were part of the wider decision-making process for teachers. A couple of interviewees were deferring their decision to continue teaching based on other professional considerations such as their development opportunities and the teaching environment and support in their school.

> There's a lot of variables there because it's not just about the money, it's about which classes you're given, it's about who your boss is, who you have to report to. Because I know that if I'd have gone to a different school [than the one I went to], and I got a different team around me, with the situation that I was going through at the time, I wouldn't have lasted.

Female, career changer aged 30 or over. Third-year teacher, March 2022

Conclusions

Recruitment

Lowering bursaries reduced recruitment to maths initial teacher training (ITT) by 10%-15%. Most of this reduction in recruitment could be accounted for by delaying the money formerly paid as a bursary (during training) to an early career payment (ECP). The PMB pilot's addition of ECPs into the financial offer had no clear influence on the number of individuals entering teacher training. That is, payments made in the third (or later) year of the career did not affect people's decision to enter initial teacher training.

Although teachers consistently say they enter teaching for altruistic reasons, bursaries were influential in drawing the 2018/19 maths training cohort into teacher training. Most applicants knew about bursaries and half of this group said they would not have made an application to become a teacher without one. Knowledge of ECPs amongst the evaluation training cohort was lower than bursaries and the influence of ECPs on the decision to enter teaching training was therefore weaker. For example, people aged 30 or older considering teacher training in 2018 said the value of the PMB pilot ECPs were too small to compensate them for lost earnings when switching careers into teaching.

Changing the value of ITT bursaries strongly influenced teacher trainee recruitment: a £1,000 increase in ITT bursary payments was associated with a 3% increase in the number of people entering maths ITT (see Appendix B). Increasing the total value of all components (the ITT bursary and future ECPs) did not have the same effect – indeed deferring (or phasing) payments at the expense of the ITT bursary reduced the number of teacher trainees. During interviews in 2018, maths undergraduates noted that they could command starting salaries greater than the reduced £20,000 ITT bursary in other sectors of the economy.

Retention

The first ECP included in the PMB pilot design reduced teacher attrition (the number of maths teachers leaving state-funded education). Furthermore, the reduction was greater in uplift areas where the ECP was the higher value of £7,500 compared to £5,000 elsewhere. However, the ratio of the decrease in attrition and the value of the ECP (the pay elasticity of exit) was the same between uplift and non-uplift areas. That is, increasing the value of the payment by 50% also increased the effect on retention by approximately 50%.

During interviews, teachers who received payments mainly described them as welcome, but they did not usually make up for other concerns they had about teaching. A few teachers were waiting for their second ECP (in the fifth year of teaching) before deciding whether to stay in the profession. Many said strategies to combat teacher workload and the working environment within their school would have a greater impact on retention than ECPs.

Overall

The PMB pilot’s smaller bursary reduced the number of maths teachers entering first year teaching positions by around 275. The pilot’s first ECP stopped an estimated 47 maths teachers leaving the profession. Eighty teachers left the profession between 2020/21 and 2021/22, rather than a projected 127 in the absence of a third-year ECP. Prospective teachers and trainees showed stronger awareness and preference for bursaries over ECPs. Given the size of the remaining cohort and historical trends in teacher attrition in years four and five of teaching, it is unlikely that the PMB pilot will result in a net increase in teacher numbers in the 2023/24 academic year. Most teachers interviewed for the study said ECPs were one consideration amongst many when making decisions about continuing a teaching career.

The overall policy goal was to maximise the number of years teachers worked in the profession. ECPs did retain teachers. However, the reduced bursary reduced the supply of first year maths teachers markedly. In each of the two years (2019/20 and 2020/21) prior to the first ECP, there would likely have been additional maths teachers in England had the initial bursary payment remained at £25,000 for the PMB pilot cohort.

Appendix A: Further detail on research methods

Research phase 1: Prospective maths teacher trainees (June to July 2018)

Quantitative methods

An online survey with registrants of the Get into Teaching (GiT) website was conducted.[36] The sample comprised 3,780 individuals who said they intended to commence training in September 2018 when they registered, and who stated maths as their first and/or second preference subject. Contact was made via the email address used on registration. Individuals may have registered with Get into Teaching for a number of reasons, including access to information events and some detailed information about teaching and the application process. Registration did not equate to definite interest in teaching.

The online survey response was boosted using computer assisted telephone interviewing (CATI) for 564 non-responders to the online survey who provided a telephone number.

A sample of 348 ITT UCAS applicants was also procured from UCAS media for a parallel evaluation of the Teacher Student Loan Reimbursement (TSLR) scheme (CFE Research, 2023[37]). Applicants choosing maths as their second-choice subject were eligible for the PMB pilot and identified during the survey through screening. This resulted in an additional three PMB survey responses.

Three separate reminders were sent at regular intervals to non-responders to increase the response rate. A total sample of 551 PMB eligible respondents was achieved from two sample sources. In total, 378 interviews were achieved through the online survey with Get into Teaching registrants, and a further 170 through the CATI sampling approach. Completed surveys were received from 548 respondents which represents an overall response rate of 16% from 3,526 valid contacts (subtracting 254 invalid email addresses in the original GiT sample). This calculation excludes the three additional interviewees drawn from the UCAS sample as the total eligible sample for PMB was unknown.

Background data that describes the population characteristics of potential trainees was limited, so representation was not assessed and the data has not been weighted.

Qualitative methods

Three focus groups were conducted with 14 final year maths undergraduate students from two universities in July 2018. The groups were conducted face-to-face on university

[36] The sample frame is registrants to a website. Individuals may register with Get Into Teaching for a number of reasons, including access to information, events, and some detailed information about teaching and the application process. Registration on this website does not equate to a definite interest in teaching.
[37] CFE Research, (2023), The Teacher Student Loan Reimbursement Scheme: Final Evaluation Report. DfE. London. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1130879/Teacher_student_loan_reimbursement_scheme_final_evaluation_report.pdf

premises and participants were sampled across a range of socio-demographic backgrounds. The two universities were different in character based on their location, admission criteria and total number of undergraduate students. The universities were purposefully selected and recruited through using CFE contacts with institutions who had taken part in previous research.

The groups were conducted to understand the potential influence of PMB pilot elements on undergraduate students' career choices and decision-making; applications for ITT; and subsequent teaching careers.

In-depth telephone interviews were also conducted with 12 older (aged 30+) GiT registrants who responded to the online survey and agreed to further research. Registrants were purposively sampled to cover different locations, age bands over thirty and prior career experiences. The purpose of these interviews was to seek their views on financial incentives for new teachers and their potential influence on decisions to pursue a career in teaching.

Research phase 2: Maths teacher trainees (May to November 2019)

Survey with initial teacher trainees

An online survey was conducted between May and June 2019. As in Phase 1, one survey instrument was used for the PMB pilot and TSLR studies.

Teacher trainees were identified using a re-contact sample from the 2018 survey of GiT registrants and via ITT providers. A sample of all 195 ITT providers offering maths (and TSLR subjects) in England was identified from DfE's Database of Trainee Teachers and Providers (DTTP). CFE sent an initial email to providers and up to five follow-up calls to ask providers to distribute a survey link. Ninety-one providers (47%) agreed to disseminate the survey to their maths trainees and responses were received from trainees of 81 providers (42%). Three separate reminders were sent at regular intervals to the GiT re-contact sample non-responders and via ITT providers to their trainees in eligible subjects. 190 of the achieved sample were eligible for the PMB pilot. The number of eligible teacher trainees contacted by providers was unknown, so it was not possible to calculate a response rate.

The sample was broadly representative of the eligible postgraduate maths ITT population by gender and degree class achieved (Table 5). There were some differences in the sample by the type of ITT undertaken. Trainees following SCITT routes were over-represented compared to those following the other two-PMB eligible routes: training via a higher education institution or School Direct (fee-funded) routes. All age groups were represented in the achieved sample, older age categories were overrepresented, and younger age categories were underrepresented. The source population data is drawn from the *Initial teacher training: trainee number census - 2018 to 2019* (DfE, 2019[38]). No weighting for differential response was applied.

Table 5: Comparison of achieved survey sample with ITT postgraduate maths ITT population (2018/2019)

Factors	ITT Population		Survey	
Gender	**n**	**%**	**n**	**%**
Male	1,105	51%	81	47%
Female	1,080	49%	88	51%
Prefer not to say			4	2%
Total	2,185		173[39]	
Degree achieved				
1st	490	23%	39	21%
2:1	920	43%	94	49%
2:2	575	27%	57	30%
Other	175	8%	0	-
Total	2,160		190	
Type of ITT		% (eligible)		
Higher Education Institution	1,100	50% (57%)	77	41%
School Centred ITT	315	14% (16%)	73	38%
School Direct (fee-funded)	505	23% (26%)	40	21%
Total in eligible ITT routes	**1,920**		**190**	
ITT types ineligible for PMB				
School Direct (salaried)	145	7%		
Postgraduate Teaching Apprenticeship	5	0%		
Teach First	120	5%		
Total	**2,190**		**190**	

In-depth interviews with newly qualified teachers (NQTs)

To contextualise findings from the survey, telephone in-depth interviews were conducted in September and November 2019 with 30 NQTs who agreed to be contacted when they

[38] https://www.gov.uk/government/statistics/initial-teacher-training-trainee-number-census-2018-to-2019
[39] Seventeen trainees did not see this question.

completed their online survey. Purposive sampling was used to recruit a range of NQTs based on gender, age and school location. All were emailed to ask if they would participate in an in-depth telephone interview. Interviews lasted up to an hour.

Subsequent longitudinal interviews were mostly drawn from this initial sample (see Table 6 later).

Phase 3: Maths early career teacher interviews (November 2020 to February 2021)

Longitudinal interviews

Twenty-two telephone depth interviews were conducted, 21 with teachers who were in their second (2020/21) year of teaching and one with an interviewee who had left teaching. Seventeen of these interviewees were longitudinal i.e., they were also interviewed during Phase 2. Replacement interviews were recruited with broadly the same profile as those lost from Phase 2 fieldwork.

The interviews covered: perceptions of teaching; knowledge and awareness of the PMB pilot and how it compares to other incentive schemes; and the influence of the financial incentives on recruiting and retaining teachers and on career decisions.

Phase 4: Maths teachers after receiving their first early career payment (March to April 2022)

Longitudinal interviews

Fifteen online depth interviews were conducted with teachers who were in their third (2021/22) year of teaching. Thirteen of these interviewees were also interviewed during Phase 3. Interviews were conducted using Microsoft Teams, Zoom or telephone, depending on interviewee preference. All interviews were recorded and the audio was transcribed for analysis, which was conducted using Nvivo software.

Qualitative sampling, Phases 2 to 4

The structure of the available longitudinal sample dictated the individuals available for interview. The table below summarises the characteristics of the whole longitudinal and cross-sectional interview sample between Phases 2 to 4.

Table 6: Longitudinal qualitative sample, Phases 2 to 4

Characteristic	Phase 2 interviews	Phase 3 interviews	Phase 4 interviews
Total	30	22	15
Male	19	8	5
Female	11	14	10
Under 30 years of age	10	5	3
30 to 39 years of age	9	6	5
40 years of age or older	9	9	6
Not listed	2	2	1
Eligible for PMB pilot only	19	14	9
Eligible for other incentives	11	8	6
Of which, in an uplift area	(6)	(6)	(5)

Appendix B: How did the phased bursary affect entry to maths teacher training

Author: Sam Sims, UCL Institute of Education and FFT Education Datalab

1. In 2018, the government introduced the Phased Maths Bursary pilot (PMB pilot) to address maths teacher shortages. The reform reduced the value of the *initial* bursary (paid during the training year) from £25,000 to £20,000, while also introducing an early career payment (ECP) of £5,000, paid to teachers in their third and fifth years of teaching in state schools in England.
2. The theory behind the PMB pilot is that any reduction in recruitment due to the decline in the value of the initial bursary would be more than offset by an increase in retention due to the introduction of the ECP. This report evaluates the effect of the PMB pilot on recruitment to maths initial teacher training. A separate report (appendix C) evaluates the effect of the PMB pilot on retention.
3. The evaluation employs the Initial Teacher Training Census, an administrative dataset which counts the number of people registered on initial training courses in England each year. The version used here covers 2014-2018 and includes 265 unique providers, between them offering 2,545 initial teacher training courses. Census data show that total recruitment to maths initial teacher training (ITT) increased by 17% between 2014 and 2016 and subsequently declined by almost the same amount between 2016 and 2018.
4. The impact of the PMB pilot is estimated using comparative interrupted time series models (see Modelling ITT recruitment trends later). This approach looks at the deviation from trend in recruitment to maths ITT at the point the PMB pilot was introduced, relative to the deviation from trend in recruitment to other subjects that were not eligible for the PMB pilot. The ideal comparison group courses would be in subjects which have similar bursary values, require similar skills and for which teachers have similar earnings potential outside of teaching. No single subject fulfils all these criteria, so a mixture of computing and science initial teacher training courses are used in the comparison groups. When science courses are used, biology, chemistry and physics courses are combined within providers, to avoid problems with trainees switching between the three based on the relative bursary values across the sciences.
5. The first research question addressed by the evaluation is: How has moving from the old maths bursary to the PMB pilot affected recruitment to maths ITT? This question relates to the impact of reducing the *initial* bursary component and introducing the ECP. The results indicate that moving from the old maths bursary to the PMB was associated with a reduction in recruitment to maths initial training of 10-15%. This finding is robust to the use of different comparison group subjects and other sample restrictions.

6. Any policy or other changes which are both a) introduced at the same time as the PMB pilot and b) affect recruitment in maths in a different way to recruitment in comparison-group subjects could bias the results of this evaluation. An obvious candidate for such a confounder is the introduction of the Teacher Student Loan Reimbursement (TSLR) policy for science and computing trainees. However, it is shown that the PMB pilot has the same impact on recruitment when compared to subjects or within regions which are not eligible for TSLR (Table 10).
7. The second research question addressed is: How has the introduction of PMB's ECP affected recruitment to maths ITT? This question relates only to the impact of the ECP component (£5k in the third and fifth years of teaching) over and above the impact of changes to the *initial* component of the bursary. This evaluation found no consistent evidence that the introduction of the ECP affected recruitment to maths initial teacher training.
8. The third research question addressed is: How has phasing (delaying) some of the bursary payment affected recruitment to maths ITT? This question relates only to the impact of the timing of bursary payments, leaving aside total bursary value. The results indicate that delaying bursary payments is associated with a reduction in recruitment. Indeed, this evaluation finds suggestive evidence that phasing the payments can account for most of the reduction in recruitment associated with the introduction of the PMB pilot.
9. Taken together, these findings suggest that bursary payments during the training year do incentivise recruitment to maths teacher training but bursary payments later in the career do not. This might reflect potential trainees discounting (placing a low value on) payments in future years of their careers. Alternatively, potential trainees may be unaware of the phased bursary payments at the point they decide whether to train. Indeed, survey research with registrants on the Get Into Teaching website found that while three quarters (75%) of respondents were aware of initial bursary payments, only one third (36%) of those eligible for the PMB pilot were aware of the phased component of the bursary (See p.11). This suggests that government should do more to communicate eligibility for phased payments to potential trainees.
10. The aim of the PMB policy was to increase the number of maths teachers working in state-funded schools in England. This evaluation was the first step in determining whether the policy is effective. A necessary second step is to determine the effect on retention (see Appendix C). Data on retention rates for the PMB pilot cohort first became available in Summer 2020. The publication of this data in Summer 2020 meant that further analysis could be done to judge whether the PMB policy achieved an overall increase in the total supply of maths teachers.

Assessing the impact of the PMB pilot on recruitment

11. The shift to the PMB pilot was theorised to affect teacher supply in two ways. First, the 20% reduction in the value of the initial component of the bursary is likely to have some negative effect on recruitment to maths teacher training. Second, the introduction of the ECPs is likely to have some positive effect on retention. The overall impact of the PMB pilot, therefore, depends on the relative magnitude of these two effects on supply.
12. Evidence suggests that early-career, shortage-subject teachers' decisions to remain in the profession are highly sensitive to increases in pay (Bueno & Sass, 2016; Feng & Sass, 2016). Summarising these evaluations, Sims (2017) found that a 1% increase in pay led to a 3.1% reduction in the number of teachers leaving the profession, on average. In contrast, there is currently very little published evidence on how training bursaries affect recruitment. Perhaps the closest thing is research by Bueno and Sass (2018), which finds no relationship between the introduction of early-career retention incentives (equivalent to the ECPs of the PMB pilot) and recruitment to teaching. It is important to note however, that the policy they analysed did not incorporate incentives during the training year (equivalent to the *initial* component of the PMB). It therefore has some important dissimilarities with the PMB pilot.
13. This report is the first of two evaluating the effects of the PMB pilot on teacher supply. It aims to quantify the effect of the PMB on recruitment to maths ITT in 2018/19. The data for this part of the evaluation became available in February 2019. The second report quantifies the effect of the PMB pilot on the retention of maths teachers in that same cohort and is provided in Appendix C. The data on year one (year three) retention rates necessary for this analysis became available in 2020 (2022). Appendix C estimates the effectiveness of the PMB for increasing the *overall* supply of in-service maths teachers.

Data and variables

Summary of findings

- The Initial Teacher Training Census for 2014-2018 contains 2,545 unique initial teacher training courses, of which 913 appear to have either opened or closed over the period.
- ITT courses in 2017/18 had a median of six and a mean of 11 participants.
- There are 265 unique providers across the five years covered by the data, 27% of which are higher education institutions (HEI) and 73% of which are School-Centred Initial Teacher Training institutions (SCITT).
- Bursary values have shown a marked upward trend between 2014 and 2018, with several subjects now attracting £26,000 initial bursary payments.

14. The dataset employed in this analysis is the Initial Teacher Training Census (ITTC) covering the years 2014/15 to 2018/19. The ITTC is an administrative dataset which counts the number of people registered on initial training courses in England between the start of the academic year and the second Wednesday of October of each year. The dataset is a provider/subject level panel, meaning that each row is a unique combination of a provider e.g. 'UCL Institute of Education' and subject e.g. 'maths'. From now on, such a combination will be referred to as a 'course'. There are 2,545 unique courses which recruit at least one trainee over the five years covered by the data.
15. The dependent variable for this study is the number of individuals recruited to each course in each year. This is known as a count variable because it is always a whole number and cannot be negative.
16. If a course is recorded as having zero recruits in a given year, this implies either that the provider didn't offer that subject in that year or that they did offer the course but failed to recruit anyone. The latter is informative about how bursary values affect individuals' propensity to enter teaching and is, therefore, useful for the purposes of this evaluation. The former is not necessarily informative. In order to exclude uninformative zeros, it is necessary to ignore courses which were not in fact open in a given year. A total of 212 courses show a pattern consistent with having been open initially but then permanently closed, during the panel. The zeros for these 'closer' courses are likely to be uninformative about the desirability of entry to teaching in a given year and are excluded from the panel data analysis. A total of 701 courses show a pattern consistent with having been closed initially but then becoming permanently open, during the panel. The zeros for these 'opener' courses are also likely to be uninformative about the desirability of entry to teaching in a given year and are also excluded from the panel data analysis.

17. There are 931 courses that show a pattern consistent with being open in all years in the panel (Table 7). These courses have no zeros and should clearly be included in the analysis. In addition, there are 148 courses that recruit trainees in both the first (2014) and last (2018) year of the panel and never recruit zero trainees for more than one year in a row in between. These 148 courses show a pattern which plausibly reflects being open throughout the period but failing to recruit in particular years. These zeros are therefore likely to be informative and are included in the analysis. This leaves 1,077 (931 + 137 + 9) courses that are open throughout.

Table 7: Course opening & closing patterns

Closers

2014	2015	2016	2017	2018	ITT Courses	Maths ITT Courses
✓	x	x	x	x	83	7
✓	✓	x	x	x	37	2
✓	✓	✓	x	x	28	2
✓	✓	✓	✓	x	64	4

Openers

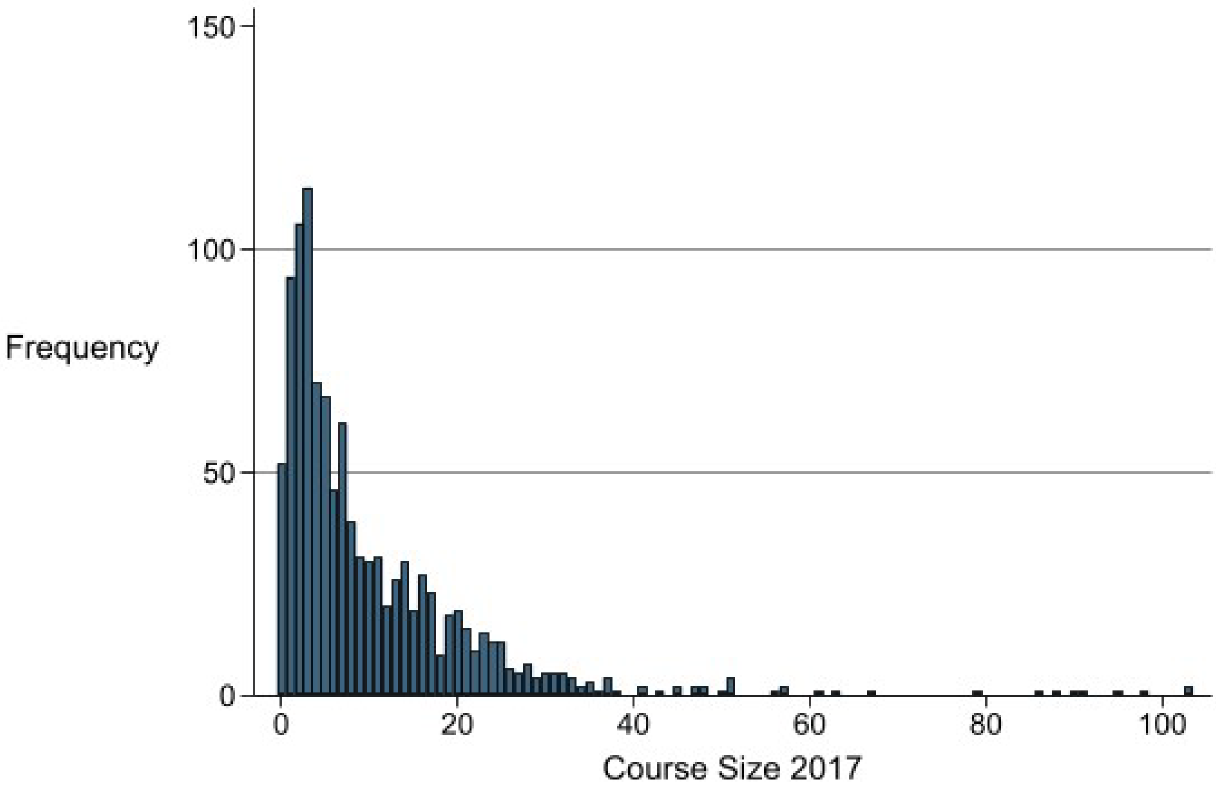
2014	2015	2016	2017	2018	ITT Courses	Maths ITT Courses
x	✓	✓	✓	✓	257	32
x	x	✓	✓	✓	206	17
x	x	x	✓	✓	134	10
x	x	x	x	✓	104	2

Open throughout

2014	2015	2016	2017	2018	ITT Courses	Maths ITT Courses
✓	Closed	Closed	Closed	✓	137	6
✓	x	✓	x	✓	9	0
✓	✓	✓	✓	✓	931	111

18. Figure 8 shows the distribution of course size (number of recruits) in 2017/18 – the academic year prior to the PMB pilot being introduced. The distribution has a strong positive skew (median = 6, mean = 11) and a long right tail (standard deviation = 14). There are a large number of zeros but zero is not the modal value.

Figure 8: Distribution of course size 2017/18



Note: Only includes courses defined as 'open throughout' in Table 7. Excludes one outlier course with size=235. Bar width is equal to one.

19. In order for the number of recruits on a course to fully reflect the desirability of entry to teaching, there must also be no upper limit on the number of recruits that a course can take on. During the early years of the panel, courses were given 'allocations' setting an upper limit on the number of trainees they could recruit. If a course reached its allocation in a given year then they were able to apply for additional places. In practice, additional places were likely to be granted to courses in subjects that were struggling to recruit enough teachers to meet the national target in each subject (as determined by the Teacher Supply Model). By contrast, courses were unlikely to be granted additional places if they were in subjects that tended to meet the overall national targets. Between 2014 and 2018 three subjects consistently met their national recruitment targets: history, English and PE (DfE, 2018a). Recruitment figures for these subjects therefore likely suffer from 'ceiling effects' and do not fully

reflect the desirability of entry to teaching. These subjects are dropped from the analysis.

20. Providers are identified in the ITTC by their name and by a unique four-digit numeric ID which persists across years. There are 265 unique providers across the five years covered by the dataset, split into two types: HEI (27%) and SCITT (73%).

21. The DfE maintains a list of designated secondary-phase initial teacher training subjects. In 2018/19, the list included 27 different subjects. Three of these (English, history and PE) are not included in this analysis because of ceiling effects. A further three of them are very small but are similar enough to larger subjects that they tend to be combined in official statistics: Food is generally combined with D&T; Classics is generally combined with Modern Foreign Languages (MFL) ; 'Physics with Maths' (which prepares trainees to teach physics to KS3 and KS4, but maths only to KS3, and is not eligible for the PMB pilot) is usually grouped with physics. These three small subjects are combined with their parent subjects, in line with official practice.[40] That leaves 21 subject groups on the designated list. Among these, there are another nine small subjects that do not get individually reported on in the official tables e.g., Leisure & Tourism, and which do not attract bursaries. These subjects were dropped since the small number of observations makes them difficult to employ in the analysis and there are no established conventions for combining them with other subjects. That left 12 subjects for analysis: Art & Design; Biology; Business Studies; Chemistry; Computing; D&T (including Food); Geography; MFL (including Classics); Music; Physics (including Physics with Maths); Religious Education; and Maths.

22. Table 8 shows the number of courses for each subject in the sample once the above sample restrictions have been applied. The largest subjects are science (if combined) and maths; followed by MFL and humanities; followed by computing, business, performing arts and D&T. The number of courses per subject ranges from 117 to just 15. From now on, this group of courses are referred to as the 'main sample'.

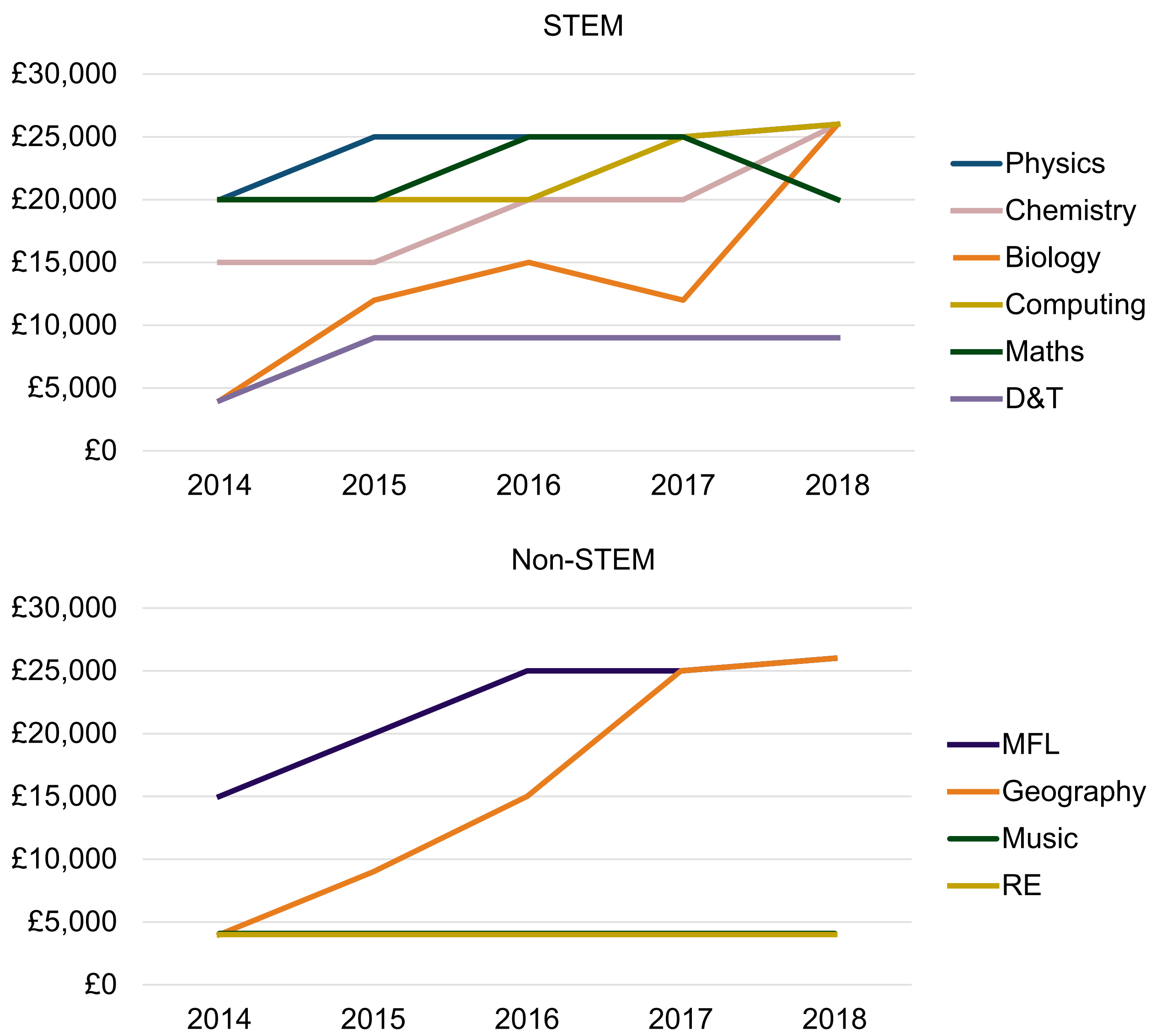
[40] All attract either the same or very similar bursary values.

Table 8: Courses in the main sample

	Subject	Frequency	Percent
1	Maths	117	14.87
2	Biology	96	12.2
3	Chemistry	95	12.07
4	MFL	85	10.8
5	Physics	83	10.55
6	Geography	78	9.91
7	Computing	53	6.73
8	Art	43	5.46
9	D&T	42	5.34
10	Music	41	5.21
11	RE	39	4.96
12	Business	15	1.91
	Total	787	100

23. The ITTC data is supplemented with information on *initial* bursary values for each subject in each year. These are taken from the official Initial Teacher Training Bursary Guide documents (DfE, 2015; 2016; 2017b; 2018b; 2018c). Figure 9 shows the evolution of bursary values across the period covered by the panel. The bursary values for STEM subjects (upper panel) generally show an upward trend over the period. The exceptions are D&T, which is flat after 2015, and maths, for which the *initial* bursary declines by £5,000 in 2018, when the PMB pilot was introduced. By 2018, physics, chemistry, biology and computing were all attracting £26,000 initial bursary payments. Among the non-STEM subjects there are clearly two distinct groups. MFL and geography (both English Baccalaureate subjects) show a strong upward trend, also attracting £26,000 initial bursary by 2018. Music and RE both attract a £4,000 bursary over the period and business and art attract no bursary over the period.

Figure 9: Initial bursary values by subject



Notes: Bursary values are for trainees with an upper-second class degree. Only main sample subjects shown. D&T = Design and Technology. MFL = Modern Foreign Languages. Business and art do not attract a bursary.

ITT recruitment trends

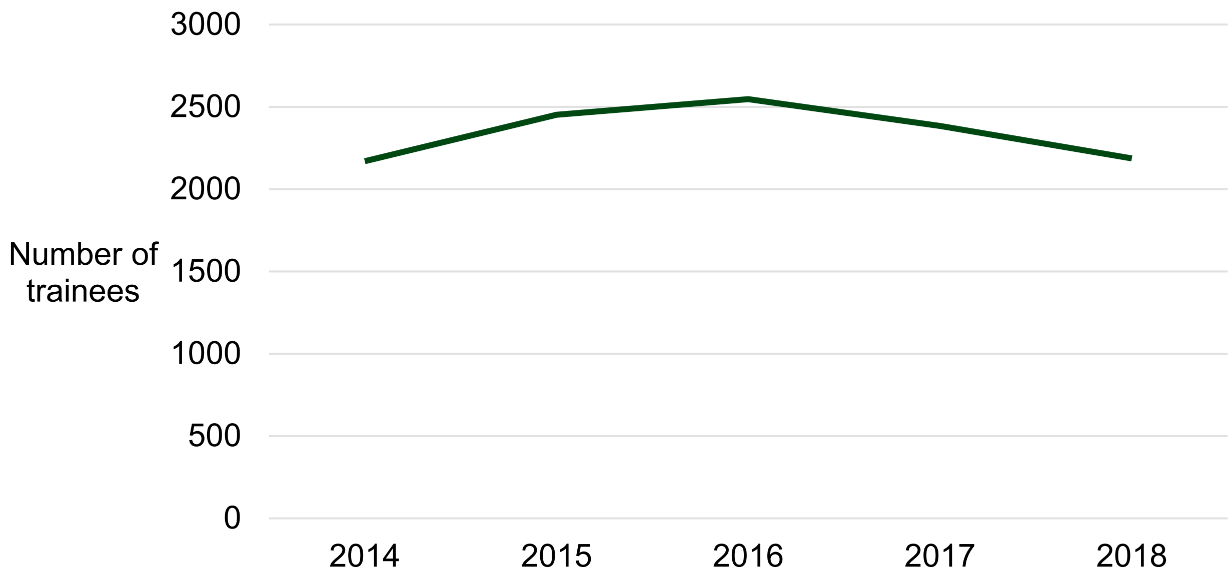
Summary of findings

- Total recruitment to maths initial teacher training (ITT) increased by 17% between 2014 and 2016; then declined by almost the same amount by 2018.
- Similar STEM subjects – D&T, chemistry, physics – showed a similar 'humped' trend over the period. The fact that D&T recruitment declined despite no change in its initial bursary value suggests that the headline decline in maths recruitment should be interpreted with caution.
- The total chemistry bursary value increased in parallel with maths between 2014 and 2018. Prior to the phasing of the maths bursary, chemistry recruitment was falling faster than maths. After the phasing, maths recruitment fell faster than chemistry.

25. Figure 10 shows total recruitment to maths teacher training across all courses in the ITTC. The trend is 'hump shaped', rising until 2016 and declining thereafter. Although the gradient looks shallow, this represents an increase and subsequent decrease of around 17% across the period. The PMB pilot (including the £5,000 reduction in initial bursary value) was introduced for the 2018 cohort. It is notable that recruitment falls between 2017 and 2018. Having said that, recruitment was clearly declining prior to the introduction of the PMB in 2017. It is, therefore, hard to conclude much from this simple time-series graph.

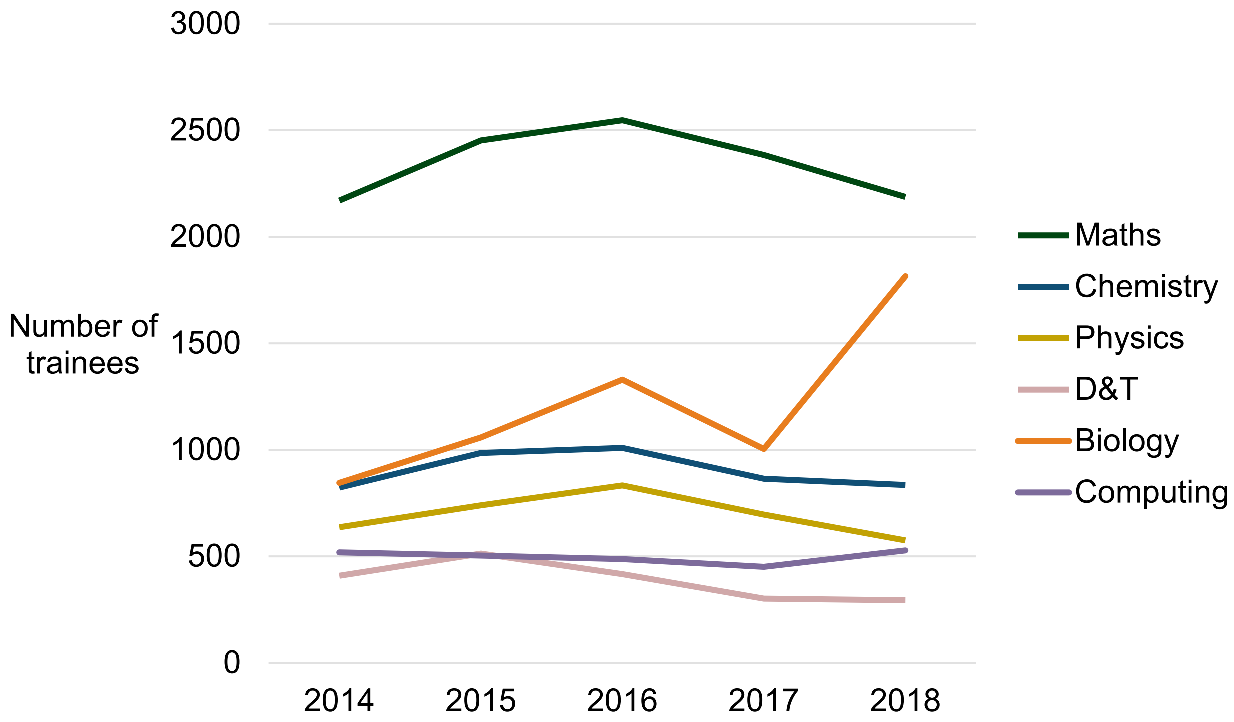
26. One way to provide context for Figure 10 is to investigate the trends for other subjects. Figure 11 shows recruitment trends for STEM subjects, which are arguably most closely related to maths. Interestingly, physics, chemistry and D&T all show a similar 'humped' trend. All three of these subjects also saw a slight decline in recruitment in 2018, despite seeing *increases* in initial bursary values in 2018 (See Figure 9). D&T is a useful comparator, in that bursary values have been fixed since 2015 (Figure 9) and it seems unlikely that potential trainees would switch between maths and D&T training courses based on relative bursary values. The small decline in D&T recruitment since 2017 provides further reason for caution when interpreting the 2018 decline in maths recruitment.

Figure 10: Maths ITT recruitment



27. Biology shows a similar humped trend until 2017, when there was a sharp increase in recruitment. Referring back to Figure 9, this coincides with a more-than doubling of the initial bursary for biology in that year (£12,000 to £26,000). It is possible that the sharp increase in biology represents a decline in biology graduates opting to train in either chemistry or physics in order to benefit from the higher bursary values. This may explain some of the decline in chemistry and physics recruitment seen in 2018.

Figure 11: STEM ITT Recruitment



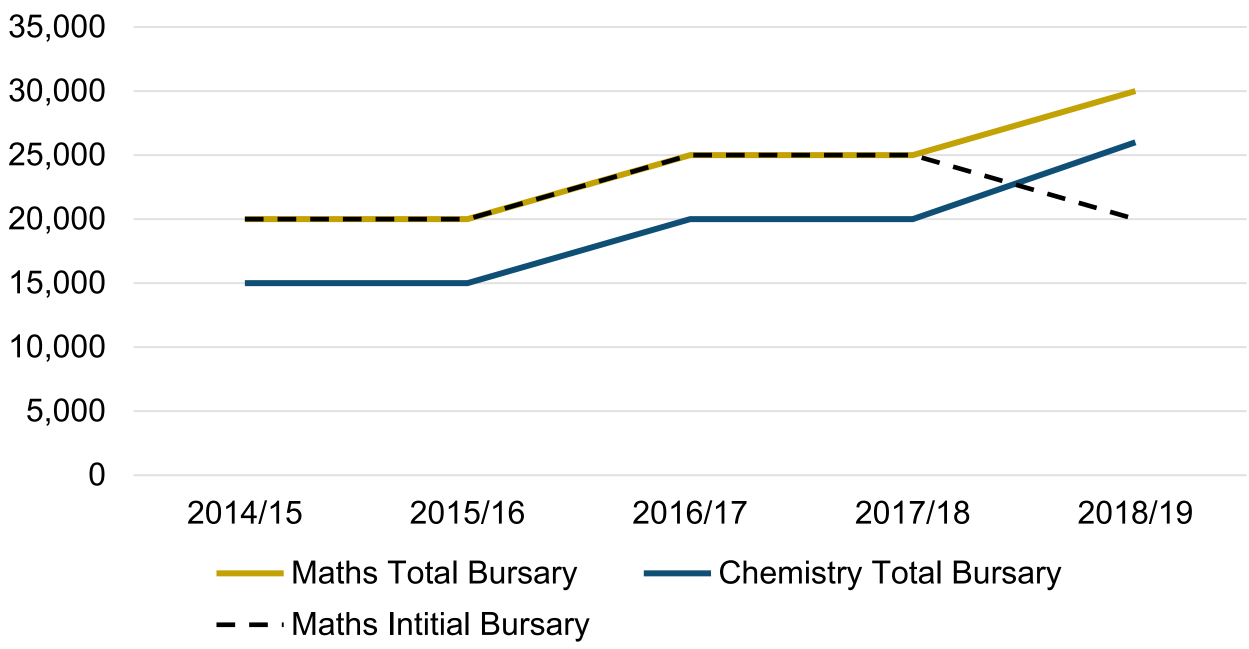
Notes: Only STEM subjects shown. D&T = Design and Technology.

28. Computing arguably follows a flatter, more linear trend than the other STEM subjects. Indeed, Figure 15 show that computing follows a trend similar to the majority of non-STEM subjects.

29. It is important to bear in mind that, while the PMB pilot reduces the value of the initial bursary, it increases the value of the total (initial bursary plus ECPs) payments by £5,000. If trainees take account of the retention payments paid in their third and fifth years of teaching when deciding whether to train as a maths teacher, this needs to be accounted for in this evaluation.

30. Notwithstanding the potential for subject switching described above, chemistry provides an interesting comparator for thinking about the effect of changes in the phasing of the bursary. Figure 12 shows the evolution of total and initial bursary values in maths and chemistry. It illustrates how the total bursary value in the two subjects has increased almost exactly in parallel over the period. This parallel path also held between 2017 and 2018 because chemistry, like maths, saw a £5,000 increase in total bursary value, albeit comprised of an increase in the initial component rather than the *phased* component introduced with the PMB pilot. Comparing recruitment in these two subjects may therefore shed light on the impact of *phasing* the maths bursary, over and above changes in the total bursary value.

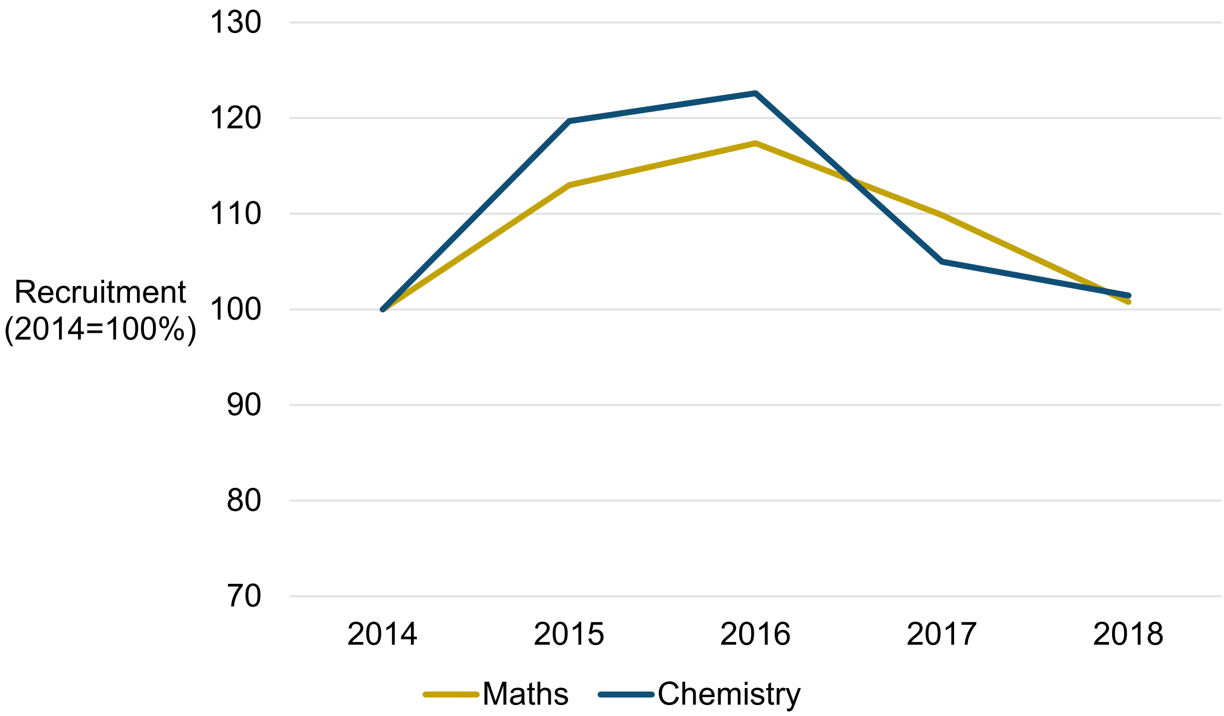
Figure 12: Maths and chemistry bursary values (£)



31. Figure 13 compares recruitment in the two subjects, expressed as a proportion of 2014 recruitment levels. Again, the figure reveals broadly parallel trends between the two subjects. Indeed, the trends are very similar up until 2016, after which the chemistry recruitment begins to fall (in percentage terms) faster than maths. After 2017 however - when the PMB pilot was introduced – - this pattern is reversed, with

maths falling faster than chemistry. This is despite the fact that there may have been biology graduates switching away from chemistry to biology initial teacher training over this period. This finding is consistent with the interpretation that delaying (or phasing) the bursary payments had a small negative effect on maths ITT recruitment. Nevertheless, there remain obvious limitations to this sort of simple graphical analysis. The next section sets out a more formal approach to evaluating the impact of the policy.

Figure 13: Comparing maths and chemistry ITT recruitment



Methods: Modelling ITT recruitment trends

Interrupted time series

32. Perhaps the simplest way of modelling the impact of the PMB pilot on maths ITT recruitment is to look at the change in recruitment before and after the policy was introduced. This design, which looks at the deviation of a time-series from its trend when a policy is introduced, is known as an Interrupted Time Series (ITS). It is the formal equivalent of investigating the change in trajectory between 2017 and 2018 in Figure 10. The deviation of the time-series from its trend can be quantified using a model of the following form:

Model 1A: $Recruit_{iy} = \alpha + \beta_1 Year_y + \beta_2 Post_y + \beta_3 Year_y * Post_y + \epsilon_{iy}$

Where:

$Recruit_{iy}$ is a count variable capturing the number of recruits to course *i* in year *y*

$Year_y$ is a linear variable capturing the academic years: 2014, 2015,…2018

$Post_y$ is a binary variable capturing whether the PMB is on (1) or off (0) in year *y*

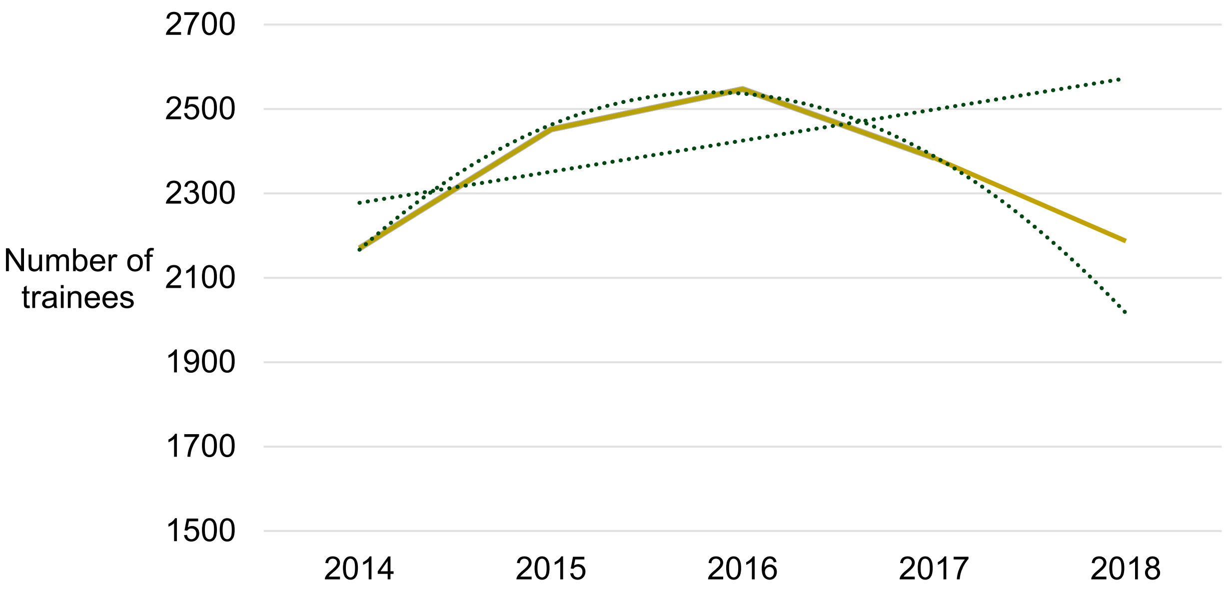
$Year_y * PMB_y$ is an interaction between the year and whether the PMB is on

ϵ is an error term capturing unexplained variation

33. The coefficients α and β in Model 1A are then estimated by finding a line of best fit for the data using regression analysis. The estimated value of α is the intercept of the regression line of best fit i.e. where the line would meet the y axis (see Figure 10). The estimated value of β_1 would be the gradient of the regression line of best fit in the period before the PMB pilot was introduced and the estimated value of β_2 would be the deviation of recruitment from the pre-treatment trend after the PMB pilot was introduced. Finally, the estimated value of β_3 would be the change in slope of the regression line in any periods after the treatment was introduced (Bernal, Cummins, & Gasparini, 2017).

34. Because the ITS aims to quantify the impact of the policy using the deviation from trend when the policy is introduced, it is essential that the pre-policy trend is modelled accurately. Figure 10 clearly shows that the trend for maths recruitment is non-linear and hump shaped. As shown in Figure 14, a non-linear regression line provides a better fit for the data than a simple linear regression line. Figure 14 also illustrates the importance of accurately modelling the pre-policy trend, since the linear line of best fit suggests recruitment declined in 2018 relative to trend, whereas the non-linear line of best fit suggests it increased relative to trend.

Figure 14 Illustration of linear and quadratic lines of best fit



Notes: Solid gold line shows recruitment to maths ITT over the period. The dashed lines are regression lines of best fit. The straight dashed line is from an equation allowing a linear line and the curved is a from a quadratic term that allows a curved line.

35. Allowing a non-linear line of best fit can be achieved by simply adding a quadratic year term $Year_y^2$:

    Model 1B: $Recruit_{iy} = \alpha + \beta_1 Year_y + \beta_2 Year_y^2 + \beta_3 Post_y + \beta_4 Year_y * Post_y + \epsilon_{iy}$

36. $\beta_1 + \beta_2$ now captures the non-linear pre-treatment trends and β_3 and β_4 capture the deviation in levels and trends in the post-treatment period, respectively. Model 1B captures the causal impact of an intervention under a certain set of assumptions. Perhaps the most important of these is the assumption that recruitment to maths ITT would have followed the same trend in the period after the PMB pilot was introduced as it did in the period before the PMB pilot was introduced, if in fact the PMB pilot had not been introduced. This is called the continuing trends assumption. This is a strong assumption because, for example, changes in graduate employment or salaries may have occurred in the year that the PMB pilot was introduced, which would have caused a deviation from trend even in the absence of the policy. This assumption cannot be checked in the data because one cannot observe what would have happened to recruitment in the year the PMB pilot was introduced, if in fact it were not introduced.

Comparative interrupted time series

37. In order to avoid the (strong) continuing trends assumption, maths courses can be compared with other non-maths courses. One option for doing this would be to use a difference in difference design. However, this relies on the common trends

assumption that the change in levels in the post-treatment period in the comparison group is equal to the change in levels that would have occurred in the post-treatment period in the treatment group. However, this assumption may not be justified in this case because the introduction of the bursary in maths, as opposed to other core subjects, likely reflects particularly poor recent trends in recruitment to maths initial teacher training (Claire, Hallberg, & Cook, 2016).

An alternative is to use a comparative interrupted time series (CITS) design. The CITS is closely related to the difference-in-difference design but involves modelling and quantifying the relative deviation from trends, rather than just levels, between treatment and comparison groups (Clair & Cook, 2015). It is the formal equivalent of investigating the comparative deviation from trends between maths and chemistry recruitment depicted in Figure 13. The deviation in the maths time-series relative to the deviation in the non-maths time-series can be quantified using a model of the following form:

Model 2: $Recruit_{iy} = \alpha + \beta_1 Year_y + \beta_2 Year_y^2 + \beta_3 Maths_i + \beta_4 Maths_i * Year_y + \beta_5 Maths_i * Year_y^2 + \beta_6 Post_y + \beta_7 Post_y * Maths_i + \epsilon_{iy}$

Where:

$Maths_i$ is a binary variable indicating whether course *i* is eligible for PMB pilot

$Maths_i * Year_y$ and $Maths_i * Year_y^2$ are interaction terms between the maths dummy and the linear and quadratic year terms

$Post_y * Maths_i$ is an interaction term which takes the value 1 when a course *i* is eligible for the PMB pilot (maths) *and* it is a year *y* in which the PMB is on (2018)

38. β_1 + β_2 now captures the pre-treatment trends in the comparison group. β_1 + β_2 + β_4 + β_5 capture the pre-treatment trends in the treatment group, with β_4 and β_5 capturing the additional linear and quadratic aspects of the treatment group pre-treatment trend, respectively. β_6 captures the deviation from trend in the comparison group in the post-treatment period and β_7 hence captures the deviation from trend in the treatment group in the post-treatment period relative to that in the comparison group.

39. The estimate of β_7 in Model 2 quantifies the impact of the PMB pilot on recruitment under a certain set of assumptions. Foremost among these is the assumption that the deviation in trend that would have been observed in the treatment group in the absence of treatment is equal to the deviation in trend observed in the comparison group. The CITS assumption is, therefore, weaker than the ITS assumption in that it does not require the pre-treatment trend in the treatment group to continue in the absence of treatment, only that the treatment group trend deviate in the same way that the comparison group trend deviates. The CITS assumption is also weaker than the assumption in the difference-in-difference model in that the CITS is not necessarily invalidated by changes in the post-treatment outcomes for the treatment group that are not reflected in the comparison group. More specifically, the CITS can

account for any such changes which are reflected in the pre-treatment trends in the treatment group (Clair & Cook, 2015). It therefore represents a weaker identifying assumption than a difference-in-difference design in certain settings. Model 2 is therefore used throughout the analysis in the following sections.

Other modelling considerations

40. Having determined the specification of the models, it is necessary to consider how the model parameters should be estimated. Regular ordinary least (OLS) squares regression assumes that the residuals (the part of each outcome observation which is unexplained) are normally distributed. Unfortunately, count data often violates this assumption due to having a large positive skew, leading to incorrect confidence intervals and p values. OLS also assumes that the residuals have constant variance. Unfortunately, count data also often violates this assumption, leading to problems with standard errors. Statistical tests (not reported) show that the data used in this research violate both of these assumptions. The large number of zeros present in the data (see Figure 8) make it impossible to solve these problems through transformation of the data, since a zero multiplied by another number is still zero. One option would be to use Poisson regression. However, statistical tests show that the ITTC data also violates the necessary assumption of equi dispersion.[41] Negative binomial regression is therefore used, on the grounds that it does not require either of the OLS assumptions about the distribution of the residuals and, unlike Poisson regression, does not make assumptions about dispersion (Huang & Cornell, 2012).

41. In line with convention, standard errors[42] and *p* values are reported in the regression tables in the following section. However, the results from this recruitment evaluation will need to be compared with the results from a second retention evaluation. Disregarding the point estimates from either of these two evaluations due to differences in statistical precision could potentially give a misleading view of the net impact of the policy. For example, discounting any impact from the recruitment evaluation due to a *p* value of 0.06 but taking account of impact from the retention evaluation based on a *p* value of 0.04 would clearly give a misleading picture of the overall effect of the policy on teacher supply. Interpretation of the regression outputs below will therefore focus on the coefficients (point estimates) rather than confidence intervals.

42. The next section employs the method set out above to evaluate the effect of the PMB pilot on recruitment to maths initial teacher training. More specifically, it answers the following three research questions (RQs):

[41] Where the mean equals the variance in a Poisson distribution.

[42] Clustered standard errors are not available in the xtnbreg command in Stata and are therefore not calculated.

RQ1: How has moving from the old maths bursary to the PMB pilot affected recruitment to maths ITT? This question relates to the impact of reducing the bursary component and introducing the ECPs.

RQ2: How has the introduction of the phased component of the PMB pilot affected recruitment to maths ITT? This question relates only to the impact of the *phased* component, putting aside the impact of changes to the *initial* component of the bursary.

RQ3: How has phasing (delaying) some of the bursary payment affected recruitment to maths ITT? This question relates only to the impact of the timing of bursary payments, putting aside the changes to the overall value of the bursary.

Results

Summary of findings

- Moving from the old maths bursary to the phased maths bursary was associated with a reduction in recruitment to maths initial training of 10-15%. This finding is robust to a range of different comparison group subjects and other sample restrictions.
- There is no consistent evidence that the introduction of the ECP (£5k payments in the third and fifth years of teaching) had an effect on recruitment to maths initial teacher training.
- Phasing/delaying bursary payments (holding total bursary value constant) can account for a large part of the reduction in recruitment associated with the introduction of the PMB. This suggest that potential trainees place little value on incentives paid three or more years into the career when deciding whether to enter teaching.

RQ1: How has moving from the old maths bursary to the PMB pilot affected recruitment to maths ITT?

47. In order to investigate the impact of both introducing the phased component of the bursary and reducing the initial component, it is necessary to compare maths recruitment to other subjects without controlling for initial bursary value.

48. Science subjects are substantively similar to maths (both fall within the STEM category) and science graduates have comparable earning potential outside of teaching. This makes them a natural candidate for use in the comparison group. However, as discussed, large changes in relative initial bursary values within the sciences co-occur with the introduction of the PMB pilot. This means that there may

be significant subject switching within the sciences by science-graduate trainees looking to benefit from the largest bursary payments. Unfortunately, data by which this could be ruled out was not available at the time of analysis.

49. Table 9 shows the results from using Model 2 to estimate the impact of the PMB pilot using three sets of alternative comparison group subjects. The top number in each cell of the table is the ‘event ratio’ – the ratio of entrants to initial teacher training in mathematics associated with a one-unit change in each of the variables in the left-hand column. Where this is above 1 it indicates an increase and where it is below 1 it indicates a decrease. For example, 0.848 in the row for ‘PMB’ indicates that there was a 15.2% reduction in entry to maths ITT associated with the PMB pilot, holding constant the other variables in the model.

50. Column 1 contains the results when only computing courses are employed in the comparison group. Computing is arguably the most substantively similar subject to maths, has comparable outside earnings (Britton et al., 2016) and has very similar initial bursary value across the period (Figure 9). The quadratic term enters with the expected negative sign, giving a hump shaped curve. The coefficient on PMB is 0.848, indicating the policy is associated with a 15% reduction in recruitment.

51. Although computing is perhaps the optimal comparator, for the sake of transparency Column 2 adds D&T, MFL, Music and RE to the comparison group. This is all the other subjects excluding art, business and geography – all three of which display trends with more than one turning point which cannot be accurately captured by Model 2. A set of dummies for all subjects apart from computing is also added to the model on Column 2 to allow for subject specific intercepts. The coefficient on PMB is very similar to Column 1 (0.88), implying the introduction of the PMB pilot led to a 12% reduction in recruitment.

Table 9: Modelling the effect of the PMB on recruitment

	(1)	(2)
Phased Maths Bursary	0.848 (0.188)	0.876 (0.102)
Linear term for year	4.553e+25* (1.372e+27)	6.057e+26* (1.740e+28)
Quadratic term for year	0.971* (0.0145)	0.970* (0.0138)
Linear year term (maths)	1.031 (0.0521)	1.029 (0.0270)
Quadratic year term (maths)	1.049 (0.0388)	1.008 (0.0195)
Subject indicators	-	✓
Comparison group subjects:	Computing	Computing, D&T, MFL, Music, RE
Number of courses	**170**	**377**
Number of observations	**850**	**1,885**

*Notes: Coefficients are event ratios. An event ratio above one indicates a positive association; below one indicates a negative association. Standard errors in parentheses. * = p<0.05; ** = p<0.01.*

52. Table 10 further investigates the robustness of this key result. In order to maintain sample size while investigating results in subsets of the data, all columns in Table 10 use the larger comparison group from Column 2 of Table 9 containing computing, D&T, MFL, Music and RE courses. Column 3 probes whether the results are dependent on the set of courses included in the main sample (see Table 7) by adding in 115 additional courses that were closed for a single year during the panel, either in 2014 (the first year of the panel) or in 2018 (the last year of the panel). The coefficient in the PMB row is very similar to that in Column 2.

Table 10: Robustness to sample variations

	(3)	(4)	(5)	(6)	(7)
Sample	Extra Openers & Closers	Excluding TSLR Areas	HEI Only	SCITT Only	2015 Onwards
PMB	0.898 (0.108)	0.907 (0.110)	0.906 (0.116)	0.797 (0.197)	0.870 (0.141)
Linear year term	0.955* (0.0174)	0.948** (0.0177)	0.948** (0.0184)	0.946 (0.0394)	0.954** (0.0170)
Quadratic year term	0.956** (0.0129)	0.977 (0.0133)	0.969* (0.0138)	1.015 (0.0307)	0.938* (0.0284)
Linear year term (maths)	1.043 (0.0282)	1.016 (0.0279)	1.002 (0.0289)	1.117* (0.0629)	1.021 (0.0265)
Quadratic year term (maths)	0.992 (0.0202)	0.989 (0.0200)	1.001 (0.0212)	0.948 (0.0399)	1.014 (0.0446)
Subject indicators	✓	✓	✓	✓	✓
Comparison group subjects:	Computing, D&T, MFL, Music, RE	Computing, D&T, MFL, Music, RE	Computing, D&T, MFL, Music, RE	Computing, D&T, MFL, Music, RE	Computing, D&T, MFL, Music, RE
No. of courses	492	332	209	168	377
No. of observations	2,460	1,660	1,045	840	1,508

*Coefficients are event ratios. An event ratio above one indicates a positive association; below one indicates a negative association. Standard errors in parentheses. * = p<0.05; ** = p<0.01*

53. An additional concern is that the introduction of the TSLR payment for science and computing courses in the same year as the PMB pilot may have affected the results. In order to investigate this possibility, in Column 4 courses located in the 25 TSLR pilot areas were excluded and the models were run using the courses located in the remaining 90 local authorities. The event ratio in the PMB row is again very similar to that in Column 2.

54. Another potential concern is that the trend towards a greater number of SCITT courses over the period may be biasing the types of courses which end up in the main sample. For example, SCITTs are a relatively recent development and are hence more likely to be categorised as ‘openers’ (see Table 7). If SCITTs are disproportionately likely to deliver maths courses compared to computing and MFL courses, then a decline in recruitment to maths courses in the main sample may

simply reflect maths trainees switching to (out of sample) ‘opener’ type courses. Columns 5 and 6 split the sample into only-HEI and only-SCITT courses, respectively. The coefficient on PMB among the HEI subsample is again very similar to in Column 2. The coefficient on PMB among the SCITT subsample falls to just under 0.8.

55. Finally, it is possible that extreme values in specific years of the time series are exerting an undue influence on the estimation of the coefficients that determine the shape of the trend. This concern can be probed by removing the first year of the time series and refitting the model to the remaining data to see if the estimate change. Dropping the observations from 2014 in Model 7 leaves the coefficient virtually unchanged.

56. Looking across the results from Columns 1-9, the main findings are robust to wide range of different comparison groups and sample variations. The exception to this is the coefficient on SCITT courses, which drops from 0.88 to 0.80. Even in this case however, the findings remain qualitatively similar.

RQ2: How has the introduction of the phased component of the PMB pilot affected recruitment to maths ITT?

57. All the models in this section control for the value of the initial bursary component. Conditioning out the value of the initial bursary component means that the estimates should now be capturing the remaining aspect of the policy - the impact of the phased component. The event ratios on the initial bursary value have the expected direction, indicating that a one-thousand-pound increase in bursary value is associated with a 3% increase in entry to initial teacher training. The main quadratic year terms again enter the model with the expected direction.

58. Now that the value of the initial bursary component is being controlled for in the models, it is no longer necessary to restrict comparison group subjects to those with similar bursary value histories, such as computing. Column 8 in Table 11 therefore includes all three main sciences collapsed within each provider into a single ‘combined sciences’ course. The rationale for this is that any subject switching *within provider* will be netted out. Bursary values are measured as the mean across the three sciences in a given year. The event ratio in the PMB row is very close to 1, indicating that the phased bursary component of the PMB pilot is not associated with any change in entry to maths initial teacher training.

59. Column 9 adds computing courses to the comparison group on the grounds that it is substantively similar and has similar outside earnings potential. The event ratio remains very close to 1.

60. Although Column 9 is the preferred specification, for transparency Column 10 employs the wider set of subjects used in Column 2 in Table 9. The coefficient on PMB rises to 1.13 implying that the introduction of the phased bursary component was associated with a 13% increase in recruitment to maths.

61. Looking across the three models, the estimates from Column 8 and 9 are to be preferred to those in Column 10 because they include comparison group subjects that are more substantively similar and have similar outside earnings potential to maths. In sum, there is no consistent evidence of an effect of the phased bursary component on recruitment. This is broadly consistent with the findings from existing research (Bueno & Sass, 2018).

Table 11: Modelling the effect of the phased bursary component on recruitment

	(8)	(9)	(10)
Phased Maths Bursary (PMB)	0.987 (0.142)	1.011 (0.103)	1.131 (0.0711)
Linear term for year	0.921** (0.0177)	0.915** (0.0156)	0.908** (0.0111)
Quadratic term for year	0.957** (0.0157)	0.964** (0.0120)	0.979* (0.00906)
Linear year term (maths)	1.024 (0.0125)	1.029 (0.0176)	1.031 (0.0123)
Quadratic year term (maths)	1.012 (0.0158)	1.002 (0.0139)	0.988 (0.0114)
Bursary (thousands)	1.028** (0.0102)	1.027** (0.00733)	1.033** (0.00420)
Subject indicators	-	✓	✓
Comparison group subjects:	Combined Sciences	Combined Sciences, Computing	Combined Science, Computing, D&T, MFL, Music, RE
Number of courses	213	266	473
Number of observations	1,065	1,330	2,365

*Notes: Coefficients are event ratios. An event ratio above one indicates a positive association with entry; below one indicates a negative association. Standard errors shown in parentheses. * = p<0.05; ** = p<0.01. Initial bursary value for Combined Science is the mean of the bursary value in each year.*

RQ3: How has phasing payment of the bursary affected recruitment to maths ITT?

62. The PMB pilot reformed both the value and the timing of bursary payments. How does the latter affect recruitment? For example, do potential trainees place a lower value on payments later in the career when deciding whether to become a teacher? Recall from Figure 12 that the *total* chemistry bursary value has evolved almost exactly in parallel with the *total* maths bursary value between 2012 and 2018. Notwithstanding the difficulties identified above in using single science subjects as comparison groups, this provides an opportunity to investigate the effect of phasing (delaying) the bursary, holding constant the overall value of the bursary.

63. Column 11 in Table 12 includes the results from an analysis using only chemistry in the comparison group. The linear and quadratic year terms again enter the model in the expected direction. The event ratio in the PMB row is 0.762, indicating that delaying some of the bursary payments until year 3 and 5 – while holding the overall value constant - is associated with a 24% reduction in recruitment. This result is, however, based on chemistry and should be interpreted with caution given the potential for switching across subjects discussed above.

64. In order to investigate this further, Column 12 uses the combined science and computing courses in the comparison group, while controlling for total bursary value. The event ratio in the PMB row falls to 0.83, indicating that delaying some of the bursary payments was associated with around a 17% reduction in entry to maths initial teacher training. Column 12 is the preferred specification because it uses the most substantively similar subjects in the comparison group. For transparency however, Column 13 adds in all other subjects as in Column 10 of Table 11. The coefficient on PMB falls to 0.93, indicating that delaying the bursary payments was associated with around a 7% reduction in recruitment. The coefficient on bursary value in both Column 12 and 13 is again 1.03, indicating that a £1000 increase in initial bursary value is associated with a 3% increase in recruitment.

65. Looking across the findings in Columns 11, 12 and 13, it is clear that phasing the payments had had a negative effect on recruitment. However, the size of the coefficients are clearly not stable across models, suggesting that these findings should be interpreted with caution. Having said that, these results are broadly consistent with other research, which has found that near-term incentive payments affect recruitment (Feng & Sass, 2018) but delayed incentives, paid after several years in the profession, do not (Bueno & Sass, 2018).

Table 12: Modelling the effect of phasing payments, holding total bursary constant

	(11)	(12)	(13)
Phased Maths Bursary (PMB)	0.762 (0.119)	0.834 (0.120)	0.927 (0.100)
Linear term for year	0.927* (0.0277)	0.908** (0.0177)	0.906** (0.0125)
Quadratic term for year	0.937** (0.0205)	0.961** (0.0146)	0.978* (0.0100)
Linear year term (maths)	1.051 (0.0372)	1.016 (0.0283)	1.009 (0.0239)
Quadratic year term (maths)	1.035 (0.0269)	1.012 (0.0213)	0.993 (0.0174)
Total bursary value (thousand)	-	1.029** (0.00784)	1.033** (0.00424)
Subject indicators	-	✓	✓
Comparison group subjects	Chemistry	Combined Science, Computing	Combined Science, Computing, D&T, MFL, Music, RE
Number of courses	212	266	473
Number of observations	1,060	1,330	2,365

*Notes: Coefficients are event ratios. An event ratio above one indicates a positive association with entry; below one indicates a negative association. Standard errors shown in parentheses. * = p<0.05; ** = p<0.01. Initial bursary value for Combined Science is the mean of the bursary value in each year.*

Discussion

66. The Phased Maths Bursary reduced the value of the bursary paid to maths initial teacher trainees from £25,000 to £20,000, while introducing a phased component worth at least £5,000 in the third and fifth year of teaching. In theory, the reduction in initial bursary value should reduce recruitment, while the introduction of the phased bursary payment should increase retention. The assumption behind the policy is that the effect of the £10,000 increase in the latter will more than offset the effect of the £5,000 decrease in the former, leading to an overall increase in the supply of maths teachers.

67. This research has evaluated the effect of the PMB pilot on recruitment – one half of this story. The results consistently indicate that monetary incentives for training matter for recruitment to initial teacher training. Indeed, across the models that incorporate bursary values, a one thousand pound increase in bursary payments is associated

with a 3% increase in the number of people training in a specific subject. The quasi-experimental results from the comparative-interrupted time series models suggest that the introduction of the PMB pilot reduced recruitment by 10-15%. By contrast, no consistent evidence is found that incentives paid later in the career affect recruitment to initial teacher training.

68. How can it be that changes in initial bursary affect recruitment, but changes in overall bursary value do not? There are at least two ways of explaining this set of findings. First, it could be the case that potential trainees value incentives paid in the future less than incentives paid in the near term. Indeed, this evaluation found no consistent evidence that the phased component of the bursary (paid in year three and five) affected recruitment to maths, while also finding that delaying payments until later time periods negatively affected recruitment. An evaluation of a similar programme in the US also found that delayed payments had no effect on recruitment (Bueno & Sass, 2018). Second, it could be that trainees are not aware of payments later in their career. Indeed, survey research with registrants on the Get Into Teaching website has found that while three quarters (75%) of respondents were aware of initial bursary payments, only one third (36%) of those eligible for the PMB pilot were aware of the phased component of the bursary (See p.11).

Limitations

69. An important limitation of this evaluation is that the models used to address RQ1 cannot account for how changes in initial bursary maths and non-maths comparison-group subjects changed over the period. For example, the crucial result in Column 1 of Table 9 uses computing courses in the comparison group, for which the initial bursary value varied from £20,000 to £26,000 over the period. If this is driving pre-treatment trends in comparison group subjects then the estimates of the deviation from trends will be biased. Having said this, it is reassuring to note that the results in Column 2, which rely on subjects with very different bursary value histories, provide almost identical results. Moreover, if there were subject-specific factors affecting recruitment in specific years, we might expect changing the years of data used to estimate the models would cause the estimates to change. However, Column 7 which excludes the 2014 data, provides very similar results.

70. The CITS design used to derive the impact estimates in this evaluation also rely on certain assumptions, foremost amongst which is that there are no changes (other than the PMB pilot) which cause recruitment to maths ITT to deviate from its pre-treatment trend differently to the way in which they cause comparison groups subjects to deviate from their pre-treatment trend. One notable change that occurred at this time was the introduction of a new marketing campaign to recruit teachers. However, this was not focused on any particular subject and should therefore have affected recruitment to maths and non-maths subjects in a similar way. One important policy change which did affect subjects differently is the introduction of the TSLR policy for science and computing subjects (but not maths) in 2018. However the results from

Column 4 in Table 10, which exclude TSLR areas, suggest this was not the case. Again, survey research with registrants on the Get into Teaching website suggests a plausible explanation for this: only 12% of respondents were aware of the TSLR policy (CFE Research, 2023). Besides changes in initial bursary values and TSLR, it is hard to identify any other policy changes that would have affected maths and non-maths subjects differently (for a review, see Foster, 2019).

71. An alternative threat to this assumption comes from changes in the broader economy. For example, if pay for maths graduates showed a positive deviation from its prior trend that differed from the way that pay for non-maths graduates deviated in 2018, then the results would also be biased. Figure 16 provides some indirect evidence on this point by showing trends in graduate starting salaries by degree subject. Although the series was discontinued a year prior to the PMB-eligible graduate cohort, the chart shows that, historically, STEM graduate earnings (particularly for maths and computing) evolve along very similar trajectories over time. This provides some reassurance that they were unlikely to have deviated in 2018. It is also reassuring to note that the findings in Table 10 are robust to the inclusion of several additional comparison group subjects, some of which provide very different graduate labour market opportunities.

Policy implications

72. Despite these limitations, the findings of this paper provide insights of direct relevance to policymakers looking to tackle teacher shortages. The number of entrants to maths initial teacher training in 2018/19 was 2,195. On the assumption that this represents a 15% reduction on what would have happened in the absence of the PMB pilot (Column 1 in Table 9), there would have been 2,582 maths teacher trainees had the old bursary remained in place. That is to say, the PMB pilot reduced recruitment to initial teacher training by 387. The Teacher Supply Model 2017/18 assumes (based on historic data) that 71% of maths initial teacher trainees subsequently take up employment in state-funded secondary schools in England. The PMB pilot can therefore be expected to have reduced the number of maths NQTs beginning employment in state-funded schools in England in 2019/20 by (387x0.71=) 275. Simplifying slightly, any future increase in retention due to the phased component of the PMB pilot will thus need to outweigh this reduction in recruitment if the PMB pilot is to increase overall teacher supply.

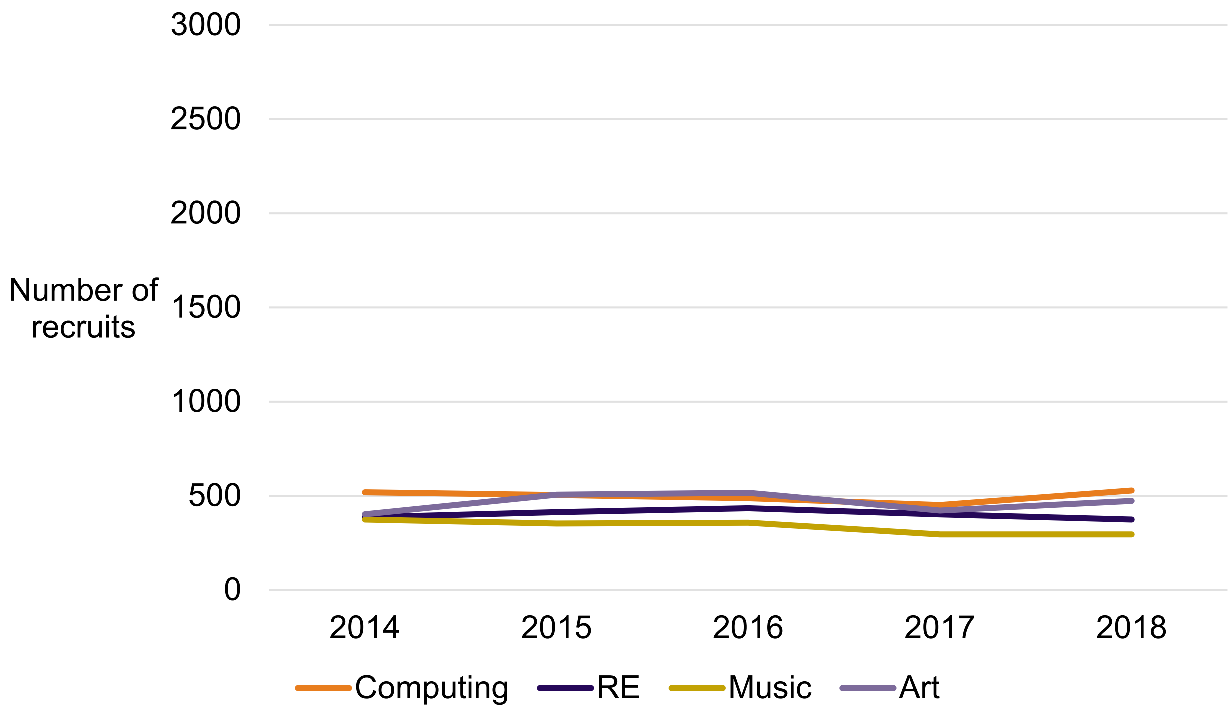
73. Similarly, the impact estimates presented here make it possible to calculate the pay elasticity of entry to training. The result from Column 1 of Table 9 implies that a 20% reduction in initial bursary value resulted in a 15% reduction in recruitment - implying an elasticity of (-15/-20=) 0.6. That is, for every 1% increase in pay there is a 0.6% increase in entry to maths initial teacher training. To put this in context, the 2018/19

target for maths ITT recruitment was 3,102 of which 2,195 (71%) were recruited.[43] Extrapolating from the estimates above, plugging this gap using the initial bursary would have required a (29/0.6=) 48.3% increase in the value of the initial bursary, from £20,000 to £29,660.

74. It should be noted however, that the above is only intended as an illustration. Strictly speaking, the policy goal is to ensure a sufficient supply of teachers working in state funded schools. Increasing recruitment is only one way of achieving this. Indeed, the PMB pilot is premised on the idea that increasing retention using the phased component of the bursary will be a more cost-effective way of achieving this aim. Determining whether the PMB pilot has the same effect on retention will require waiting for data on the retention of teachers from the 2018/19 trainee cohort. This will become available in 2020.

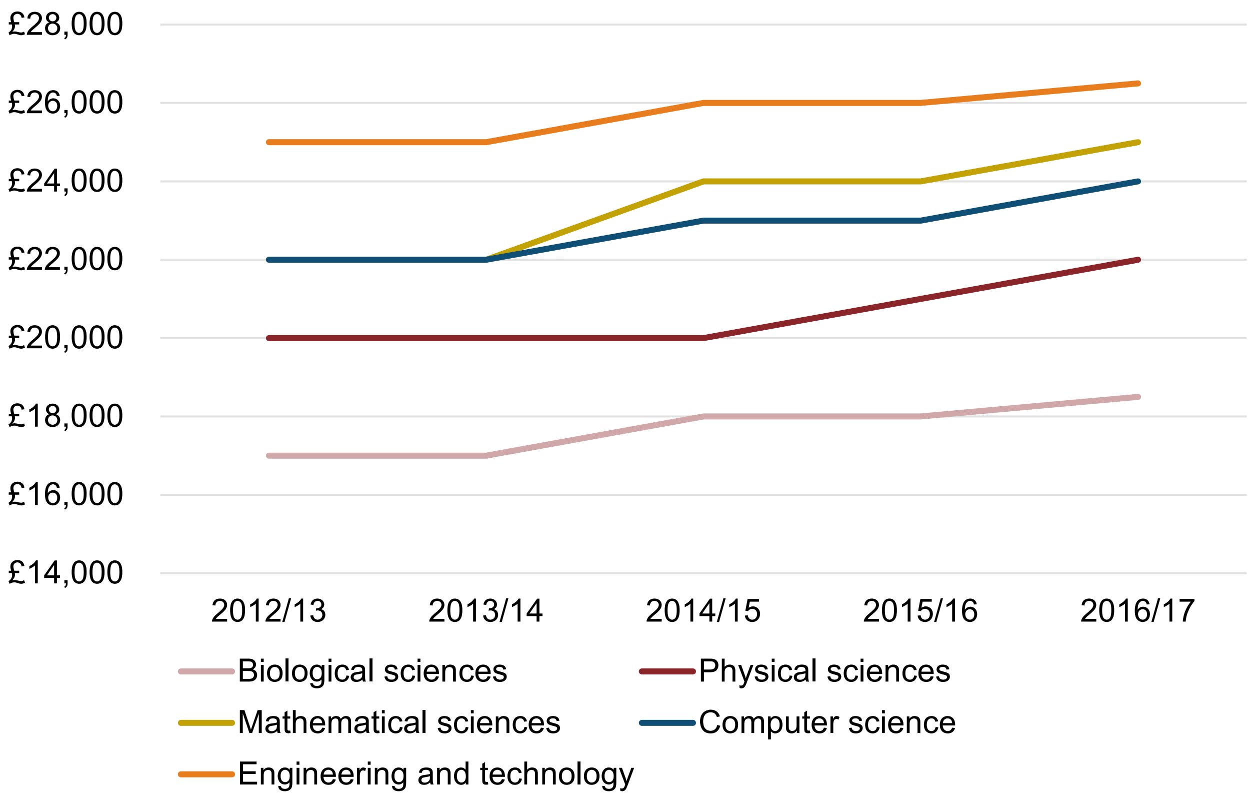
Annex B.1

Figure 15: Computing and non-STEM subjects



43 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/759718/ITT_Census_2018_to_2019_Main_Tables.ods

Figure 16: Graduate starting salaries



Notes: source data comes from the (now discontinued) HESA Higher Education Leaver Statistics dataset. Data covers all UK publicly funded higher education institutions. Earnings are measured via a survey administered in the academic year following graduation. Data available from: https://www.hesa.ac.uk/news/28-06-2018/sfr250-higher-education-leaver-statistics-employment

Appendix C: How did the phased maths bursary affect retention of teachers

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1. England has a shortage of secondary school teachers, with maths teachers being in particularly short supply (Worth & Faulkner-Ellis, 2022). This is in large part due to declining early-career retention (Sims, 2018).
2. In 2017, the government announced that it would be trialling a new Phased Maths Bursary pilot (PMB pilot), with the aim of increasing the supply of maths teachers. This would reduce the value of the initial (training) bursary payment from £25,000 (2017/18 trainees) to £20,000 (2018/19 trainees). However, it also introduced an ECP, paying £5,000 to teachers at the beginning of their third and fifth years of teaching. Those teaching in 39 disadvantaged 'uplift areas' would receive £7,500 (not £5,000) at each payment point.
3. The shift to the PMB pilot will likely have affected teacher supply in two ways. First, the 20% reduction in the value of the initial bursary payment is likely to have some negative effect on recruitment to maths initial teacher training (ITT). Indeed, an earlier part of this evaluation found that cutting the initial bursary value by £5,000 resulted in approximately 275 fewer newly qualified teachers beginning employment in state-funded schools in 2019/20.
4. Second, the introduction of a £5,000 (or more) phased bursary payment should increase retention. This report finds that, in the year in which the phased bursary was first paid (2021/22), it reduced attrition from the workforce by 37%. Assuming a third-year teacher would have been paid £29,664 in 2021/22, this was equivalent to a 17% increase in pay for that year. In sum, a 17% increase in pay resulted in a 37% reduction in the probability of leaving, which implies a pay-elasticity-of-exit of -2.2. Elasticities describe the percentage change in one variable (e.g., probability of leaving teaching) in response to a percentage chance in another variable (e.g. pay).
5. The number of PMB eligible teachers who left the workforce between 2020/21 and 2021/22 was 80. The impact estimates presented above imply that 127 teachers would have left the workforce were it not for the PMB pilot. Hence, the policy increased the number of maths teachers retained in schools between 2020/21 and 2021/22 by 47.
6. In uplift areas, the PMB pilot reduced attrition by 58%. A 25% increase in pay resulted in a 57% reduction in the probability of leaving, which is a pay-elasticity-of-exit of -2.3. This suggests that increasing bursaries from £5,000 to £7,500 had a broadly linear effect on retention. However, the impact estimate for uplift areas is based on a small sample and should be interpreted with caution.
7. These findings should, of course, be interpreted in light of the limitations of this evaluation. The triple difference model used here relies on the (common trends) assumption that retention in the treatment and comparison groups would have

followed a common trajectory in the absence of the policy. We (indirectly) tested this assumption in the two years prior to the first PMB ECP and found reasonably good support for the assumption. Perhaps of greater concern is the placebo effects observed for chemistry teachers, who were not eligible for the policy. This suggests that the triple-difference model may not have perfectly isolated the effect of the PMB pilot and suggests that caution should be exercised when interpreting our main findings.

8. Looked at in the round, the PMB pilot resulted in 275 fewer newly qualified maths teachers beginning employment in state-funded schools in England in 2019/20 but also retained an additional 47 maths teachers in between 2020/21 and 2021/22. In sum, the PMB pilot probably resulted in a net reduction in the number of maths teacher years (supply) among the 2018/19 maths trainee cohort. However, a second phased payment will be made to this cohort in 2023/24.

Evaluating the impact of the PMB pilot

9. The shift to the PMB pilot will likely affect teacher supply in two ways. First, the 20% reduction in the value of the initial bursary payment is likely to have some negative effect on recruitment to maths teacher training. Second, the introduction of the phased bursary payment is likely to have some positive effect on retention. The overall impact of the PMB pilot on supply therefore depends on the relative magnitude of these two effects.

10. This report is the second of two evaluating the effects of the PMB pilot on teacher supply. The first report evaluated the effect of the PMB pilot on recruitment to maths ITT in 2018/19. It found that moving from the old maths bursary to the PMB pilot was associated with a reduction in recruitment to maths initial training of 10-15%. Using data about the proportion of maths trainees that enter the profession in the year after qualifying from previous cohorts, this implies there would have been 275 additional first-year maths teachers entering schools in 2019/20 if the PMB pilot had not been introduced.

11. This report, which is the second of the two, will quantify the effect of the PMB pilot on the retention of maths teachers in that same cohort. These teachers would have entered their second (potential) year in the profession in 2020/21 and their third (potential) year in the profession in 2021/22. They would therefore have been eligible for their first ECP in 2021/22, having accrued two full years of service. The analysis reported here evaluates the effect of the PMB pilot on retention in the 2021/22 academic year, using data that first became available in the 2022/23 academic year.

12. The overall objective of this report is to understand whether any increased retention due to the ECPs made in 2021/22 outweighed the initial reduction in recruitment associated with the reduction in the value of the initial bursary payment.

Data and Variables

13. The dataset used in this analysis consists of the Initial Teacher Training Census (ITTC)[44] linked to the School Workforce Census (SWC)[45]. Teachers were linked across the two datasets using their unique Teacher Reference Number (TRN). The ITTC is an administrative dataset which counts the number of people registered on initial teacher training courses in England between the start of the academic year and the second Wednesday of October of each year. The ITTC allows us to count the number of individuals who began training to teach in each subject in each academic year. The SWC, which runs each November, is an administrative dataset that collects information from schools and local authorities on the school workforce in state-funded schools in England. The SWC allows us to count the number of teachers from each ITT cohort who remain in teaching in each academic year. By linking the ITTC and SWC, we are able to calculate teacher retention rates from the point of training.

14. Our analytic sample includes data from three trainee cohorts, ranging from those who completed their ITT in the 2016/17 academic year to those who completed their ITT in the 2018/19 academic year. For each of these cohorts we observe all available years of data in the SWC. For the 2016/17 trainee cohort, this comprises the 2017/18, 2018/19, 2019/20, 2020/21 and 2021/22 SWC years. For the 2017/18 trainee cohort, this comprises the 2018/19, 2019/20, 2020/21 and 2021/22 SWC years. Finally, for the 2018/19 trainee cohort, this comprises the 2019/20, 2020/21 and 2021/22 SWC years. The first phased bursary payment is made to the last of these trainee cohorts (2018/19) in the last year of the SWC data (2021/22).

15. The dependent variable for this analysis is attrition. For present purposes, attrition is defined as occurring when an individual who qualified to teach is no longer working in a state-funded school in England. For example, consider an individual who completed their ITT in the 2016/17 trainee cohort, then taught in a state-funded school in England in 2017/18, but did not teach in a state-funded school in England in 2018/19. In this example, attrition occurred in 2018/19.

16. It is important to note that the definition of attrition used here captures retention from the point of training, rather than the more commonly used retention from the point of entry to the school workforce. To see the difference, consider an individual who completed their ITT in the 2017/18 trainee cohort but never entered employment in a state funded school in England. In terms of retention from the point of training, attrition occurred in 2018/19, which was the first year after training in which they were not teaching. By contrast, this individual would not even feature in statistics on retention in the workforce because they never entered the workforce to begin with.[46]

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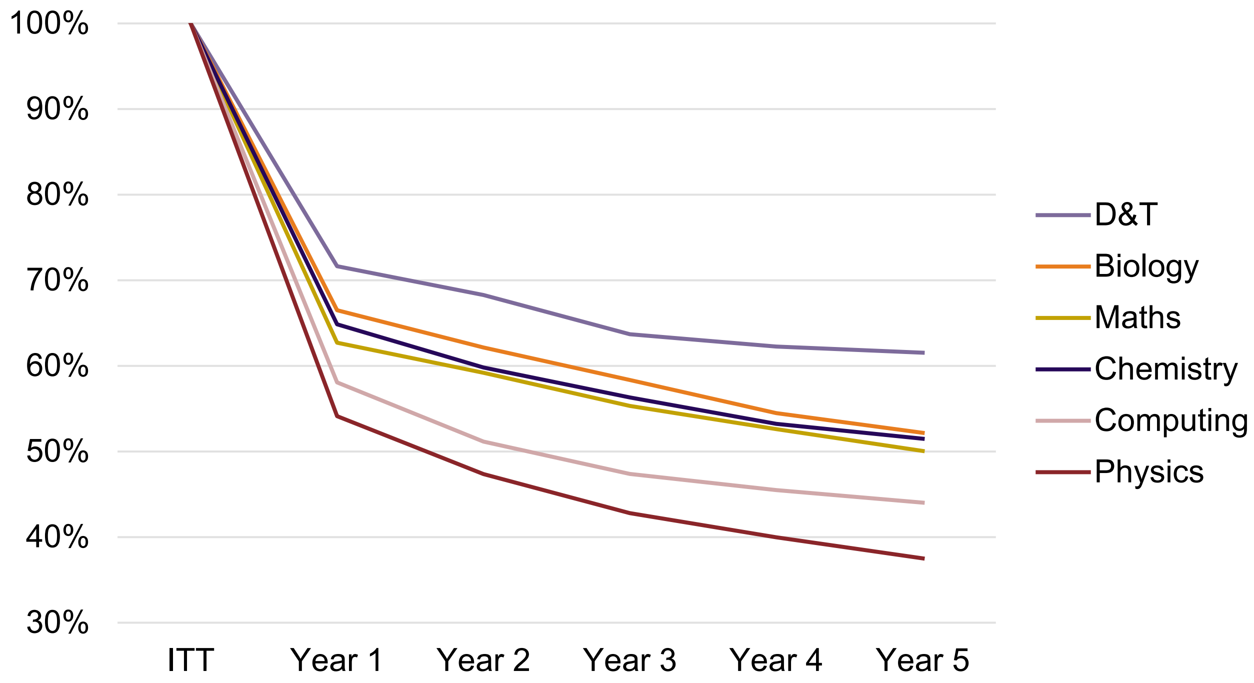
[44] More information about this dataset is available here: https://explore-education-statistics.service.gov.uk/find-statistics/initial-teacher-training-census
[45] More information about this is available here: https://explore-education-statistics.service.gov.uk/find-statistics/school-workforce-in-england
[46] Figure 18 shows net retention thus it includes individuals who return to the workforce after a period of absence. However, this is not the case for the definition of attrition used in the modelling for this analysis.

17. Figure 17 below shows retention rates for each of the STEM (science, technology, engineering, maths) ITT subjects, for one trainee cohort. The chart uses data on the 2016/17 cohort because that is the cohort with the longest follow-up period (five years post qualification) in our data. The chart shows net retention i.e., it includes individuals who return to the workforce after a period of absence from the workforce. The left-most point on the horizontal axis (labelled 'ITT') corresponds to the year in which an individual completed their ITT (2016/17). The next point along the horizontal axis (labelled 'Year 1') corresponds to the first (potential) year in the workforce following ITT (2017/18), and so on.

Figure 17: Net retention for the 2016/17 trainee cohort, STEM subjects



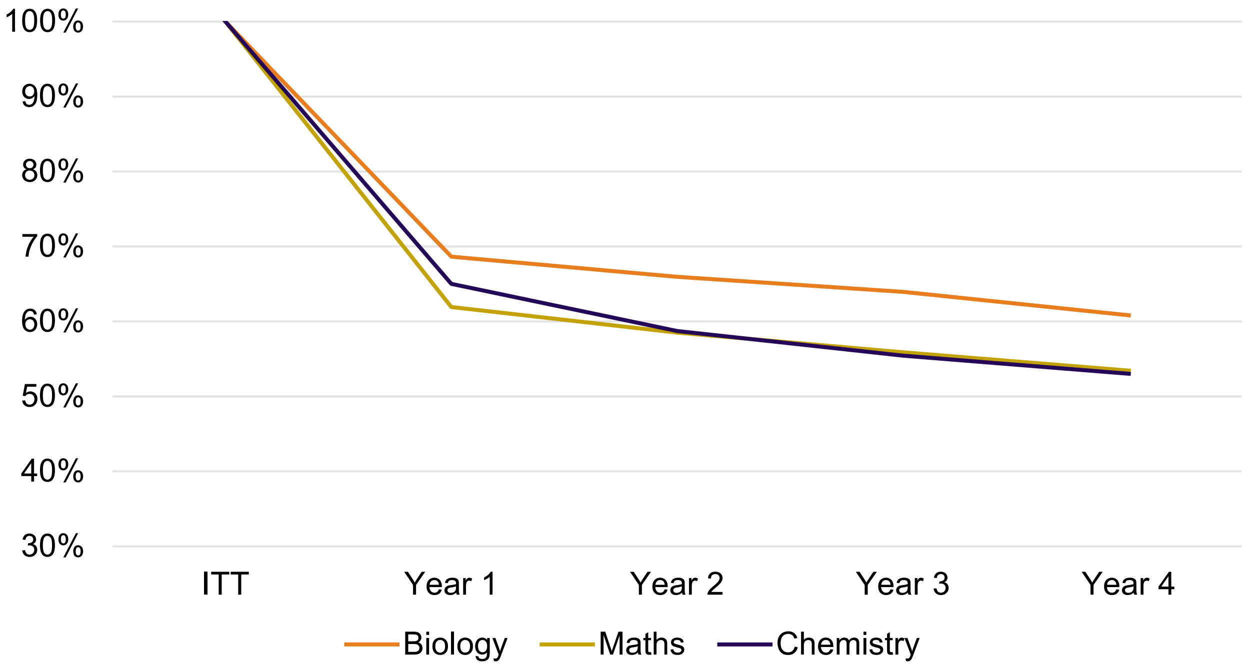
Source: Linked ITTC and SWC data. N=6,291 unique teachers.

18. Figure 17 reveals four interesting facts. First, a large proportion of trainees do not go on to teach in the year immediately following initial teacher training. For maths, just over one third (37%) of trainees do not teach in their first year following their initial teacher training course.[47] Second, the proportion who do not go on to teach in the first year following their ITT course varies considerably by subject, ranging from 24% in English to 46% in physics. In terms of 'Year 1' attrition rates, the subjects that are most similar to maths (37%) are chemistry (35%) and biology (33%). Third, retention

[47] The 37% of trainees who do not teach in their first year includes trainees that could not become a teacher because they did not achieve QTS at the end of their training.

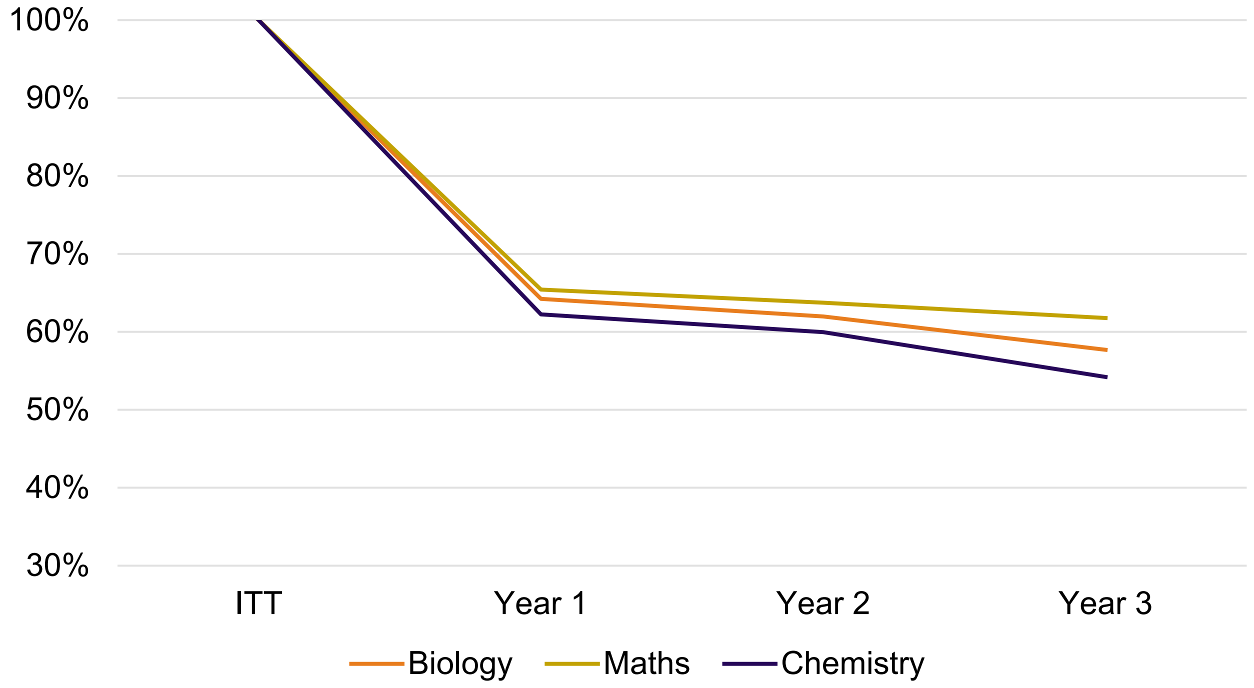
rates after ‘Year 1’ follow fairly linear downward slopes. For maths, retention rates decline by between 2-4 percentage points per year between ‘Year 1’ and ‘Year 5’. Fourth, the decline in retention rates between ‘Year 1’ and ‘Year 5’ varies across subjects, ranging from a reduction of 17 percentage points in physics to 6 percentage points in history. The subjects that are most similar to maths (13 percentage points) are again chemistry (13 percentage points) and biology (14 percentage points). Figure 18 and Figure 19 below show that chemistry and biology also follow similar trends to maths in subsequent cohorts.

Figure 18: Net retention for the 2017/18 trainee cohort (selected subjects)



Source: Linked ITTC and SWC data. N=3,855 unique teachers.

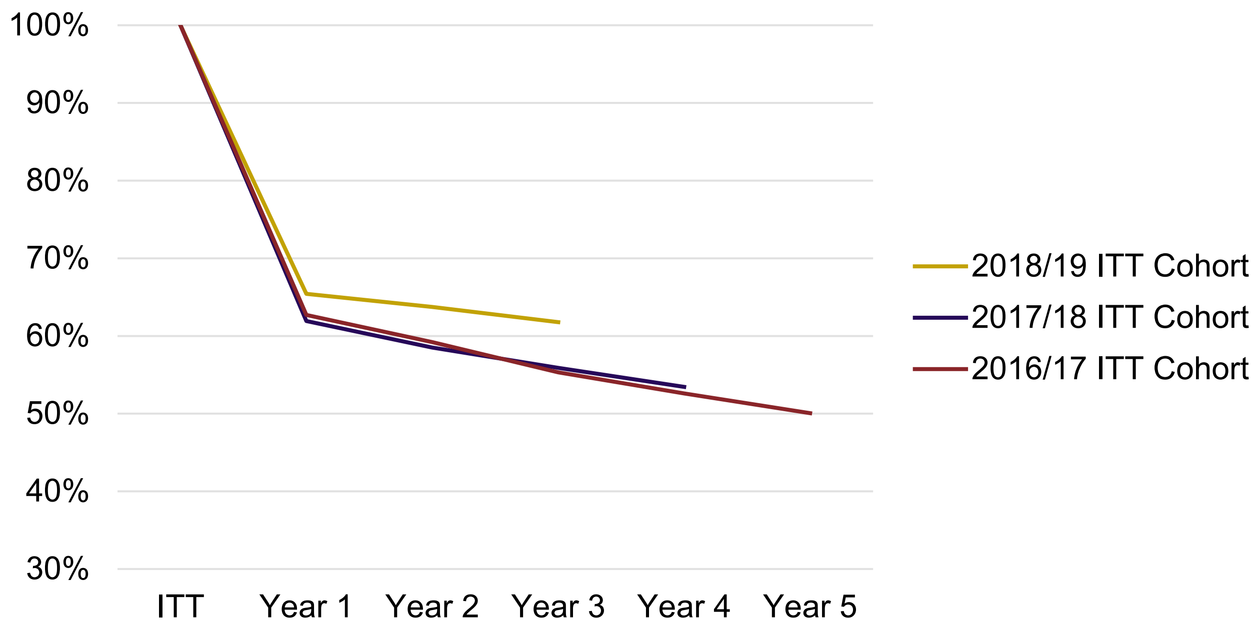
Figure 19: Net retention for the 2018/19 trainee cohort (selected subjects)



Source: Linked ITTC and SWC data. N=4,272 unique teachers.

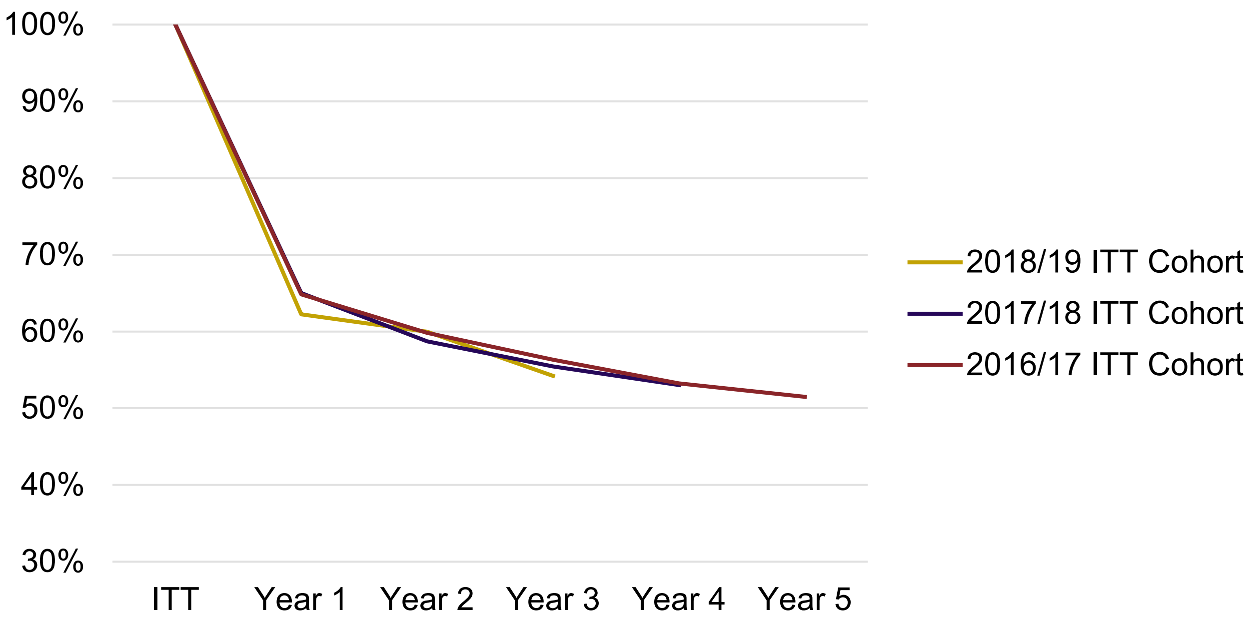
19. Figure 20 to Figure 23 show retention across cohorts by subject. They show that cohorts in a given subject follow broadly parallel trends from year 1 onwards.

Figure 20: Net retention by cohort for maths trainees



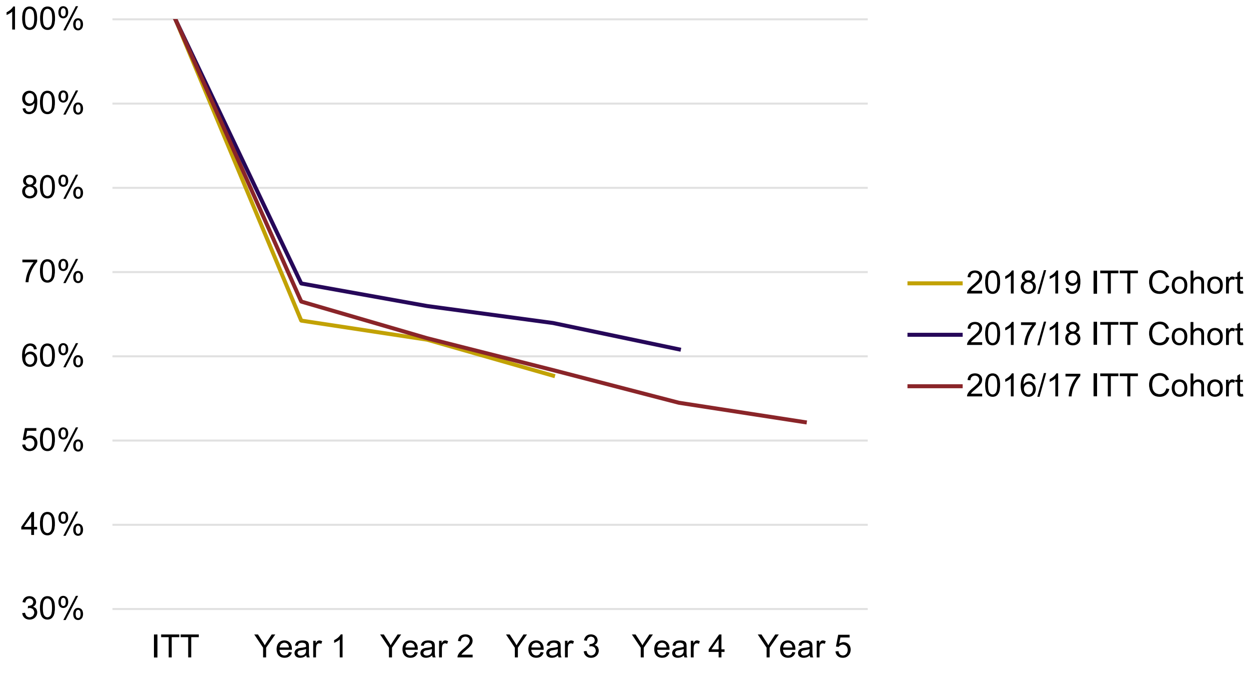
Source: Linked ITTC and SWC data. N=4,272 unique teachers.

Figure 21: Net retention by cohort for chemistry trainees



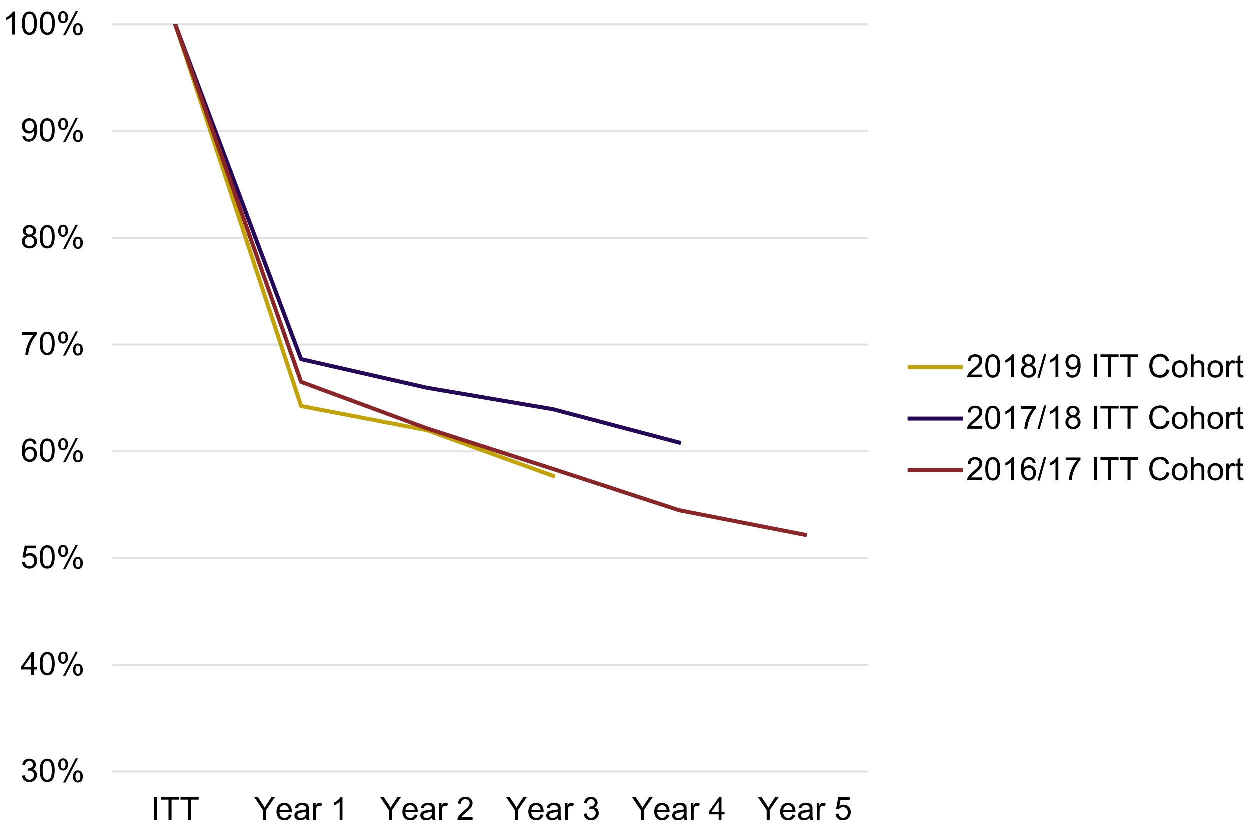
Source: Linked ITTC and SWC data. N=2,546 unique teachers.

Figure 22: Net retention by cohort for biology trainees



Source: Linked ITTC and SWC data. N=3,747 unique teachers.

Figure 23: Net retention by cohort for physics trainees



Source: Linked ITTC and SWC data. N=3,747 unique teachers.

20. The variable of interest for this analysis is eligibility for the PMB pilot payments. A teacher working in a state-funded school in England is potentially eligible for an ECP in 2021/22 if they meet the following three criteria: 1) qualified to teach in the 2018/19 academic year 2) qualified to teach maths 3) teaching at least 50% of their timetabled hours in maths.[48] Criteria 1) is captured here using a cohort eligibility indicator, which takes the value 1 if the teacher qualified in the 2018/19 cohort and 0 otherwise. Criteria 2) is captured here using a subject-qualification eligibility indicator, which takes the value 1 if a teacher qualified to teach maths and 0 otherwise. Finally, criteria 3) is captured here using a subject-taught eligibility indicator, which takes the value 1 if a teacher is teaching at least 50% of their timetabled hours in maths, and zero otherwise.
21. Table 13 shows descriptive statistics for the analytic sample, which includes 41,956 teachers across the three trainee cohorts. The average teacher is a white female, who enters the workforce at age 25. Between 15% and 16% of each trainee cohort has trained to teach maths. Of those who trained to teach maths, and began teaching

[48] Early-career payments for teachers - GOV.UK (www.gov.uk)

the following year, 99% do indeed teach maths in more than half of their timetabled hours.

Table 13: Descriptive statistics for the analytic sample

	Full sample	2016/17 trainee cohort	2017/18 trainee cohort	2018/19 trainee cohort
Year 1 attrition	36%	35.7%	36.1%	36.3%
Trained to teach maths	15.3%	16.3%	16.5%	13.2%
…of which teach >50% maths	99.1%	99.2%	99.1%	99%
Age (median years)	25	26	25	25
Male	39.6%	40.5%	40%	38.3%
Ethnicity: white	79.2%	80.1%	79.7%	77.7%
Ethnicity: black	4.6%	4.2%	4.5%	5%
Ethnicity: Asian	10%	9.2%	10.3%	10.6%
Ethnicity: other	6.3%	6.5%	5.5%	6.7%
N	41,956	14,706	12,901	14,349

All time-varying variables are evaluated for the year after completing initial teacher training. Percentages may not sum to 100 within categories due to rounding.

Source: Linked ITTC and SWC data.

Methods

22. The primary challenge in evaluating the impact of the PMB pilot is around internal validity i.e., separating variation in retention rates that are the effect of the policy from variation in retention rates that are not the effect of the policy.

23. One option would be to compare retention rates of eligible teachers in the years before and after the policy was introduced. However, there was likely a reason that the government introduced the PMB pilot at the time they did. For example, they may have believed that teacher retention was generally dropping year on year. Simply comparing retention rates in the years before and after the policy was introduced is therefore unlikely to be valid because it risks confusing such naturally occurring year-by-year reductions in retention with the effect of the PMB pilot.

24. A second option would be to compare retention in the eligible (2018/19) trainee cohort with ineligible trainee cohorts, who did their initial teacher training before the PMB pilot was introduced. Comparing cohorts is different to comparing years because each cohort is observed across multiple years. However, there may also have been a reason that the government introduced the PMB pilot in the cohort that they did. For example, they may have had reason to believe that retention was dropping in each new cohort of trainees. Simply comparing retention rates in the cohorts before and after the policy was introduced is therefore unlikely be valid because it risks confusing any naturally occurring cohort-by-cohort reductions in retention with the effect of the PMB pilot.

25. A third option would be to compare retention rates of eligible maths teachers with non-maths teachers. However, once again, there may have been a reason that the government introduced early-career retention incentives for maths teachers before other subjects. For example, they may have thought that retention was falling particularly quickly among maths teachers. Simply comparing retention rates between maths and non-maths subjects is therefore unlikely to be valid because it risks confusing any naturally occurring maths-specific reductions in retention with the effect of the PMB pilot.

26. To address these three threats to validity, this evaluation employs a triple-difference design. This research design has the advantage of addressing these three threats of validity simultaneously. This looks at the change in retention of maths teachers before and after the policy was introduced in the eligible trainee cohort (first difference), net of changes in retention of maths teachers before and after the policy was introduced in ineligible cohorts (second difference) *and* net of the changes in the retention of non-maths teachers before and after the policy was introduced in eligible cohorts (third difference).

27. The ‘first difference’ helps address the subject-specific threat to internal validity described above because maths teachers are compared with other maths teachers. Netting out the ‘second difference’ helps address the year-specific threat to validity described above because it compares maths teachers working in the same year the policy was introduced. Finally, netting out the ‘third difference’ helps address the cohort-specific threat to validity described above because it compares teachers working in the same cohort.

28. More generally, under the assumption that maths teachers in ineligible cohorts (‘second difference’) and non-maths teachers in eligible cohorts (‘third difference’) between them capture the change in retention that would have happened to maths teachers in eligible cohorts in the absence of the policy, the triple-difference design addresses all threats to internal validity and therefore captures the causal effect of the PMB pilot. This assumption is known as the ‘common trends’ assumption (Olden & Møen, 2022).

29. As shown empirically in Figure 17 above, chemistry and biology follow very similar retention trends to maths. This also makes sense theoretically, since chemistry and

biology graduates have similar outside earnings potential to maths graduates (MAC, 2017). Given the importance of common trends (see paragraph above), chemistry and biology teachers are therefore used as the main comparison group for this evaluation. We will also report the results when using slightly different subjects in the comparison group, to check whether our findings are sensitive to this choice.

30. All teachers that receive an ECP receive it in the same year (2021/22), meaning that problems with using this research design with time-varying treatment do not apply in our setting (Roth et al., 2022). Standard errors are clustered at the level of treatment assignment i.e., the teacher (Abadie et al., 2017).

Models and estimation

31. The goal of the PMB pilot is to increase the total amount of time that teachers stay in the profession by incentivising retention. The relevant outcome measure is therefore duration of service. Such an outcome measure would be left-skewed (non-normal) and right-censored (not yet evaluated) for all teachers who have not left the profession by 2020/21. In addition, trainees in different cohorts have different 'time-at-risk' in that those in earlier cohorts have had longer to potentially leave the profession. All this makes Cox proportional hazard models an appropriate way of modelling our data (Cleves et al., 2016; Cox, 1972).

32. Formally, the Cox triple-difference model can be written as:

$$h_t = h_0(t)\exp\left(\beta_1 E_{math} + \beta_2 E_{cohort} + \beta_3 E_{year} + \beta_4 (E_{math} E_{cohort}) + \beta_5 \left(E_{cohort} E_{year}\right) + \beta_6 \left(E_{year} E_{math}\right) + \beta_7 \left(E_{math} E_{cohort} E_{year}\right) + X\right)$$

Where:

- h_t is the hazard function, which represents the probability of the teacher leaving in a given year, conditional on them not having left in a prior year
- $h_0(t)$ is the baseline hazard
- E_{math} is an eligibility dummy that takes value 1 if a teacher trained to teach in maths and takes value 0 otherwise.
- E_{cohort} is an eligibility dummy that takes value 1 if a teacher trained to teach in the 2018/19 trainee cohort and takes value 0 otherwise
- E_{year} is an eligibility dummy that takes value 1 if the observation is in a year that the PMB pilot was 'on' and takes values 0 otherwise
- β_7 is the coefficient of interest which, under the common trends assumption, captures the causal effect of the policy
- X is a vector of categorical covariates: age, gender, ethnicity. Other observable controls were not included due to high levels of missingness and lack of relevance to the substantive research topic.

33. Eligibility depends on whether an individual taught >50% of maths in a given year as well as whether they trained to teach maths. However, these two variables are highly colinear (see Table 7), so we just use the indicator for the latter in the above model and omit the former.

When is the PMB pilot 'on'?

34. The PMB pilot was announced in 2017. This means that the teachers in the 2018/19 trainee cohort potentially knew from the time they started training that they were eligible for an ECP in their third year of teaching. The anticipation of the payment (in 2021/22) could therefore have potentially influenced their attrition decisions in any year between 2019/20 and 2021/22. This begs the question: in which year should the policy be considered to be having an effect? That is, in which years should the E_{year} variable be set to equal one? This is important because if the E_{year} is set to equal one only in 2021/22, but the effects on retention emerge earlier than that, then the triple-difference design outlined above may underestimate the effect of the PMB pilot.

35. There is a large behavioural economics literature showing that people tend to discount (partially ignore) future benefits (Critchfield & Kollins, 2001; Frederick et al., 2002; Odum et al., 2020). This suggests that teachers' retention decisions would be more influenced by the phased bursary payment the closer they get to the payment year. That is, any 'anticipation effects' would be larger in the year immediately prior to 2021/22. Looking back at Figure 19, which shows the PMB eligible cohort, it is clear that maths, biology and chemistry retention follow very similar trends right up until the year in which the phased bursary is actually paid ('Year 3' in the graph), after which they appear to diverge. There is no evidence that the trends for maths and chemistry/biology teachers diverge in years prior to the payment year. Figure 17 and Figure 18, which depict cohorts not eligible to the PMB pilot, also show maths and chemistry/biology following very similar trends up to and including the year in which the ECP is paid. In short, comparison of trends in the pre-treatment across cohorts and subjects does not provide any reason to think that there are anticipation effects.

36. It is also possible to check for anticipation effects more formally by estimating the triple difference model above but with the E_{year} variable set equal to one in years prior to 2021/22. If we fail to find any evidence of an effect in these prior years, then this implies one of two things. First, there genuinely are no (detectable) anticipation effects. Second, there are anticipation effects but these are being cancelled out by underlying deviation in the pre-treatment trends between maths and chemistry/biology, i.e. bias. Given the graphical evidence of very similar pre-treatment trends presented in Figure 17, Figure 18 and Figure 19, the latter explanation seems very unlikely. The results of this analysis are reported in Table 14 below.

37. It is also possible to run a different version of the model which is agnostic about the particular year in which the effect emerges. More specifically, we can drop the E_{year} term entirely, thereby converting our model from a three-way fixed effects

specification to a two-way fixed effects specification, where the outcome variable is a binary indicator of whether a teacher is still teaching in any school in 2021/22. The coefficient of interest in this model is on the two-way interaction $(E_{math}E_{cohort})$, which captures the relationship between retention until 2021/22 and being in the PMB eligible cohort and teaching maths, over and above either being in the eligible cohort but not teaching maths, or teaching maths but not being in the eligible cohort. By looking at cumulative retention between ITT and 2021/22 and dropping the E_{year} term, this specification does not depend on any assumptions about when any effect of the PMB pilot might emerge. The results of this analysis are also reported in Table 14 below.

Results

38. Table 14 shows the main results from our cox triple-difference regressions. Each column reports the results from a slightly different regression model. The coefficients reported in the table are hazard ratios. Recall that the hazard is the probability of leaving teaching in a given year, conditional on not having left yet. Hazard ratios therefore express the (proportional) change in the hazard for one unit increase in a given variable, holding all other variables in the model constant. For example, a hazard ratio of 0.6 means that a one unit increase in the relevant variable is associated with a 40% (0.6-1 = -0.4) reduction of the hazard, all else constant. A hazard ratio of 1.1 means that a one unit increase in that variable is associated with a 10% (1.1-1 = +0.1) increase in the hazard, all else constant. The numbers reported in parentheses in the table are the standard errors.

39. The rows of the table include the (combinations of) eligibility criteria described in the methods sections. As a reminder, E_{math} captures eligibility for PMB based on the ITT subject criterion, E_{cohort} captures eligibility for PMB based on the ITT cohort criterion, and E_{year} captures eligibility for PMB ECP in a given academic year. Under the common trends assumption, the effect of the PMB pilot is equal to the coefficient on the interaction $E_{math}E_{cohort}E_{year}$, which captures the group of teachers who are eligible across all three indicators. From now on, this is referred to as the 'coefficient of interest'.

40. Column (1) reports the results from the simplest version of the triple difference model, which does not include the age, ethnicity and gender covariates and uses only teachers that trained in chemistry and biology in the comparison group. The coefficient of interest indicates that eligibility for a PMB ECP was associated with a 39% reduction in the hazard of leaving teaching in 2021/22 academic year. Column (2) includes the age, ethnicity and gender covariates in the model, which helps to account for any changes in the composition of individuals in the sample over time.

The coefficient of interest now indicates that eligibility for PMB was associated with a 38% reduction in the hazard in 2021/22.

41. Column (3) includes both covariates and year dummies, which helps to account for any year-specific cross-subject and cross-cohort (e.g., beginning of COVID) shocks to retention. The addition of year dummies changes the cohort coefficients quite substantially, presumably because the year dummies can soak up year-to-year variation in retention more flexibly than the cohort dummies. The coefficient of interest remains virtually unchanged from column (2), indicating that eligibility for PMB was associated with a 37% reduction in the hazard in 2021/22. Column (4) adds physics teachers to the comparison group. This is likely to be a sub-optimal comparison group in terms of common trends (see Figure 17). However, it may also better account for any labour market shocks occurring across the three main scientific disciplines. The coefficient of interest now indicates that eligibility for PMB was associated with a 38% reduction in the hazard in 2021/22. Column (5) adds all ITT subjects to the comparison group. The coefficient of interest now increases slightly to 0.69, indicating that eligibility for PMB was associated with a 31% reduction in the hazard in 2021/22. This is likely to be a sub-optimal comparison group in terms of common trends (see Figure 17). However, it shows that our findings are not overly sensitive to choice of comparison group.

Table 14: Main triple-difference cox regression models

	(1)	(2)	(3)	(4)	(5)
$E_{math}E_{cohort}E_{year}$	0.61** (0.11)	0.62** (0.11)	0.63** (0.11)	0.62** (0.10)	0.69* (0.10)
$E_{cohort}E_{year}$	1.47* (0.22)	1.48** (0.22)	0.33** (0.05)	0.35** (0.05)	0.30** (0.02)
$E_{year}E_{math}$	0.99 (0.11)	0.99 (0.11)	0.98 (0.11)	1.00 (0.11)	1.05 (0.09)
$E_{math}E_{cohort}$	0.87** (0.04)	0.88** (0.04)	0.86** (0.04)	0.90* (0.04)	0.90** (0.03)
E_{cohort}	0.89** (0.03)	0.87** (0.03)	10.77** (0.82)	10.22** (0.70)	10.43** (0.42)
E_{year}	0.89 (0.11)	0.90 (0.11)	0.01** (0.001)	0.01** (0.001)	0.01** (0.001)
E_{math}	1.09** (0.03)	1.01 (0.03)	1.03 (0.03)	0.97 (0.03)	0.97 (0.02)
Age, ethnicity, gender covariates	No	Yes	Yes	Yes	Yes
Year dummies	No	No	Yes	Yes	Yes
Comparison group	Bio, Chem	Bio, Chem	Bio, Chem	Bio, Chem, Phys	All subjects
Number of observations	33,897	33,897	33,897	38,490	111,800
Number of teachers	12,710	12,710	12,710	14,667	41,956

Notes: Each column shows the results from a different regression. E_{math} *= eligible for PMB on the initial teacher training subject criterion.* E_{cohort} *= eligible for PMB on the initial teacher training cohort criterion.* E_{year} *= eligible for PMB ECP in current academic year. Coefficient are hazard ratios. Standard errors, which are clustered at the teacher level, are shown in parentheses. * = p<0.05. ** = p<0.01. Bio = biology, Chem = chemistry, Phys = physics.*

Source: Linked ITTC and SWC data. Year dummies are for 2018/19, 2019/20, 2020/21, leaving 2017/18 as the omitted category.

42. Table 15 reports the results from an additional set of regressions aimed at separating the effects of different retention incentives. Table 15 follows broadly the same format as Table 14. However, all models now include covariates and year dummies – the preferred specification. Likewise, all models in Table 15 now exclusively use biology and chemistry in the comparison group because these subjects have the most similar (or common) trends to maths (see Figure 17).This makes the approach in Table 15 analogous to column (3) in Table 14.

43. Column (1) in Table 15 reports the results excluding teachers who had ever taught in the 25 local authorities in which science, computing and languages teachers were also eligible for TSLR retention incentives. This helps separate out any effect of TSLR on retention from our estimates of the effect of the PMB pilot on retention. The coefficient of interest is very similar to that in column (3) in Table 14, suggesting that our PMB impact estimates are not infected by effects of the TSLR policy. Column (2) in Table 15 reports the results also excluding any teacher who had ever worked in the 42 local authorities in which 2018/19 maths ITT cohort were also eligible for the Maths and Physics Retention Payments (MPRP) payments in certain years. Again, the coefficient of interest remains very similar to that in column (3) in Table 14, suggesting that our PMB estimates are also not infected by effects of the ECP policy.

44. Columns (3) and (4) in Table 15 attempt to separate out the impacts of the two different PMB payment values: £7,500 in 'uplift areas' and £5,000 in all other areas. Column (3) in Table 15 reports the results excluding the 39 'uplift' local authorities, leaving only those areas in which eligible teachers received £5,000. The coefficient of interest again remains virtually unchanged from column (3) in Table 14, indicating that eligibility for a £5,000 PMB ECP resulted in a 37% reduction in the hazard. Column (4) in Table 15 reports the results when excluding all teachers not working in one of the 39 'uplift' local authorities in the year prior to the PMB ECP being paid. The coefficient of interest now falls to 0.43, indicating that eligibility for a £7,500 PMB ECP payment resulted in a 57% reduction in the hazard. Putting these results together reveals that the 50% increase in payment values in 'uplift areas' (£5,000 increased to £7,500) also results in an approximately 50% increase (38% increased to a 57%) in the effect of the policy on retention. It should be noted, however, that the estimates in column (4) are based on a small sample, are therefore somewhat imprecise and should be interpreted with caution.

Table 15: Separating the effects of different retention incentives

	(1)	(2)	(3)	(4)
$E_{math}E_{cohort}E_{year}$	0.66* (0.13)	0.67* (0.13)	0.63* (0.12)	0.43 (0.24)
$E_{cohort}E_{year}$	0.35** (0.06)	0.31** (0.06)	0.35** (0.06)	<0.001 (<0.001)
$E_{year}E_{math}$	1.00 (0.13)	1.04 (0.14)	1.06 (0.14)	0.62 (0.19)
$E_{math}E_{cohort}$	0.84** (0.04)	0.85** (0.04)	0.84** (0.04)	1.27 (0.46)
E_{cohort}	11.73** (0.97)	11.96** (1.04)	10.48** (0.78)	<0.001 (<0.001)
E_{year}	0.01** (0.002)	0.01** (0.002)	0.01** (0.001)	<0.001 (<0.001)
E_{math}	1.03 (0.03)	1.02 (0.03)	1.03 (0.03)	1.27 (0.20)
Excluded areas	TSLR	TSLR, MPRP	ECP Uplift	Not ECP uplift
Comparison group	Bio, Chem	Bio, Chem	Bio, Chem	Bio, Chem
Number of observations	28,767	25,176	28,796	5,101
Number of teachers	11,165	10,060	11,268	1,442

*Notes: Each column shows the results from a different regression. All models include controls for age, gender, ethnicity and year dummies. Year dummies are for 2018/19, 2019/20, 2020/21, leaving 2017/18 as the omitted category. E_{math}= eligible for PMB on the initial teacher training subject criterion. E_{cohort}= eligible for PMB on the initial teacher training cohort criterion. E_{year} = eligible for PMB ECP in current academic year. Coefficients are hazard ratios. Standard errors, which are clustered at the teacher level, are shown in parentheses. Column 4 uses bootstrapped standard errors. * = p<0.05. ** = p<0.01. TSLR = Teacher Student Loan Reimbursement. ECP = early-career payment. PMB uplift areas = those where phased maths bursary was worth £7,500 not £5,000.*

Source: Linked ITTC and SWC data

45. Table 16 reports the results of a series of placebo and sensitivity tests. The rationale for placebo tests is to look for an 'effect' of the PMB pilot in years or subjects where (logically speaking) the PMB pilot should not have had an effect. For example, teachers who trained to teach physics are not eligible for PMB, so there cannot be an effect of PMB pilot for these teachers. If the models used in this evaluation find such (placebo) effects for physicists, then this calls into question whether the model is isolating the effect of the PMB pilot for maths teachers in Table 14 and Table 15. Likewise, assuming no 'anticipation effects', we would not expect there to be an effect in the year(s) prior to payment (2021/22). If the triple-difference models used in this evaluation find such (placebo) effects in prior years, this suggests that the common trends assumption - and thus the findings more generally - may be invalid.

46. Row 1 of Table 16 reports a test for placebo effects one year before (2020/21) teachers were eligible for a PMB ECP. The coefficient is fairly close to one (1.21). Row 2 of Table 16 reports a test for placebo effects two years before (2019/20) teachers were eligible for a PMB ECP. This coefficient is one (1.00). Recall that a hazard ratio of 1.00 indicates no changes in the probability of leaving, indicating that there no clear evidence of a placebo effect. It is not possible to test for a placebo effect three years before teachers were eligible for a payment, because the eligible cohort had not yet begun teaching at this point. Taken together, these year placebo tests provide reasonably good indirect support for the common trends assumption.

47. Row 3 of Table 16 presents the results from the cross-sectional, two-way fixed effects model described in paragraph 44. Recall that this model looks at cumulative retention by 2021/22 across eligible/ineligible cohorts and subjects, thereby remaining agnostic about the year in which any effects of the PMB pilot might merge. The coefficient of interest remains negative and statistically significant, which implies that our finding that the PMB pilot improves retention is not overly sensitive to assumptions about the year in which the effect of the policy emerges. It should be noted that the coefficient is an odds ratio (from a logistics regression) rather than a hazard ratio (from a cox logistic regression). The former is expressed in terms of odds and the latter is expressed in terms of probabilities, which means the magnitude of the coefficient in row 3) cannot be directly compared to the magnitudes of the coefficients in other rows of Table 16.

48. Rows 4), 5) and 6) of Table 16 report placebo tests for all the science ITT subjects that were not eligible for PMB ECPs in the same year the PMB ECP would have been paid (2020/21). Row 6 looks for a placebo effect among physicists, in comparison to chemists and biologists. The coefficient for physics is very close to one (1.01), indicating no placebo effect. Row 4 looks for placebo effect among chemists, in comparisons to biologists and physicists. Row 5 looks for a placebo effect among biologists, relative to physicists and chemists. The coefficients for these two placebo tests deviate from 1 by +0.37 (chemistry), -0.26 (biology). This is somewhat concerning, since it suggests that the triple-difference models employed in this evaluation are picking up some signs of a (placebo) effect where there should be

none. Chemistry is particularly concerning because the size of the placebo effect is comparable with that of our impact estimate for the PMB (though with the opposite sign).

Table 16: Placebo and sensitivity tests

Placebo	Comparison group	Coefficient of interest	Number of (teachers)
1) One year early (2020/21)	Bio, Chem	HR = 1.21 (0.18)	27,623 (12,710)
2) Two years early (2019/20)	Bio, Chem	HR = 1.00 (0.13)	27,623 (12,710)
3) Two-way fixed effects	Bio, Chem	OR = 0.83* (0.06)	12,710 (12,710)
4) Chemistry	Bio, Phys	HR = 1.37 (0.30)	21,424 (8,248)
5) Biology	Chem, Phys	HR = 0.74 (0.15)	21,424 (8,248)
6) Physics	Bio, Chem	HR = 1.00 (0.24)	21,424 (8,248)

*Notes: Rows shows the results from separate regressions, including controls for age, gender, ethnicity and year dummies. 2017/18 is always the omitted category for year. Coefficients are hazard ratios. Standard errors, which are clustered at the teacher level, are shown in parentheses. * = p<0.05. ** = p<0.01. OR = odds ratio. HR = hazard ratio. The magnitudes of odds ratios and hazard ratios are not directly comparable. The 2021/22 year has been excluded in rows 1 and 2 to ensure the comparison group is not affected by any real effect of the PMB. Those who trained to teach maths have been excluded in rows 3-6 to ensure the comparison group is not affected by any real effect of the PMB.*

Source: Linked ITTC and SWC data.

Discussion

49. The Phased Maths Bursary reduced the value of the bursary paid to maths initial teacher trainees from £25,000 to £20,000, while introducing an ECP worth at least £5,000 in the third and fifth years of teaching. In theory, the reduction in initial bursary payment value should reduce recruitment, while the introduction of the phased bursary payment should increase retention. The assumption behind the policy is that the effect of the £10,000 increase in the latter will more than offset the effect of the £5,000 decrease in the former, leading to an overall increase in the supply of maths teachers.

50. This research has evaluated the effect of the PMB pilot on retention. Our preferred specification suggests that, in the year in which the incentive was paid (2021/22), it reduced attrition from the workforce by 37%. This finding was broadly insensitive to a range of different model specifications, including accounting for other financial incentive payments introduced around the same time. Under the reasonable assumption that a third-year teacher (outside London) would have been paid £29,664 in 2021/22, this £5,000 PMB ECP was equivalent to a 17% increase in pay for that year. In sum, a 17% increase in pay resulted in a 37% reduction in the probability of leaving, which implies a pay-elasticity-of-exit of -2.2.

51. We also found some evidence of a dose-response effect, in that the 50% increase in payment values in ‘uplift areas’ (£5,000 increased to £7,500) results in an approximately 50% increase (38% increased to a 58%) in the effect of the policy on retention. We found no evidence that the PMB pilot affected retention decisions in the years prior to the first payment (2021/22). Again, adopting the reasonable assumption that a third-year teacher (outside London) would have been paid £29,664 in 2021/22, this £7,500 PMB ECP was equivalent to a 25% increase in pay for that year. In sum, a 25% increase in pay resulted in a 58% reduction in the probability of leaving, which implies a pay-elasticity-of-exit of -2.3. Keeping in mind that there is some overlap between the 95% confidence intervals on the two estimates, this suggests that there is a broadly linear relationship between incentive value and retention between £5,000 and £7,500.

52. These findings should, of course, be interpreted in light of the limitations of this evaluation. The triple difference model used here relies on the (common trends) assumption that retention in the treatment and comparison groups would have followed a common trajectory in the absence of the policy. We (indirectly) tested this assumption in the two years prior to the first PMB ECP and found reasonably good support for the assumption. Perhaps of greater concern is the placebo effects observed for chemistry teachers, who were not eligible for the policy. This suggests that the triple-difference model may not have perfectly isolated the effect of the PMB pilot and suggests that caution should be exercised when interpreting out main findings.

Policy implications

53. Keeping this important caveat in mind, the findings of this paper provide insights of relevance to policymakers looking to tackle teacher shortages. The number of PMB eligible teachers who left the workforce between 2020/21 and 2021/22 was 80. The impact estimates presented above imply that 127 (127 * 0.63 = 80) teachers would have left the workforce this year were it not for the PMB pilot. Hence, the PMB pilot increased the number of maths teachers retained in schools between 2020/21 and 2021/22 by 47.

54. A prior evaluation of the effects of the PMB pilot on recruitment to ITT found that cutting the initial bursary payment value by £5,000 resulted in approximately 275 fewer newly qualified teachers beginning employment in state-funded schools in England in 2019/20. This reflects an estimated pay-elasticity-of-entry-to-training of +0.6.

55. Putting together the findings from the paragraphs above implies that the reduction in initial bursary payment value most likely reduced the number of teachers entering the profession in 2019/20 by 275 and the introduction of the ECP in 2021/22 increased the number in the profession that year by 47. The overall number of maths teachers in the eligible cohort by 2021/22 is therefore likely to be lower as a result of the PMB pilot. Moreover, it should be kept in mind that the overall policy goal is to maximise the number of teacher years in the profession, as opposed to the number of teachers in the profession in 2021/22. In *each* of the two years (2019/20 and 2020/21) prior to the 2021/22 PMB payment, there would have been additional maths teachers in England had the initial bursary payment still been £5,000 higher.

56. At the point of this evaluation, the full PMB pilot had not been fully implemented as a second ECP is due in year five of teaching. Therefore, a limitation of the evaluation is that it can only assess impact arising from the first ECP paid.

57. Understanding what is driving this result involves keeping two pieces of information in mind. Bursaries paid during the training year have a much weaker relationship with recruitment (elasticity of +0.6) compared to the relationships between the phased bursary payments and retention (elasticity of -2.2). However, the smaller elasticity of the initial bursary payment is more than offset by the larger number of teachers to which this elasticity applies. There are around 2,000 applicants to maths ITT each year compared to around 80 maths teachers leaving the profession after their second years of teaching each year. In short, while training bursaries have a weaker relationship with supply, this is more than made up for by the fact that training incentives apply to many more teachers.

58. Of course, the second £5,000 ECP will be paid in the 2023/24 academic year. However, since retention rates decline broadly linearly after the first year (Figure 17), there will be even fewer maths teacher leaving the profession in 2023/24. The second PMB ECP is therefore unlikely to fully compensate for the decline in recruitment that

likely occurred as a result of the PMB pilot being introduced. This second, phased bursary payment will also increase the overall cost of the PMB pilot.

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