Bad Economy, Good Teachers? The countercyclicality of enrolment Into Initial Teacher Training Programmes in the UK

Joshua Fullard
Institute for Social and Economic Research
University of Essex

INSTITUTE FOR SOCIAL
& ECONOMIC RESEARCH

Economic
and Social
Research Council

University of Essex

Non-technical summary

To avoid the negative effects of entering the labour market during a recession many graduates decide to defer entry into the labour market by enrolling into postgraduate study. One of the beneficiaries to this increase in demand for education are Initial Teacher Training Programmes. For instance, the Covid-19 induced recession increased the number of applicants to teacher training programmes for the 2019/20 round by 65 percent compared to the five year average. However this boost will only increase the number of trainee teachers if there is enough capacity in the system to accommodate these additional applicants, such as after a period of prolonged shortages (e.g. when policymakers failed to meet recruitment targets between 2013 and 2019).

Using data from 10 graduate cohorts (2002/03 – 2011/12) in England (Destination of Leavers from Higher Education (DLHE)) we test the hypothesis that a possible response to a period of high unemployment is for graduates to go into teaching, a profession that generally requires at least one year of postgraduate study and an occupation whose demand is mostly unrelated to economic conditions as it depends on the number of school aged children and government policies.

We find no evidence that graduating during a period of high unemployment had any effect on the probability that a graduate will go into a teacher training programme. While recessions do not increase the quantity of graduates who enrol onto teaching, due to capacity constraints, a more diverse pool of applicants does boost the diversity of trainee teachers – more male graduates, more graduates from ethnic minority backgrounds and more Russell Group graduates as well as a positive effect on subject specific shortages (more Physics graduates).

In a wider context these results indicate that if policymakers want to take advantage of a boost in applications they need to ensure that there are enough schools willing to place these trainees, they could do this by providing schools with incentives to take trainee teachers.

Bad Economy, Good Teachers? The countercyclicality of enrolment into Initial Teacher Training Programmes in the UK

Joshua Fullard[†]

6 August 2021

Abstract

Using data from the Destination of Leavers from Higher Education (DLHE), we take advantage of the plausibly exogenous variation in the unemployment rate, by field of study, at time of graduation to investigate the impact of labour market condition on teacher supply, measured by enrolment onto an Initial Teacher Training Programme (TTP). We find that labour market conditions have no effect on the probability that a graduate will go into a TTP. However, heterogeneity analysis suggests that periods of high unemployment impact the composition of graduates who enrol with effects on diversity (more male graduates and more ethnic minority graduates), subject specific shortages (more Physics graduates) and quality (more graduates from Russell Group Universities).

JEL classifications: E32;I23;J22;J23

Keywords: Teacher Supply, Business Cycle, Graduates

[†]University of Essex: jjfull@essex.ac.uk

1 Introduction

Shifts in labour demand caused by technological growth and an increase in trade with developing counties have resulted in human capital playing a more prominent role in securing a well-paid position in the labour market (David and Dorn 2013, Goos et al., 2014, Michaels et al., 2014). This is the case in England where recent evidence shows that the decision to apply to university is motivated by expected labour market returns (Delavande et al., 2018). However, the lag between the decision to apply to university and graduation means that the investment in human capital might not pay off if entry into the labour market occurs during a period of low labour demand. Research shows that graduating during a period of low labour demand can have scarring effects on labour market outcomes (Altonji et al., 2016, Cockx and Ghirelli 2016, Kahn 2010, Oreopoulos et al., 2012) . Indeed, young people who graduate during a recession are less likely to find a job and those who do face a wage penalty (Baert et al., 2013, Del Bono and Morando 2016, Oyer 2006, Shvartsman 2018, van den Berge and Brouwers 2017).

To avoid the negative effects of entering the labour market during a recession individuals may decide to defer entry by remaining in education. Existing evidence shows that economic conditions do effect education related choices in a variety of settings including the decision for graduates to enrol into postgraduate study and the decision for school leavers to enrol into post-compulsory schooling (Barr and Turner 2015, Clark 2011, Del Bono and Morando 2016, Foote and Grosz 2020, Kondo 2015). In this paper, we test the hypothesis that a possible response to periods of low labour demand is for graduates to go into teaching, a profession that generally requires at least one year of postgraduate study, and an occupation whose demand is mostly unrelated to economic conditions as it depends on population demographics and government policies. Specifically, we exploit the plausibly exogenous variation in labour market conditions at the time of graduation to investigate how this affects the probability that a graduate will enrol onto an Initial Teacher Training Programme (TTP). We find no evidence that graduating during a period of high unemployment has any effect on the probability that a graduate will enrol onto a TTP. While the quantity of graduates who enrol in TTP's might not necessarily respond to labour market conditions due to capacity constraints, the composition of trainee teachers might still be affected. Our heterogeneity analysis suggests a compositional effect on the diversity of trainee teachers - more male graduates, more graduates from ethnic minority backgrounds and more Russell Group graduates as well as a positive effect on subject specific shortages (more Physics graduates).

Understanding the factors affecting the supply of teachers is important because teachers are an essential component of the education production function whose impact on the development of human capital impacts student outcomes in both the short (Hanushek et al., 2014) and the long run (Chetty et al., 2011). The magnitude of the effect is illustrated by Hanushek (2011) who shows that a teacher who is 0.25sd more effective at raising student test scores than the average teacher annually generates marginal gains of more than $105,000 for a class of twenty students. Furthermore, teachers have a significant impact on the wider economy as emphasised by Hanushek and Woessmann (2011), who show that improving test scores by 0.25sd (just over half the difference between the US and Canada) would increase the present value of GDP by $44 trillion.

In the simplest terms, the demand for teachers is driven by the quantity of school aged children and the policymakers' desired pupil to teacher ratio (Zabalza et al., 1979). Even though we can reject the notion that class sizes have an economically meaningful impact on pupil performance as long as policymakers prioritise small class sizes, growing pupil numbers will ensure that teacher demand is unlikely to fall (Woessmann and West 2002).

The supply of teachers comes down to the retention of current teachers, the return of qualified teachers who are not teaching and the recruitment of graduates into teacher training programmes (Chevalier et al., 2007). The recruitment of graduates to teacher training programmes will be our focus here as it is the largest source for filling new demand needs. In England, teacher training occurs after at least three years of undergraduate study and students typically apply to these programmes during the final year of their undergraduate course. Similar to a bachelor's courses, teacher training requires fees to be repaid through income contingent loans (see section 2.1).

Existing research provides evidence that the supply of teachers is sensitive to labour market conditions in England. Using graduate cohort data from the 1960s to the 1980s and the 1960s to the 1990s Dolton and Mavromaras (1994) and Chevalier, et al. (2007), respectively found that the graduate unemployment rate and relative wages have a significant impact on the probability that graduates will go into teaching. However, the graduates in their data are observed between five and seven years after graduation. Therefore, it is difficult to distinguish between enrolment and retention, as it is possible that graduates who are

successfully placed onto a teacher training programme are less likely to leave the profession during periods of low labour demand.[1]

While there is evidence that the graduates decision to go into teaching is countercyclical this does not, necessarily, mean that periods of low economic activity translate into lower pupil-to-teacher-ratios. This is because teachers are costly - they are the largest component of educational expenditure - and school funding is not, necessarily, immune to periods of low economic activity. Therefore an increase in the supply of teachers will only lower the pupil-to-teacher-ratio if the system have both the capacity and the funds to absorb them. In England, for instance, many aspects of school funding is 'ring fenced' which means current, and planned, expenditure on salaries is generally protected. As a consequence, even in a recession, schools generally will have the funding to maintain its current workforce and fill existing vacancies and temporary filled posts. As a consequence pupil-to-teacher-ratios in England tend to be more related to government policies than economic conditions, measured by the GDP growth rate (Dolton et al., 2003). But this is not the case in every context. In America, for example, many schools faced severe budgetary issues due to the 2008 financial crisis causing almost 300,000 teachers to lose their jobs. As a consequence pupil-to-teacher ratios increased to 17.4, the highest level since 1989/90 (Evans et al., 2019).

This paper contributes to this literature in three ways. First, we are able to more precisely estimate the effect of labour market conditions on teacher supply as we observe graduates six months after graduation rather than five to seven years after graduation. Second we test the hypothesis in a new environment, one with tuition fees and a formal assessment. The existing evidence from England uses data prior to the introduction of tuition fees, when there were no financial costs associated with teacher training, or certification requirements, i.e. applicants did not have to pass a formal assessment (Dolton and Klaauw 1995, Dolton and van der Klaauw 1996, Dolton and Mavromaras 1994). These are two important distinctions as empirical evidence demonstrates that these policies both have a meaningful impact on the supply of teachers. Castro-Zarzur et al., (2019) finds that tuition fees make teaching less attractive and negatively impacts the quality and quantity of students who go into teaching. A relatively small body of literature, including Hanushek, et al. (1995) and Manski (1987), shows that teaching certification requirements reduces supply. Therefore, we would expect the introduction of tutition fees, and certification requirements to change the relationship

---

[1] Attrition rates in England are high, roughly one in three new teachers quit within five years. See Fullard and Zuccollo (2021) for a summary of the latest literature on teacher retention in England and Fullard (2021b) for a discussion of the Department for Education's current pay policy in England.

between economic conditions and enrolment onto a TTP – particularly for male graduates who tend to be more responsive to costs incurred.

Our third contribution is to investigate if the effect that graduating in a tough labour market has on the composition of graduates entering teaching measured by their university attainment (degree classification), the prestige of the university they attended and degree studied as well as their gender, ethnicity and socioeconomic status. Existing evidence suggests that salaries and economic conditions affect the composition of individuals who enter the profession. In the UK, Nickell and Quintini (2002) show that the decline in teachers' relative wages caused the quality of men going into teaching, measured by childhood test scores, to fall. Using administrative data on teachers in Florida, Nagler et al., (2015) found that teachers who started their career during a recession were more efficient in raising student test scores. However, this relationship is not well-established. Hanushek et al., (1999) and Hanushek and Rivkin (2007) using a rich data set on public schools in Texas, show that salaries do not explain teacher quality or ability, while Horvath et al., (2018) found that other factors are stronger predictors of entry into teaching – the most prominent of which is how much individuals enjoyed their teaching experiences during their teacher training.

Teaching is a female dominated profession across the OECD.[2] A potential reason why the majority of teachers tend to be female is that, consistent with the gender pay gap, women are significantly less likely to face a wage penalty in teaching compared to their male counterparts (Fullard 2019b). Moreover, the difference in the relative attractiveness of teaching in terms of earnings might also explain why schools struggle to recruit and retain graduates with a degree in a STEM subject (Clotfelter et al., 2008).[3]

Our ability to investigate the effects of economic conditions at graduation by observable charactersitcs is important as existing research suggests that a teacher's ethnicity and sex influence pupil performance. Dee (2007) found that same sex teachers in high school generally have a positive effect on pupil performance, while Hermann (2017) found that female teachers had a strong negative effect on high-achieving boys in England. Gershenson et al., (2018) found that black pupils assigned to black teachers in the Tennessee STAR experiment were significantly more likely to graduate from high school and enrol into college

---

[2] See Fullard (2020b) for a summary of how the composition of the school workforce has changed in England between 2010 and 2020.
[3] Note STEM is an acronym that stands for science, technology, engineering and mathematics.

Our data, the Destination of Leavers from Higher Education survey (DLHE), is collected 6 months after graduation on the population of graduates from all UK Higher Education Institutions. Due to data availability we focus our analysis on the graduation years from 2002/03 to 2011/12. The data contains information about each graduate's labour market outcomes, prior education (vocational and academic qualifications, and performance levels obtained both before and during university), family background, and demographic characteristics. We combine this graduate level data with labour market statistics and the Index of Multiple Deprivation (IMD) produced by the Office for National Statistics (ONS), data on teacher vacancies from the Department for Education's (DfE) School Workforce Census (SWC) and a measure of economic conditions from the Labour Force Survey (LFS). Due to the size and quality of our data, we can estimate the effect that economic conditions have on the enrolment behaviour of graduates onto TTPs and investigate the effects on the composition of trainees. As economic conditions are plausibly exogenous – young people in our setting enrol onto a specific degree programme with a fixed graduation date, typically three years after enrolment, and there is very little scope for deferring graduation or switching programmes - these estimates are intended to be interpreted as causal effects.

This paper is organized as follows, section 2 discusses the institutional setting, sections 3 discusses the empirical strategy , section 4 discusses the data we use, section 5 presents our descriptive statistics, section 6 presents our main results, section 7 our robustness checks and we conclude in section 8.

2 Higher Education in England

In this paper, we restrict our analysis to the English-domiciled students graduating from English Universities, as Scotland, Wales and Northern Ireland have some differences in their teacher training requirements and education systems. In England, all teachers in state schools are required to have a minimum of a lower second class (2:2) degree, qualified teacher status (QTS), and relevant school experience. To obtain a 2:2 degree, a student must enrol at a university and achieve an overall mark of between 50-59%. For an English student to enrol at a UK university, they must apply through the Universities and Colleges Admissions Service (UCAS). Students typically apply in the second year of their A-Levels (See the Appendix for further details of the application process in England).[4]

---

[4]A-levels are Key Stage 5 in the national curriculum. Students typically start their first year at 16 and finish at 18. KS5 typically occurs at a sixth form college.

Unlike many countries, including the US, students in England enrol onto a specific programme at university and there is little switching between degree subjects and institutions, and a low dropout rate (Vignoles and Powdthavee 2009). Consequently, there is little scope for undergraduates to defer their graduation, dropout or switching degrees in response to periods of high unemployment. As the degree subject is chosen prior to university enrolment and it is not practically possible for graduates to adjust either their degree subject or when they graduate in our setting, we argue that the subject specific unemployment rate, at time of graduation, is exogenous.

2.1 Initial Teacher Training Programme

During the final year of undergraduate studies (typically a student's third year), students can apply through UCAS to do a Post Graduate Certificate in Education (PGCE), which is a one year Initial Teacher Training Programme (TTP) – a TTP is any teacher training programme that leads to qualified teacher status (QTS). This programme is made up of taught classes and school placements. Like the undergraduate process, students apply to five institutions/programmes through UCAS, attend interviews and are either accepted or rejected. If a student is rejected from all five of their choices, they have a second round, named 'Apply 2'. In this round, students apply to one institution/programme at a time, but can make an unlimited number of choices until they are accepted onto a programme. According to UCAS's Analysis and Insights data, over 2,500 people (around 11% of those enrolled onto TTPs) found a teacher training place through Apply 2 in 2016. After completing a PGCE students are recommended for QTS which is the requirement to teach in England.

In our data, we observe if a graduate is enrolled onto a teacher training programme six months after graduation, but we do not observe which programme they are enrolled on. The most popular route to QTS is the PGCE but there are other routes.[5] These include Schools Direct and Postgraduate Teaching Apprenticeships. Like a PGCE, these are one-year routes also applied for through UCAS. But, unlike a PGCE, they are salaried programmes where schools, in conjunction with partnering schools or a university, train teachers on the job. There are two similar employment-based teacher training programmes, Teach First and Premier Pathways, where students work for two years and are awarded a PGCE upon completion. A final route into teaching is a three year undergraduate degree in Education. But

---

[5] The Initial teacher training census 2014-15 shows that 72% of those enrolled were on a PGCE. To this day, the PGCE remains the most popular route, but the alternative options have become more popular. For example, in 2009, 485 graduates enrolled onto Teach First, while in 2017, 1,300 were enrolled.

not all undergraduate degrees in education lead to QTS, and for those that do not, to achieve QTS, students would have to take one of the programmes outlined above (See the appendix for further details about initial teacher training programmes).

2.2 Testing Requirements

To enrol onto a TTP, all students are required to pass the professional skills test. This test assesses the numeracy and literacy of potential teachers. Since 2012, the pass threshold was increased (students had to achieve a higher score to pass) and students were limited to 2 resits. Students who fail their two resits are not allowed to retake the test for 24 months. Due to of these changes the Department for Education professional skills tests statistics show that the pass rate fell from 98% (99%) in numeracy (literacy) in 2011/12 to 85% (87%) in 2012/13.

2.3 Tuition Fees

From 1962, full time undergraduate students in the UK did not have to pay any tuition fees until their reintroduction in 1998 by the Teaching and Higher Education Act. Fees were initially capped at £1,000 per year for the cohort starting a university course in 1998. These tuition fees also apply to anyone starting a PGCE. The 2004 Higher Education Act tripled fees to £3,000 per year for the cohort starting in 2006. Following the Browne review, the UK Parliament capped fees at £9,000 for the 2012 cohort. Institutions typically set tuition fees to the highest possible level, but there is some variation. Table 1 in the Appendix presents the fees schedule by year of entry.

3 Empirical Strategy

The aim of this paper is to investigate if labour market conditions have an effect on graduates' decision to enrol onto a teacher training programme (TTP). To do this, we are going to exploit the variation in the unemployment rate at the time of graduation, which we assume is exogenous as we know students in England cannot choose their time of graduation once enrolled.

Our unit of analysis is a graduate i who obtained a degree in the field of study f, from Higher Education Institute h, lives in region d and is observed at time t (six months after graduation). Our principal interest is to establish if the unemployment rate during the previous year, $U_{f,t-1}$, affects the probability that they will be enrolled onto a TTP (Y_{ifhdt}). Our initial specification is the following:

$$Y_{ifhdt} = \beta_0 + \beta_1 U_{f,t-1} + \theta'_t + \sigma_d + \mu_h + \delta_f + \epsilon_{ifhdt} \qquad (1)$$

Where β_1 is our coefficient of interest which denotes the effect of a one percentage point increase in the subject specific unemployment rate on the probability that a graduate is observed in a TTP six months after graduation. Note that the unemployment rate that each graduate is assigned is the average of the unemployment rate the two quarters before, and two quarters after June, which is when the student graduates. We also include year fixed effects (θ'_t), region fixed effects (σ_d), institution fixed effects (μ_h) and field of study fixed effects (δ_f). Our robust standard errors are clustered at the year subject level.

Our main specification uses the subject specific unemployment rate. As we always include subject fixed effects, we are exploiting within subject across time variation. However, we might be concerned that the composition of each cohort differs. Therefore, we also control for graduates' observable characteristics, including socioeconomic status (SES) and academic characteristics (X_{ifhdt}), as well as sex, ethnicity and degree classification.

There is evidence that both the decision to enter university and the degree a student studies is responsive to the labour market conditions at time of enrolment. We therefore include regional unemployment rates, measured by the claimant count, the year before entry into university ($U_{d,t-4}$) to control for this. In addition a graduate's decision to enrol onto a TTP might be sensitive to the fluctuation in the demand for teachers at the regional level. We use a novel approach to control for this by using teacher vacancies at the regional level during the year of graduation ($V_{d,t-1}$).

Finally we include subject specific time trends to account for any systematic changes in enrolment onto TTP over time by field of study ($\gamma(\delta_f * t)$). Therefore our main specification is:

$$Y_{ifhdt} = \beta_0 + \beta_1 U_{f,t-1} + \beta_2 X_{ifhdt} + \beta_3 V_{d,t-1} + \beta_4 U_{d,t-4} + \theta'_t + \sigma_d + \mu_h + \delta_f \qquad (2)$$
$$+ \gamma(\delta_f * t) + \epsilon_{ifhdt}$$

Our identification strategy takes advantage of the fact that students in England enrol onto a specific undergraduate programme at the age of 18, and there is very little scope for them to change programmes/institutions and dropout rates are low. As the time of graduation, and

field of study, is largely fixed, students are unable to react to changes in labour market conditions. Therefore, we argue that the subject specific unemployment rate, at the time of graduation, is plausibly exogenous and β_1 represents the causal effect of labour market conditions on enrolment onto a TTP.

We will also consider the interaction of $U_{f,t-1}$ with dummies including the graduate's sex (male), ethnicity (white), degree classification (2:1 or above), university prestige (Russell Group) and socioeconomic status to investigate how periods of high graduate unemployment might affect the composition of graduates enrolled onto TTPs.

We will also use subsample analysis to investigate how the effect differs by degree subject. We will do this by restricting our sample to graduates with a specific degree subject and run a modified version of equation 2 by dropping our year fixed effects, subject fixed effects and subject specific time trends:[6]

$$Y_{ihdt} = \beta_0 + \beta_1 U_{t-1} + \beta_2 X_{ihdt} + \beta_3 V_{d,t-1} + \beta_4 U_{d,t-4} + \sigma_d + \mu_h + t + \epsilon_{ihdt} \qquad (3)$$

Using the subject specific unemployment rate relies on assumptions about graduate mobility. Although graduates are highly mobile in England, a region specific graduate unemployment rate $U_{d,t-1}$ might be more appropriate. Therefore, we modify equation 2) by replacing subject fixed effects and subject-specific trends with regional fixed effects and region-specific trends $(\delta_d * t)$:

$$\begin{aligned} Y_{ifhdt} = \beta_0 + \beta_1 U_{d,t-1} + \beta_2 X_{ifhdt} + \beta_3 V_{d,t-1} + \beta_4 U_{d,t-4} + \theta'_t + \sigma_d + \mu_h + \delta_f \qquad (4) \\ + \gamma(\delta_d * t) + \epsilon_{ifhdt} \end{aligned}$$

Here, the standard errors are clustered at the year-region level and the region of analysis (d) is either the home domicile or the region of university, depending on whether we are using the university or the home domicile unemployment rate.

The unemployment rate might be correlated with other factors that might influence the decision to go into teaching. Therefore, we will also estimate the effect of teachers relative wages, at the regional level, on the probability of enrolling onto a TTP by estimating equation

---

[6] Note that our standard errors for this specification, where we restrict our sample to graduates with a specific degree (equation 3) are clustered at the year level to take into account possible correlation between graduates over time. To adjust for the relatively small number of clusters, we implement the wild cluster bootstrap procedure as recommended by Cameron and Miller (2015). To implement this in stata we use the boottest command using 1,000 reps (Roodman et al., 2019).

4 but replacing $U_{d,t-1}$ with $Wage_{d,t-1}$, which is the difference in the natural log of teacher and non-teacher wages:

$$Y_{ifhdt} = \beta_0 + \beta_1 Wage_{d,t-1} + \beta_2 X_{ifhdt} + \beta_3 V_{d,t-1} + \beta_4 U_{d,t-4} + \theta'_t + \sigma_d + \mu_h + \delta_f \quad (5)$$
$$+ \gamma(\delta_d * t) + \epsilon_{ifhdt}$$

Where β_1, our coefficient of interest, denotes the effect of a one percentage point increase in teachers relative wages.

4 Data

The dataset we use in this paper comes from the Destination of Leavers from Higher Education (DLHE). The DLHE is a survey that is carried out on the whole population of graduates from all UK Higher Education Institutions six months after graduation. The survey is carried out by the Higher Education Statistics Agency (HESA) and the data is linked to data from the Universities and Colleges Admissions Service (UCAS). The graduation years we use are from 2002/03 to 2011/12.[7]

We remove all the respondents who graduated in veterinary sciences as: i) none of our respondents with a veterinary degree enrolled onto teacher training programmes, and ii) we do not have any variation in the unemployment rate at the time of graduation to exploit. We also drop graduates from the following subjects, as we do not have significant variation in TTP enrolment over time: Medicine, Agriculture, Architecture, Engineering, Law, Business and Communication.[8] This leaves us with a sample of 741,815 graduates from 10 subjects.

Most of these graduates are female (58%), white (86%) and state school educated (86%). In terms of academic achievement 95% achieved at least a 2:2 which is the minimum requirement to teach. Specifically, 14% of the graduates achieved a 1st class degree, 54% achieved a 2:1 and 27% achieved a 2:2. This is largely similar to the distribution of achievement in the whole population such that we are confident of the external validity of our results. [9]

---

[7] DLHE has a non-response rate of about 19% so our data represents a sample of labour market outcomes for roughly 81% of all university graduates from 2002/02 to 2011/12.

[8] We drop those who study Medicine, Agriculture, Architecture, Engineering, Law, Business and Communication as only 16, 4, 2, 21, 16, 56 and 10 individual graduates go into TTPs respectively.

[9] In 2012/13, for example, 19% achieved a 1st, 51% a 2:1 and 25% a 2:2 according to HESA's January 2018 Higher Education Student Statistics.

Most of our graduates obtained a degree in Arts (20%), Biological Sciences (17%), Social Studies (15%), Languages (12%), History and Philosophy (10%) and Physical Sciences (8%). The sample characteristics are presented in Table 1.

4.1 Unemployment Rate by Field of Study

We use the 2003-2012 Labour Force Survey (LFS) to calculate the unemployment rate by field of study at the year of graduation (U, t-1). Using the LFS, we restrict our sample to the respondents who are between 21 and 65 and have a university degree. Using this sample, we compute the unemployment rate by field of study.[10] Table 2 shows that the average unemployment rate is just over 3%, peaking at 4% in 2010.

The field of study with the highest average unemployment rate is Arts (4%) and the lowest is Education (just under 1%). Social studies have the least variation in the unemployment rate over time while mathematical sciences have the largest variation (Table 2 in the appendix shows the variation in the unemployment rate by field of study).

4.2 Unemployment by Year of Entry

Using NOMIS, a service provided by the Office for National Statistics, we also add the regional claimant count the year prior to university enrolment to control for selection into university (U_{t-4}). For graduates whose home address is missing (7%) we use a missing dummy and assign them the national average claimant count. The claimant count is a measure of the number of people claiming unemployment related benefits. It has a mean of 2.3% a minimum of 1.2% (South East 2002 and South West 2005) and a maximum of 4.8% (North East 2000).

The argument we make here is that the claimant count at the regional level reflects the labour market that young people would have faced when they finished school. As a robustness check we also use the LFS to estimate the youth unemployment rate (aged 18-24 and without a degree) by region, where we find it has no impact on our results. We do not use a national measure as school leavers tend to be less mobile so a national measure would not be appropriate.

---

[10] We compute the unemployment rate by dividing the quantity who are unemployed by the sum of those who are employed and unemployed. We restrict our sample to those who are between 21, as that is the typical age of a university graduate, and 65, which is the retirement age. We use the retirement age and not a younger age to keep the sample size large enough to allow us to create a meaningful measure by degree subject. The number of observations we use to calculate the unemployment rate is relatively small and could bias our estimates. To minimise this we use the largest available sample (age 21-65) rather than restricting it to ages 21-30, for example.

4.3 Teacher Vacancies

Graduate enrolment onto TTPs might be sensitive to the fluctuations in the demand for teachers at the regional level. But it is not clear the effect fluctuations in demand will have on the decision to teach. An increase in teacher demand could be a signal of more favourable job opportunities, but it could also be perceived as a signal of stress or burnout among teachers (high dropout rate of existing teachers) possibly deterring graduates from the profession. We use a novel approach to control for this by using teacher vacancies at the regional level. To do this we use data from the School Workforce Census (SWC) on the quantity of advertised teacher vacancies, the quantity of temporary filled vacancies (a post filled by someone who is on a contract for one term or less) and the quantity of teachers currently in posts. The SWC is a census that is completed annually by every school in England in November.[11] We create our teacher vacancies indicator by dividing the total teacher vacancies (the sum of the quantity of advertised teacher vacancies and the quantity of temporary filled vacancies) by the total quantity of teachers in current posts. We compute this measure at both the regional and national level. Specifically every graduate has a regional and national vacancy rate from the November of the year when they would have applied to teacher training $(t - 1)$. The highest vacancy rates are in London (2.1% in 2003), while the lowest rates are in the South West (between 0.2% and 0.4%).

4.4 Socioeconomic Status Measures

The HESA data set has two measures of the graduate's socioeconomic classification prior to university enrolment: parent's occupation and a low participation neighbourhood marker (LPN). The LPN is a 0/1 dummy which indicates that the graduate comes from an area where university participation rates are less than two-thirds of the national average.[12]

To complete our SES indicators we add geographical indices of deprivation (IMD). The IMD is a relative measure of deprivation constructed by combining the following seven weighted domains of deprivation: Income, Employment, Education, Health, Crime, Barriers to Housing and Living Environment. The IMD comes at the Lower-layer Super Output Area (LSOA) level while the HESA data comes at the larger local authority district (LAD) level. Therefore,

---

[11] Although we are aware that this measure is highly dependent on the date of the survey, we feel that this is an adequate measure for teacher demand. Note that for the HESA respondents whose region we are missing, we assigned them the national average vacancy rate.

[12] Neighbourhoods in the LPM are sorted into 160 clusters based on their post code.

we construct our measure by averaging the IMD across all the LSOAs within each LAD.[13] For our analysis we split the IMD ranks into approximate quartiles by the year of graduation. Therefore, IMD is an ordinal variable where Rank 1 represents the least deprived quantile of graduates and rank 4 represents the most deprived.[14]

4.5 Relative Wages

Using the Labour Force Survey, we calculate teacher and non-teacher wages for each Government Office Region in England by year (2003-2012).[15] We use two different methods to identify non-teachers wages. First we use the average non-teaching graduate's earnings, in a given year for a given region. Using this measure teachers' relative wages can be broadly split into three categories, these are teachers who earn: i) significantly less than the average graduate (East of England, London and South East) ii) a fairly similar amount to the average graduate (South West, East Midlands, North West and West Midlands) iii) more than the average graduate (North East and Yorkshire and the Humber).

Entry into teaching is a choice and therefore using graduates' salaries to estimate non-teachers' earnings might not reflect how much teachers would be able to earn in an alternative profession. In our second method to identify non-teachers' wages we follow Chevalier and Dolton (2004) and Fullard (2019b) and use propensity score matching (PSM) to estimate non-teachers' wages controlling for differences in observable characteristics.[16] Using this measure of teachers' relative wages teachers earn significantly more than the average non-teacher in every region apart from the: East Midlands, East of England, London and the South East.

In the DLHE, we assign each graduate a teacher and non-teacher wage based on i) the year they graduated and ii) the region of domicile or the region of the university they graduated from. For example, for an individual who graduated in 2010 from the North West we assign them a teaching wage of £700 p/w (£36,400 p/a), a non-teaching wage of £666 p/w (£34,532 p/a), which is estimated using our first method and a non-teaching wage of £610 p/w

---

[13] The LSOA is a geographical area that has a minimum population of 1000 and a mean of 1500. There is an LSOA for each postcode in England. As the measure of deprivation chance over time we use 2000 for the 2000-03 cohort entry years, we use 2004 for the 2004-2006 entry years and 2007 for the 2007-09 entry years. These datasets are available in the national archives.

[14] We do not have exactly 25% in each group due to the clumping of IMD scores in the distribution.

[15] To calculate these wages, we restrict our sample to those who have a university degree, are working full time, are of working age and earn more than the national minimum wage. Teachers are identified as individuals who are working as a secondary or primary school teacher while non-teachers are graduates who are in an occupation other than teaching. We use non-teaching graduates as our comparison group because teachers in England are legally required to have a university degree therefore all occupations available to university graduates are, in principle, also available to teachers.

[16] The controls we use include, age, age squared, sex, ethnicity, degree subject and degree classification.

(£32,720 p/a), estimated using our second method. We can therefore estimate teachers' relative wages at the regional level using either of our measures of non-teachers' wages by taking the difference in the natural logs (ln(Teacher Wage) – ln(Non-teacher Wage)).

As policymakers have recently made the commitment to increase teachers' initial wages to £30k (per year) by 2022 with the expressed purpose of recruiting the best and brightest graduates into teaching understanding the relationship between relative wages and the supply of graduates into initial teacher training programmes is a policy relevant question.

5 Results

5.1 Descriptive Statistics of graduates going into Initial Teacher Training Programmes

In our sample, 4.5% (33,400) of our graduates enrol onto TTPs. The characteristics of those who enrolled onto TTPs are shown in table 3, along with a comparison of the graduates who did not enrol. Female (88% vs 56%), white (95% vs 85%) and state school educated (96% vs 86%) graduates are over-represented among those enrolling onto TTPs. They also tend to have worse degree classifications (52% vs 54% with a 2:1, 37% vs 26% with a 2:2 and 8% vs 15% with a 1st), and come from less prestigious institutions relative to the overall population of graduate (0.4% vs 4% from Oxbridge and 1.8% vs 26% from Russell Group). We also find that graduates who enrol onto TTPs have a UCAS tariff that is, on average, 50 points lower, significant at the 1% level.[17,18] Most of the graduates who enrol onto TTPs have a Degree in Education (75% vs 3%) followed by Biology (7% vs 18%), Languages (6% vs 13%) and Arts (4% vs 20%). The smallest group is physics (1% vs 9%). While there are also modest differences in representation on TTPs among the least deprived (20% vs 24%) and among the most deprived (24% vs 22%). Furthermore over 12% (vs 8%) are from low participation neighbourhoods (LPN).

Table 4 shows that the quantity of graduates enrolling onto TTPs varies both by year and observable characteristics. Column 1 shows that enrolment is highest between 2009 and 2011 while the remaining columns report the ratio of those enrolled onto TTPs against those who are not, by characteristics and by graduation year.[19] For example, column 3 shows that among

---

[17] The UCAS Tariff is an aggregate indicator of the student's pre-university attainment. Specifically it assigns each student a numerical score based on the grades and qualifications achieved. Its purpose it to make achievements in different qualifications directly comparable. A higher UCAS Tariff indicates higher attainment.

[18] A 50 point difference in UCAS tariff is roughly similar to the difference between a student achieving A*A*A in their A-levels and someone achieving BBC.

[19] (Percentage of graduates on a TTP who have degree classification x)/(Percentage of gradates not on a TTP who have degree classification x). A figure closer to 1 means that the two groups have a more similar distribution of x, a figure less than a means that the proportion of graduates with x is higher in the non-TTP group while a figure greater than one indicates

2003 graduates, 51% of those on TTPs have a 2:1 degree, and 51% of those not on a TTP, so the ratio is 1.00. Between 2004 and 2009 the proportion with a 2:1 degree was lower among those on TTPs than those who were not, but by 2012 it was 6% higher. Column 2 shows that first class degrees were always under-represented among those on TTPs, but catching up fast between 2009 and 2012.

Column 4 shows that lower second-class degrees are always over-represented among those on TTPs, but the difference is falling significantly from 2010 to 2012. We also observe that men and the least deprived graduates are consistently under-represented (column 6 and 9) while white graduates are consistently over-represented (table 4 column 12).

In our data, we observe a higher proportion of Black graduates graduating year on year, yet, from 2007, we observe a general decline in the proportion of black graduates enrolling onto teacher training (table 4 column 13). While Asians' participation rates remain relatively consistent, the proportion on TTPs increases significantly over time (column 14).

5.2 Bad Economy, More Teachers?

Estimates of the effect of graduating during a period of high unemployment based on the different models discussed in section (3) are presented in Table 5. Column 1 shows our first model (equation 1), and we build from this by adding our graduate specific covariates (column 2) and other controls that might affect the cohort composition and the decision to go into teaching (column 3) until we reach our preferred specification in column 4 (equation 2). In all of these specifications we find that unemployment has no effect on the probability of enrolling on a TTP.

The lack of any effect of the unemployment rate might be because the unemployment rate measured at the year of graduation might not capture the labour market conditions that graduates faced when they decided to apply for teaching. The application round for TTPs for a given graduate cohort opens in the October of the year prior to graduation and over half of applications have already been submitted by the end of the year. Therefore, it might be more appropriate to assign graduates the unemployment rate the year prior to graduation ($U_{f,t-2}$). It is also possible that the unemployment rate is a lag of labour market conditions and, to get an accurate sense of the labour market conditions these graduates face, it might be more appropriate to use the unemployment rate the year after graduation ($U_{f,t+1}$).

that the proportion in the TTP group with x is higher than the non-TTP group. We use odds ratios to account for the fact that the proportion of graduates with certain characteristics, such as a 1st class degree, change over time.

Columns 1 and 2 (5 and 6) in table 6 report the coefficient using a one year lagged (lead) unemployment rate. Similar to our estimates using the unemployment rate from the year of graduation (columns 3 and 4) we observe a precisely estimated no effect.

Another check we perform is to consider variation at the regional level. Instead of using our subject specific unemployment rate, which assumes that all graduates, for a given cohort and degree subject, face the same labour market conditions, it might be more appropriate to use a regional unemployment rate. Relaxing our assumption about perfect graduate mobility and exploiting across regional variation in the regional unemployment rate (home or university) we estimate equation 4.

Columns 1 to 2 and 3 to 4 in table 7 show the effect of a 1pp increase in the graduate unemployment rate, at the home and university region respectively, on the probability that a graduate will be enrolled onto a TTP. Across all of these specifications we observe that graduating during a period of high unemployment (measured at the regional level) has a very small effect on the probability of enrolling onto a TTP and this is statistically indistinguishable from zero.

The prevalence of a statistically insignificant estimate of labour market conditions on the probability that a graduate will enrol onto a TTP is not, necessarily, unexpected. This is because of capacity constraints. If we had data on application behaviour for this period we would expect to see a positive effect, but we only observe enrolment. We will discuss this in detail in section 7. Next we consider whether labour market conditions at graduation might affect the composition of graduates on TTPs.

5.3 Bad Economy, More Diverse Teachers?

Now we turn to possible heterogeneity in the effect of the unemployment rate at graduation on enrolment behaviour by interacting indicators for sex (table 8 column 1) and ethnicity (column 2) with the subject specific unemployment rate in equation 2. These results show that the unemployment rate impacts enrolment behaviour differently according to these individual characteristics. Specifically an increase in the unemployment rate increases the probability that a male graduate will enrol onto a TTP by 1pp, relative to female graduates,

while it decreases the probability that a white graduate will enrol by 1.4pp, relative to non-white graduates.[20]

Similar to many western countries, the school workforce is fairly homogeneous (female and white) and struggles to attract male graduates and graduates from ethnic minority backgrounds into the profession. An increase in the unemployment rate makes teaching more appealing to everyone. In response to this boost in interest, TTP providers are unable to recruit additional graduates, due to capacity constraints, but a more diverse pool of applicants results in a more diverse cohort of trainee teachers.

We are also interested in whether the effect differs by a graduate's socioeconomic status measured by our indicator for higher education participation in the area (column 3) or parental occupation (column 4).[21] These results show that graduates from less affluent backgrounds differ in their enrolment behaviour in response to an increase in the unemployment rate relative to their more affluent peers. Although the magnitude of the effect is fairly small, an increases in the unemployment rate increases the probability that a graduate from a low SES household will enrol by 0.2pp (column 4), relative to their more affluent peers. Therefore an increase in the unemployment rate is unlikely to have a transformative effect on the SES composition of trainee teachers.

5.4 Bad Economy, Better Teachers?

Next we investigate whether the effect on the composition of graduates enrolled onto TTPs is likely to be welfare improving for pupils. Empirical evidence shows that low quality teachers negatively affect pupils to the same, or greater, extent that high quality teachers improve pupil outcomes. Therefore, any impact on the supply of teachers (through retention and/or recruitment) is only welfare improving for students if it, on average, improves teacher quality (Hanushek et al., 2015, Hanushek and Woessmann 2011).

Unlike Nagler et al., (2015), who uses pupil performance to create a value-added measure of teacher quality, we are unable to directly measure the quality of teachers. But we can use a graduate's degree classification and the selectivity of the university they attended as a proxy. As policymakers are trying to recruit more graduates: i) from more prestigious institutions ii) with higher degree classifications into teaching we will assume that an increase (decrease) in

---

[20] Note that a relatively small number of non-white graduates (1.57%) go into teaching so, while the coefficient is positive, it is difficult to get a good idea of the effect size.

[21] The parent occupation dummy indicates whether graduates come from a household where their parents are employed in either a semi-routine or routine occupation or they are long term unemployed.

graduate quality measured by i) and/or ii) is welfare improving (decreasing). Although, with the exception of experience, it is difficult to identify teacher quality based on observable characteristics (Rivkin et al., 2005, Wiswall 2013) we feel that this assumption is reasonable due to policymakers current recruitment objectives and the strong relationship between teachers' cognitive skills and student performance (Hanushek et al., 2014).

Now we turn to possible heterogeneity in the effect by the graduate's degree classification (table 8 column 5) and the prestige of the university they attended (column 6). The interactions indicate that an increase in the unemployment rate has a negative effect on the probability that a graduate with a 2:1 or above will enrol on a TTP (0.7pp), relative to graduates with a 2:2 or below, and has a positive effect on graduates from a Russell Group university (1.69pp), relative to non-Russell Group graduates. These results demonstrate that a 1pp increase in the unemployment rate decreases the probability that a graduate with a 2:1 or above will enrol on a TTP (0.39pp) and increases the probability that a graduate from a Russell group university will enrol on a TTP (1.16pp).[22] The modest negative effect we observe for graduates with a 2:1 or above might be driven by the boost in enrolment from graduates from more prestigious universities due to less grade inflation in more prestigious institutions.[23]

While we are unable to confirm that the compositional effect brings teachers into the profession who are more effective at raising pupil test scores, we can confirm that it increases the proportion of graduates from more selective universities which is likely to be welfare improving for pupils (Ehrenberg and Brewer 1994, Ferguson 1991). Indeed we would expect an increase in the pool of potential teachers to improve the quality of enrolees as the TTP selection process (assessments, interviews, practical assignments) is intended to select the most suitable graduates.

5.5 Bad Economy, More Subject Specialist Teachers?

The school workforce in England overwhelmingly consists of general teaching professionals rather than subject specialists - 75 percent of graduates on a TTP have an undergraduate degree in Education. Policymakers struggle to recruit subject specialist teachers, particularly those with Physics degrees. Therefore, we would expect a boost in applications for TTPs,

---

[22] Note that few Russell Group graduates go onto TTPs (0.01%) therefore it is difficult to get a good sense of the magnitude of the effect size.

[23] Between 2003 and 2012 the proportion of non-Russell group graduates who were awarded a first class degree increased by 72% (compared to 35% of Russell group).

caused by a tougher graduate labour market, to decrease the probability that a graduate with a degree in Education will be enrolled onto a TTP and increase the probability that a subject specialist will be enrolled. Specifically, a boost in the number of graduates interested in a career in teaching from a wide range of academic backgrounds will increase the subject diversity of those enrolled onto TTPs..

This is what table 9 shows. A 1pp increase in the unemployment rate increases the probability that a Physics (social studies) graduate will enrol onto a TTP by 0.2pp (and 0.8pp), columns 2 and 5 respectively, and decreases the probability that an Education graduate will enrol by 0.36pp (column 9). As outlined above, our standard errors for our subsample analysis (equation 3) are clustered at the cohort level. To adjust for the small number of clusters we also report the wild bootstrap cluster p-values and 95% confidence intervals (using 1,000 repetitions).

Our subsample analysis shows that the unemployment rate has a positive effect on the probability that a Physics and Social Studies graduate will enrol onto a TTP. However the subject specific specifications might be too noisy to get a good idea of the effect size (i.e. less than 1 percent of graduates from these subjects enrol).

To assess the possible effect size, in table 10, I interact a STEM dummy with the unemployment rate. While the effects are initially positive (column 1 shows equation 1) when we include subject fixed effects and build up to our preferred specification (column 4 which shows equation 3) we find a precisely estimated no effect. The likely cause of this is that Physics and Social Science graduates make up a fairly small proportion of STEM and Non-STEM graduates respectively (the groups we find positive effects for) so when we combine them together it becomes difficult to find an effect.

5.6 Higher Wages, More Teachers?

In table 11, we estimate equation 5 using our matched relative wage (column 1 and 3) and graduate relative wage (column 2 and 4) at the home domicile (columns 1 and 2) and university (column 3 and 4) regions. As with unemployment rates, relative wages are found to have no effect on the probability that a graduate will be enrolled onto a TTP six months after graduation.

Interestingly we do find a positive relationship between teachers' relative wages at the time of university enrolment and the probability of a graduate enrolling onto an undergraduate

programme in Education (table 12 column 1 and 2). This does show that young people from regions where teachers' relative wages are higher are more likely to enrol on an undergraduate programme in Education. However, the effect does disappear when we include our region fixed effects and time trends (column 3 and 4) which suggests that the effect is driven by some other unobservable, such as regional differences in degree preferences, which is correlated with teachers' relative wages.

6 Robustness Check

For our main model we decide to use a linear specification. However, a non-linear model might be more appropriate in our setting as only a small proportion of our sample enrol onto TTPs. In Table 13 we compare the effect of a 1pp increase in the unemployment rate, and a selection of covariates, on the probability of enrolling onto a TTP using linear (column 1) and non-linear specifications (column 2 probit and 3 logit).

These estimates show that when we use our preferred model (equation 2) we find that graduating during a period of decreased labour demand has no effect on the probability of going into a TTP across our specifications. Therefore we are confident that our estimates are not driven by our decision to use a linear specification. Looking at our other covariates we observe that male graduates are less likely to go into teaching as are those with a 3rd class degree.[24]

7 Discussion and concluding remarks

In this paper we use the variation in the unemployment rate at time of graduation to investigate the effect that labour market conditions have on enrolment onto Initial Teacher Training Programmes (TTPs) for 10 graduate cohorts (2002/03-2011/12) in England.

Our main result is that enrolment on a TTP does not respond to periods of low labour demand. While it is almost certainly true these periods do boost the number of graduates interested in teaching for instance, the Covid-19 induced recession increased the number of applicants to teacher training programmes for the 2019/20 round by 65% (see Figure A1 in the appendix), we found no impact on enrolment, and we suspect that this is due to capacity constraints.[25] Each year roughly half of applications are not placed on a TTP programme. The

---

[24] Note that the institution fixed effects we use in this section is at a higher level to ensure that none of our dummies perfectly predict failure and are therefore dropped from our regression. The institution fixed effects in this specification are grouped using the following: Russell Group institutions are split into quintiles by size and non-Russell group institutions are split into twenty categories by size.

[25] There is no publically available data on teacher training applications for our time period so we are unable to check.

reason so many are rejected is because, for each trainee teacher, providers must secure school based placements - often two twelve week placements as well as multiple shorter placements. Sourcing placements can be tricky as many schools are reluctant to take on trainee teachers, as it is costly to them, and providers have a limited number of schools they can place students as all placements must be in a similar geographical region to the TTP provider. [26,27]

In a wider context, these results indicate that any boost in the relative attractiveness of teaching, in terms of earnings, will only increase the supply of teachers as long as there is capacity in the system to accommodate these applicants. This means that any boost in the number of graduates interested in going into teaching will only impact teacher supply if it happens to coincide with a period of prolonged shortages (such as policymakers failure to meet recruitment targets between 2013 and 2019). But even then, any increase in supply, due to a recession, for example, will be mitigated by the reduction in attrition (teacher attrition is also pro-cyclical). If policymakers want to take advantage of any boost in applications they need to ensure that there are enough schools willing to place these trainees, they could do this by providing schools with incentives to take trainee teachers.

Our heterogeneity analysis suggests that an increase in the graduate unemployment rate has a positive effect on the diversity of trainee teachers. In a general sense, this is beneficial as there are numerous advantages to a diverse workforce. Specifically, this may positively benefit boys, who underperform at school relative to girls, as there is some evidence of role model effects - male students performing better with male teachers - in England (Hermann 2017).[28]

In addition, our heterogeneity analysis raises questions about whether making teaching more attractive (paying more) is welfare improving for students in England. Our results show a positive effect for subject specialist teachers (Physics) and Russell Group graduates but we

---

[26] Many schools are unwilling to take on trainee teachers because it is costly to the school: i) trainee teachers are paired with a mentor (a senior teacher) who is required to go through additional training ii) trainee teachers require additional support and mentoring for the duration of their placement which increases the workload of existing teachers iii) teacher quality (measured by the ability to improve student outcomes) increases with experience therefore many schools are unwilling to take on trainee teachers due to the potentially negative impact it might have on their academic rankings.

[27] Moreover, the ability for providers to find school placements tends to become more difficult during periods of high unemployment. Attrition from teaching is procyclical, when there are fewer employment opportunities teachers are less likely to quit, which means that the demand for trainee teachers might actually fall.

[28] In the USA Dee (2007) finds that same-gender teachers improves the achievement of both boys and girls. But other papers including Canes and Rosen (1995) and Ehrenberg et al., (1995) find no effect while Antecol et al., (2015), using a randomized experiment, found that same gender teachers actually reduce the maths scores of female primary school students, which suggests that other factors, such as teacher quality, are more important. Even if there is an effect additional research needs to be done to estimate the welfare effects from an increase in gender diversity for teachers in England, it is possible that the positive effects for having more male teachers (for male students) could be offset by the impact on female students.

also find a negative effect for graduates with a 2:1 or above. Further research is needed to establish if the compositional effect we observe is welfare improving for students. This is particularly important in our setting where existing research suggests that some of the methods used to identify the quality of potential teachers, such as the professional skills test, are largely uncorrelated with the ability to improve student outcomes. Therefore a project looking at the effectiveness of teachers in England using a new dataset seems like a promising topic of future research.

In this paper we test the hypothesis that graduates enrol into Teacher Training during periods of low economic activity because the demand for teachers is largely unrelated to economic conditions. As existing evidence shows that the supply of teachers and other public sector professions, such as nurses, is responsive to economic conditions we are confident that this is a plausible mechanism (Konetzka et al., 2018, Li et al., 2019). However, in our case, we are looking at enrolment into Teacher Training – a form of postgraduate study. It is also plausible that during periods of low labour demand graduates might enrol into any form of education, not just teacher training, to avoid becoming unemployed.

We do not have data on applications to teacher training, or any other postgraduate qualifications, so we cannot distinguish between these two mechanisms. However we do control for teacher demand in our regressions and find a persistent negative, albeit small, statistically significant effect which suggests that the demand for teachers does influence the graduate's decision to enrol. Further research is needed to investigate how the change in demand for teacher training, during periods of low economic activity, compares to the change in demand for other postgraduate qualifications.

Our data does not allow us to identify attrition rates, given that existing evidence suggests that those who graduate during a recession have higher occupational mobility (more likely to switch jobs earlier) future research is needed to determine if recessions have a lasting impact on the supply of teachers (Shvartsman 2018, van den Berge and Brouwers 2017).

Finally, our data does not allow us to identify which teacher training route, or course, graduates enrol onto. As there has been a significant expansion in salaried training routes over the last few years, it would be interesting to know if the increase in the cost associated

with the traditional training route (PGCE) has influenced either the decision to enrol, or which programme graduates enrol onto.[29]

---

[29] As far as we are aware Fullard (2019a) and Castro-Zarzur et al., (2019) are the only paper that investigates the effect of tuition fees on teacher supply. The former is in our setting and paper finds that the increase in tuition fees has a negative effect on the probability that a graduate will enrol, where the effect is significantly stronger for male graduates. But the data they use does not allow them to identify which programmes graduates enrol onto.

Table 1 Descriptive Statistics of Graduates in our Sample

Variable	Frequency	Percentage (%)	Variable	Frequency	Percentage (%)
Sex			**Subject**		
Male	315,255	42.5	Biology	127,225	17.2
Female	426,560	57.5	Physics	62,265	8.4
			Maths	26,270	3.5
Ethnicity			Computer Science	55,015	7.4
White	635,850	85.7	Social Studies	111,590	15.0
Black	14,080	1.9	Languages	94,565	12.8
Asian	57,215	7.7	History/Philosophy	70,750	9.5
Other	22,370	3.0	Arts	145,120	19.6
NA	12,300	1.7	Education	43,915	5.9
			Combined	5,110	0.7
Degree Classification[+]					
1st	107,490	14.5	**Region**		
2:1	400,515	54.0	London	112,680	15.19
2:2	198,775	26.8	North East	18,815	2.54
3rd	30,755	4.15	West Midlands	67,575	9.11
Unclassified	4,270	0.6	East of England	82,065	11.06
			South East	143,725	19.37
Institution			East Midlands	61,625	8.31
Oxbridge	27,355	3.7	South West	58,040	7.82
Russell Group	181,015	24.4	Yorkshire and the Humber	64,600	8.71
			North West	77,830	10.49
			Missing	54,880	7.4

This table describes our sample of university graduates who graduated between 2002/03 to 2011/12 as described in section 4. The frequencies are all rounded to the nearest 5 or 0 as required by the data providers. [+] We are missing nine respondent's degree classifications. We include them in our unclassified group. Our results do not change if we do, or do not, include them.

Table 2 Unemployment rate by graduation year (2003-2012)

Year	Mean (%)	Interquartile Range(%)[+]	Range (%)[++]	Std. Dev	Skewness[+++]
2003	3.31	0.29	3.28	0.87	0.22
2004	2.61	0.87	3.26	0.85	-0.53
2005	2.57	1.40	4.51	0.92	0.39
2006	2.82	0.52	3.42	0.54	-1.89
2007	2.35	0.97	3.08	0.65	-0.90
2008	2.63	0.39	3.65	0.69	-0.62
2009	3.21	2.24	5.03	1.44	-0.42
2010	4.04	4.15	7.21	1.93	0.45
2011	3.05	0.45	5.22	0.75	-0.44
2012	3.33	2.20	3.53	1.07	-0.04
All Year	3.02	0.99	7.20	1.17	0.88

The table shows the unemployment rate by graduation year. The unemployment rate is calculated using data from the Labour Force Survey. We calculate it by dividing the quantity of graduates who are unemployed by the quantity of graduates who are employed as described in section 4.1. [+] p75-p25[++](min-max) [+++] Measures the degree and direction of asymmetry in a distribution, a symmetric distribution has a skewness of 0. A distribution that is skewed to the left has a negative skewness, while a distribution skewed to the right has a positive skewness.

Table 3. Descriptive Statistics. The proportion of Graduates in our Sample of those who enrolled onto Initial Teacher Training Programs (TTP) and those who did not by observable characteristics.

Variable	On TTP	Not on TTP	Variable	On TTP	Not on TTP
Sex			**Subject**		
Male	12.0	43.9	Biology	6.5	17.7
Female	88.1	56.1	Physics	0.9	8.7
			Maths	2.1	3.6
Ethnicity			Computer Science	1.1	7.7
White	95.0	85.3	Social Studies	1.3	15.7
Black	0.5	2.0	Languages	6.3	13.1
Asian	2.8	7.9	History/Philosophy	2.4	9.9
Other	1.2	3.1	Arts	3.8	20.3
NA	0.5	1.7	Education	74.6	2.7
			Combined	1.0	0.7
Degree Classification[+]			**IMD**		
1st	7.7	14.8	Score	21.4	20.7
2:1	51.6	54.1	Rank 1 (least Deprived)	20.3	24.1
2:2	37.2	26.3	Rank 2	24.0[Y]	23.7
Institution			Rank 3	29.7	31.7
Oxbridge	0.4	3.8	Rank 4 (most Deprived)	24.0	22.4
Russell Group	1.8	25.5			
Non Russell Group	98.2	75.5	Low Participation Neighbourhood	11.7	8.4
State School Educated	96.1	85.8			

The table shows the observable characteristics of the graduates who enrolled onto TTPs and those who did not. These differences are all statistically significant at the 1% level apart from those that are marked with a Y, which are not statistically significant. [+]We are missing nine respondent's degree classifications. We include them in our unclassified group (n=4377). Our results do not change if we do, or do not, include them.

Table 4 Equality of means across time. The figures presented are ratios (the percentage of TTP with each category/the % of non TTP) by a Graduates degree Classification, Sex and SES.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
		Degree Classification				Sex	IMD SES Rank					Ethnicity		
Grad Year	Quantity going into TTP (as a % of graduate)	first Class Degree	2:1 Degree	2:2 Degree	3rd Degree	Male	1 (Least deprived)	2	3	4 (Most Deprived)	Low Participation area	White	Black	Asian
2003	3,585 (5.44%)	0.43	1.00[Y]	1.30	0.60	0.29	0.88	0.99	1.11	1.02[Y]	1.37	1.11	0.23	0.32
2004	2,775 (4.33%)	0.37	0.95	1.41	0.87[Y]	0.24	0.86	1.03[Y]	1.09	1.03[Y]	1.41	1.12	0.26	0.24
2005	2,780 (4.32%)	0.40	0.86	1.54	1.00[Y]	0.28	0.85	0.91	1.13	1.13	1.55	1.13	0.26	0.27
2006	2,755 (4.10 %)	0.40	0.89	1.53	0.87[Y]	0.25	0.80	1.03[Y]	1.08	1.10	1.49	1.11	0.34	0.28
2007	3,230 (4.62 %)	0.40	0.90	1.51	0.95[Y]	0.26	0.84	1.00[Y]	1.10	1.08	1.41	1.10	0.28	0.37
2008	3,540 (4.65%)	0.44	0.91	1.54	0.82	0.27	0.79	0.99[Y]	1.13	1.12	1.52	1.11	0.22	0.37
2009	3,830 (4.94%)	0.48	0.95	1.46	0.89[Y]	0.26	0.87	0.99[Y]	1.11	1.06	1.46	1.10	0.30	0.47
2010	3,865 (4.78%)	0.51	0.98[Y]	1.41	0.77	0.30	0.84	1.03[Y]	1.08	1.06	1.32	1.12	0.25	0.37
2011	3,735 (4.35%)	0.70	1.02[Y]	1.27	0.43	0.26	0.87	1.02[Y]	1.08	1.03[Y]	1.28	1.11	0.25	0.39
2012	3,310 (3.68%)	0.84	1.06	1.10	0.33	0.29	0.79	1.14	1.03	1.06	1.34	1.12	0.19	0.38

This table shows that the quantity of graduates enrolling onto TTPs varies both by year and observable characteristics. The closer the ratio is to 1 the more similar the means are. Figures under 1 mean that they are underrepresented on TTP while figures over 1 mean they are overrepresented on TTP. All of the mean differences between the TTP and non TTP groups are statistically significant unless marked with a Y which means there is no statistically significant difference between TTP and non TTP means. The frequencies are all rounded to the nearest 5 or 0 as required by the data providers.

Table 5. The effect of the unemployment rate, at time of graduation, on the probability of enrolling onto a teacher training program.

	(1)	(2)	(3)	(4)
Unemployment Rate 0-100	-0.00056	-0.0006	-0.00061	-0.00166
	(-0.00096)	(-0.00095)	(-0.00095)	(-0.00111)
Year FE	X	X	X	X
Region FE	X	X	X	X
Institution FE	X	X	X	X
Subject FE	X	X	X	X
Individual Controls		X	X	X
Claimant Count			X	X
Vacancy Rate			X	X
Subject TT's				X
Constant	0.0452**	0.0495**	0.0551***	0.0258
	(-0.0204)	(-0.0206)	(-0.0204)	(-0.0207)
N	741815	741815	741815	741815
DV mean	0.045	0.045	0.045	0.045
(SD)	(0.207)	(0.207)	(0.207)	(0.207)

Source: DLHE data on the selected sample described in section 4 linked with the subject specific unemployment rate derived from the Labour Force Survey and the Office for National Statistics data.
Note: Individual controls include: sex, ethnicity, degree classification, the IMD rank and the Vacancy Rate, derived from the School Workforce Census. The claimant count is the unemployment rate, measured by the claimant count, the year prior to university enrolment. The vacancy rate is the number of teaching vacancies, at year of graduation, as a proportion of total teachers (by region). Robust standard errors are clustered at the degree subject year level and reported in brackets. * $p<0.10$, ** $p<0.05$, *** $p<0.01$

Table 6 Lag and lead unemployment rate on the probability of enrolling onto a teacher training program.

	(1)	(2)	(3)	(4)	(5)	(6)
	Year before graduation		Year of graduation		Year after graduation	
Unemployme nt Rate 0-100	0.00111 (-0.00087)	0.00123 (-0.00093)	-0.0009 (-0.00094)	-0.00083 (-0.00075)	-0.00115 (-0.00086)	-0.00102 (-0.00082)
Year FE	X	X	X	X	X	X
Region FE	X	X	X	X	X	X
Institution FE	X	X	X	X	X	X
Subject FE	X	X	X	X	X	X
Subject TT		X		X		X
Constant	-0.0241 (-0.0155)	-0.0277 (-0.0194)	-0.0163 (-0.0149)	-0.0203 (-0.019)	-0.0154 (-0.0144)	-0.0198 (-0.019)
N	586027	586027	586027	586027	586027	586027
DV mean (SD)	0.045 (0.207)	0.045 (0.207)	0.045 (0.207)	0.045 (0.207)	0.045 (0.207)	0.045 (0.207)

Source: DLHE data on the selected sample described in section 4 linked with the subject specific unemployment rate derived from the Labour Force Survey and the Office for National Statistics data. Columns 1 and 2 use the unemployment rate the year prior to graduation (i.e. the 2008 graduates are assigned the 2007 subject specific unemployment rate), columns 3-4 use the unemployment rate of the year of graduation and columns 5-6 use the unemployment rate the year after graduation.
Note: Individual controls include: sex, ethnicity, degree classification, the IMD rank and the regional vacancy rate, derived from the School Workforce Census. The sample size is reduced because we drop the 2003 and 2012 graduates as we cannot assign them a lagged and lead unemployment rate respectively. Robust standard errors are clustered at the degree subject year level and reported in brackets. * $p<0.10$, ** $p<0.05$, *** $p<0.01$

Table 7 The effect of the regional unemployment rate on TTP enrolment

Area	(1)	(2)	(3)	(4)
	Home Region		Uni Region	
Unemployment rate 0-100	-0.00000661	-0.0000332	-0.000376	-0.000367
	(0.000220)	(0.000227)	(0.000258)	(0.000266)
Controls	X	X	X	X
Year FE	X	X	X	X
Region FE	X	X	X	X
Institution FE	X	X	X	X
Subject FE	X	X	X	X
Region TT		X		X
Constant	0.0513***	0.0503***	0.0703***	0.0694***
	(0.0132)	(0.0131)	(0.0191)	(0.0190)
N	686937	686937	734511	734511
DV mean	0.045	0.045	0.045	0.045
(SD)	(0.207)	(0.207)	(0.208)	(0.208)

Source: DLHE data on the selected sample described in section 4 linked with the regional unemployment rate derived from the Labour Force Survey and the Office for National Statistics data.

Note: Our controls are: sex, ethnicity, degree classification, regional vacancies, derived from the School Workforce Census and IMD rank. Specification 1 and 2 use the unemployment rate based on the graduates home region. Specifications 3 and 4 use the unemployment rate based on the region of the university they attended. Robust standard errors are clustered at the year region level, where the region differs depending on if we are using the university or home unemployment rate and reported in brackets. * $p<0.10$, ** $p<0.05$, *** $p<0.01$

Table 8 Heterogeneity analysis by observable characteristics

Characteristic	(1) Male	(2) White	(3) Low Participation Region	(4) Low SES	(5) Degree 2:1 or above	(6) Russell Group
Characteristic* Unemployment Rate	0.0101*** (0.00352)	-0.0142*** (0.00490)	0.00229 (0.00144)	0.00232** (0.00114)	-0.00724** (0.00280)	0.0169*** (0.00486)
Unemployment rate	-0.00659*** (0.00242)	0.0103*** (0.00373)	-0.00185 (0.00115)	-0.00191 (0.00118)	0.00333* (0.00172)	-0.00522*** (0.00187)
Constant	0.0374* (0.0216)	-0.0263 (0.0255)	0.0304 (0.0207)	0.0309 (0.0207)	0.00852 (0.0217)	0.0503** (0.0209)
N	741815	741815	741815	741815	741815	741815
DV mean (SD)	0.045 (0.207)	0.045 (0.207)	0.045 (0.207)	0.045 (0.207)	0.045 (0.207)	0.045 (0.207)

Source: DLHE data on the selected sample described in section 4 linked with the subject specific unemployment rate derived from the Labour Force Survey and the Office for National Statistics data.

Note: Our regression include year fixed effects, region fixed effects, institution fixed effects, subject fixed effects and subject degree time trend. In addition we control for: sex, ethnicity, degree classification, regional vacancies, derived from the School Workforce Census, and IMD rank. Specification 1 and 2 interacts male and white dummies with the unemployment rate. Specifications 3 and 4 interact a low participation dummy (indicates if the graduates is from a region where university participation is less than two thirds of the national average) and a low SES dummy (defined as been from a home whose parents are either in a semi-routine, routine occupation or long term unemployed). Specifications 5 and 6 interact Degree 2:1 or above and Russell Group dummies with the unemployment rate. Robust standard errors are clustered at the degree subject year level and reported in brackets. * p<0.10, ** p<0.05, *** p<0.01

Table 9 Heterogeneity by subject

Sample	(1) Biological Sciences	(2) Physics	(3) Math	(4) Computer Sciences	(5) Social Studies	(6) Languages	(7) History/Philosophy	(8) Arts	(9) Education	(10) Combined
Unemployment rate	0.00163 (0.00137)	0.00226* (0.00115)	0.000149 (0.00084)	0.000271 (0.00029)	0.00768*** (0.00174)	0.000136 (0.0003)	0.00132 (0.00086)	0.000225 (0.0003)	-0.0358* (0.0177)	0.000225 (0.00242)
Wild Cluster p-values	[0.4797]	[0.4738]	[0.8888]	[0.4750]	[0.1162]	[0.5687]	[0.4187]	[0.5779]	[0.3537]	[0.9366]
Wild cluster CI's	[-.003999, .007791]	[-.004927, .009165]	[-.002465, .003001]	[-.001768, .002791]	[-.003898, .01206]	[-.001059, .0008665]	[-.002429, .00543]	[-.004183, .002665]	[-.1158, .04352]	[-.009193, .009642]
Constant	0.0284*** -0.00735	-2.9E-05 -0.00293	0.0367** -0.0124	0.0192*** -0.00387	-0.0106** -0.00351	0.0404*** -0.00556	0.0190*** -0.00285	0.0165*** -0.00382	0.135* -0.0714	0.0195 -0.0124
N	127223	62266	26270	55013	111591	94563	70751	145117	43914	5107
DV mean (SD)	0.0171 (0.129)	0.0049 (0.070)	0.027 (0.162)	0.00669 (0.081)	0.0038 (0.062)	0.0222 (0.147)	0.0111 (0.105)	0.0087 (0.093)	0.567 (0.495)	0.064 (0.245)

Source: DLHE data on the selected sample described in section 4 linked with the subject specific unemployment rate derived from the Labour Force Survey and the Office for National Statistics data.

Note: Our regression include Region Fixed Effects, Institution Fixed Effects, Time Trends and our usual controls: sex, ethnicity, degree classification, regional vacancies and IMD rank. Robust standard errors are clustered at the year level and reported in parenthesis with stars indicating statistical significant at the usual levels: * $p<0.10$, ** $p<0.05$, *** $p<0.01$. In square brackets we report the wild bootstrap cluster p-values and 95% confidence intervals, using 1,000 repetitions.

Table 10 Heterogeneity analysis by STEM vs Non-STEM

	(1)	(2)	(3)	(4)
STEM* Unemployment Rate	0.0540***	0.0540***	-0.00147	-0.000450
	(0.0190)	(0.0190)	(0.00187)	(0.00128)
Unemployment rate	-0.0622***	-0.0622***	-0.000386	-0.00158
	(0.0142)	(0.0142)	(0.00105)	(0.00122)
Controls	X	X	X	X
Year FE	X	X	X	X
Region FE	X	X	X	X
Institution FE	X	X	X	X
Time Trend		X	X	
Subject FE			X	X
Subject TT				X
Constant	0.233***	0.233***	0.0547***	0.0257
	(0.0530)	(0.0530)	(0.0204)	(0.0207)
N	741815	741815	741815	741815
DV mean	0.045	0.045	0.045	0.045
(SD)	(0.207)	(0.207)	(0.207)	(0.207)

Source: DLHE data on the selected sample described in section 4 linked with the subject specific unemployment rate derived from the Labour Force Survey and the Office for National Statistics data.
Note: Our controls are: sex, ethnicity, degree classification, regional vacancies, derived from the School Workforce Census, and IMD rank. Our specifications interact a STEM dummy with the unemployment rate. Robust standard errors are clustered at the degree subject year level and reported in brackets. * p<0.10 , ** p<0.05, *** p<0.01

Table 11 Teachers relative wages and enrolment onto a TTP

	(1)	(2)	(3)	(4)
	Home region		University Region	
Relative Wage (match)	0.00143 (0.00561)		-0.000774 (0.00632)	
Relative Wage (grad)		-0.00917 (0.00921)		-0.0176 (0.0111)
Controls	X	X	X	X
Year FE	X	X	X	X
Region FE	X	X	X	X
Institution FE	X	X	X	X
Subject FE	X	X	X	X
Region TT	X	X	X	X
Constant	0.0503*** (0.0130)	0.0484*** (0.0129)	0.0679*** (0.0188)	0.0646*** (0.0188)
N	686937	686937	734511	734511
DV mean (SD)	0.045 (0.207)	0.045 (0.207)	0.045 (0.208)	0.045 (0.208)

Source: DLHE data on the selected sample described in section 4 linked with the regional relative wages derived from the Labour Force Survey and the Office for National Statistics data.

Note: Our controls are: sex, ethnicity, degree classification, regional vacancies, derived from the School Workforce Census, and IMD rank. Specification 1 and 2 use the relative wages based on the graduates home region. Specifications 3 and 4 use the wages based on the region of the university they attended. Robust standard errors are clustered at the year region level, where the region differs depending on if we are using the university or home unemployment rate and reported in parenthesis.
* $p<0.10$, ** $p<0.05$, *** $p<0.01$

Table 12 Relative wages on the probability of enrolling onto a degree in education

	(1)	(2)	(3)	(4)
Relative Wage (grad) at time of uni enrolment	0.139*** (0.0113)	0.0422*** (0.00831)	0.00354 (0.0125)	0.00279 (0.0104)
Controls	X	X	X	X
Year FE	X	X	X	X
Institution FE		X	X	X
Region FE			X	X
Region TT				X
Constant	0.151*** (0.00473)	0.0513*** (0.00183)	0.0505*** (0.00227)	0.0519*** (0.00208)
N	547449	547449	547449	547449
DV mean (SD)	0.064 (0.245)	0.064 (0.245)	0.064 (0.245)	0.064 (0.245)

Source: DLHE data on the selected sample described in section 4 linked with the regional relative wages, from the year of enrolment, derived from the Labour Force Survey and the Office for National Statistics data. Our sample size is reduced because we only have the relative wages, at year of enrolment, for the 2006-2012 graduate cohorts.

Note: Our relative wage measure is the difference in the logged teachers and non-teaching graduate's wages. Our dependent variable is a dummy that indicates if a graduate has enrolled onto a undergraduate program in education, or not. Our controls are: sex, ethnicity, degree classification, regional vacancies, unemployment rate at time of enrolment and IMD rank Robust standard errors are clustered at the year region level, where the region is the home region, and reported in parenthesis. * p<0.10, ** p<0.05, *** p<0.01

Table 13 Linear vs non-linear specification

Specification	(1) OLS	(2) probit	(3) logit
Unemployment Rate (0-100)	-0.00157 (0.00110)	-0.000629 (0.000432)	-0.000367 (0.000515)
Male	-0.0163*** (0.00217)	-0.0216*** (0.00140)	-0.0229*** (0.00162)
Degree 1st Class	-0.00357 (0.00219)	-0.00581** (0.00245)	-0.00459 (0.00296)
Degree 2:1	0.000470 (0.00201)	-0.000482 (0.00135)	0.000521 (0.00141)
Degree 3rd Class	-0.0158*** (0.00328)	-0.0139*** (0.00155)	-0.0143*** (0.00149)
Controls	X	X	X
Year FE	X	X	X
Region FE	X	X	X
Institution FE	X	X	X
Subject FE	X	X	X
Subject TT	X	X	X
N	741815	741815	741815
DV mean (SD)	0.045 (0.207)	0.045 (0.207)	0.045 (0.207)

Source: DLHE data on the selected sample described in section 4 linked with the subject specific unemployment rate derived from the Labour Force Survey and the Office for National Statistics data.

Note: Our controls are: sex, ethnicity, degree classification, regional vacancies, unemployment rate the year prior to enrolment and IMD rank. For the institution FE's I use a higher level to ensure that stata does not drop observations so that the coefficients are comparable. The Russell Group institutions are split into quintiles by size and non-Russell group institutions are split into twenty categories by size. Robust standard errors are clustered at the degree subject year level and reported in parenthesis. * p<0.10, ** p<0.05, *** p<0.01

References

ALTONJI, JOSEPH G, LISA B KAHN, and JAMIN D SPEER (2016): "Cashier or Consultant? Entry Labor Market Conditions, Field of Study, and Career Success," *Journal of Labor Economics*, 34, S361-S401.

ANTECOL, HEATHER, OZKAN EREN, and SERKAN OZBEKLIK (2015): "The Effect of Teacher Gender on Student Achievement in Primary School," *Journal of Labor Economics*, 33, 63-89.

BAERT, STIJN, BART COCKX, and DIETER VERHAEST (2013): "Overeducation at the Start of the Career: Stepping Stone or Trap?," *Labour Economics*, 25, 123-140.

BARR, ANDREW, and SARAH TURNER (2015): "Out of Work and into School: Labor Market Policies and College Enrollment During the Great Recession," *Journal of Public Economics*, 124, 63-73.

CAMERON, A COLIN, and DOUGLAS L MILLER (2015): "A Practitioner's Guide to Cluster-Robust Inference," *Journal of Human Resources*, 50, 317-372.

CANES, BRANDICE J, and HARVEY S ROSEN (1995): "Following in Her Footsteps? Faculty Gender Composition and Women's Choices of College Majors," *ILR Review*, 48, 486-504.

CASTRO-ZARZUR, ROSA, RICARDO ESPINOZA, and MIGUEL SARZOSA (2019): "Unintended Consequences of Free College: Self-Selection into the Teaching Profession."

CHETTY, RAJ, JOHN N FRIEDMAN, and JONAH E ROCKOFF (2011): "The Long-Term Impacts of Teachers: Teacher Value-Added and Student Outcomes in Adulthood," National Bureau of Economic Research.

CHEVALIER, ARNAUD, and PETER J DOLTON (2004): "The Labour Market for Teachers," Working Paper Series.

CHEVALIER, ARNAUD, PETER DOLTON, and STEVEN MCINTOSH (2007): "Recruiting and Retaining Teachers in the Uk: An Analysis of Graduate Occupation Choice from the 1960s to the 1990s," *Economica*, 74, 69-96.

CLARK, DAMON (2011): "Do Recessions Keep Students in School? The Impact of Youth Unemployment on Enrolment in Post-Compulsory Education in England," *Economica*, 78, 523-545.

CLOTFELTER, CHARLES, ELIZABETH GLENNIE, HELEN LADD, and JACOB VIGDOR (2008): "Would Higher Salaries Keep Teachers in High-Poverty Schools? Evidence from a Policy Intervention in North Carolina," *Journal of Public Economics*, 92, 1352-1370.

COCKX, BART, and CORINNA GHIRELLI (2016): "Scars of Recessions in a Rigid Labor Market," *Labour Economics*, 41, 162-176.

DAVID, H, and DAVID DORN (2013): "The Growth of Low-Skill Service Jobs and the Polarization of the Us Labor Market," *American Economic Review*, 103, 1553-97.

DEE, THOMAS S (2007): "Teachers and the Gender Gaps in Student Achievement," *Journal of Human Resources*, 42, 528-554.

DEL BONO, EMILIA, and GRETA MORANDO (2016): "For Some, Luck Matters More: The Impact of the Great Recession on Early Careers of Graduates from Different Socio-Economic Backgrounds," Working Paper.

DELAVANDE, ADELINE, JOSHUA FULLARD, and BASIT ZAFAR (2018): "Parental Background, Labour Market Expectations and University Applications Intentions in the Uk," *Mimeo*.

DOLTON, PETER J, and KOSTAS G MAVROMARAS (1994): "Intergenerational Occupational Choice Comparisons: The Case of Teachers in the Uk," *The Economic Journal*, 104, 841-863.

DOLTON, PETER, and WILBERT VON DER KLAAUW (1995): "Leaving Teaching in the Uk: A Duration Analysis," *The Economic Journal*, 105, 431-444.

DOLTON, PETER, ANDREW TREMAYNE, and TSUNG-PING CHUNG (2003): *The Economic Cycle and Teacher Supply*. OECD Paris.

DOLTON, PJ, and W VAN DER KLAAUW (1996): "Teacher Salaries and Teacher Retention, Assessing Educational Practices: The Contribution of Economics," MIT Press, Baumol and Becker (eds).

EHRENBERG, RONALD G, and DOMINIC J BREWER (1994): "Do School and Teacher Characteristics Matter? Evidence from High School and Beyond," *Economics of Education Review*, 13, 1-17.

EHRENBERG, RONALD G, DANIEL D GOLDHABER, and DOMINIC J BREWER (1995): "Do Teachers' Race, Gender, and Ethnicity Matter? Evidence from the National Educational Longitudinal Study of 1988," *ILR Review*, 48, 547-561.

EVANS, WILLIAM N, ROBERT M SCHWAB, and KATHRYN L WAGNER (2019): "The Great Recession and Public Education," *Education Finance and Policy*, 14, 298-326.

FERGUSON, RONALD F (1991): "Paying for Public Education: New Evidence on How and Why Money Matters," *Harv. J. on Legis.*, 28, 465.

FOOTE, ANDREW, and MICHEL GROSZ (2020): "The Effect of Local Labor Market Downturns on Postsecondary Enrollment and Program Choice," *Education Finance and Policy*, 15, 593-622.

FULLARD, JOSHUA (2019a): "How Much Do You Want It? The Impact of Financial Costs on the Decision to Teach," Work In Progress: Institute for Social and Economic Research.

FULLARD, JOSHUA (2019b): "Relative Wages and Pupil Performance, Evidence from Timss," Work In Progress: Institute for Social and Economic Research.

FULLARD, JOSHUA (2020a): "Teacher Supply and Covid-19," https://epi.org.uk/publications-and-research/teacher-supply-and-covid-19/: Education Policy Institute.

FULLARD, JOSHUA (2020b): "Trends in the Diversity of Teachers in England," https://epi.org.uk/publications-and-research/diversity-of-teachers/: Education Policy Institute.

FULLARD, JOSHUA (2021a): "The Pandemic and Teacher Attrition: An Exodus Waiting to Happen?," https://epi.org.uk/publications-and-research/the-pandemic-and-teacher-attrition-an-exodus-waiting-to-happen/: Education Policy Institute.

FULLARD, JOSHUA (2021b): "Teacher Pay Policy: One Size Fits All?," https://epi.org.uk/publications-and-research/teacher-pay-policy-blog/: Education Policy Institute.

FULLARD, JOSHUA, and JAMES ZUCCOLLO (2021): "Local Pay and Teacher Retention in England."

GERSHENSON, SETH, CASSANDRA HART, JOSHUA HYMAN, CONSTANCE LINDSAY, and NICHOLAS W PAPAGEORGE (2018): "The Long-Run Impacts of Same-Race Teachers," National Bureau of Economic Research.

GOOS, MAARTEN, ALAN MANNING, and ANNA SALOMONS (2014): "Explaining Job Polarization: Routine-Biased Technological Change and Offshoring," *American Economic Review*, 104, 2509-26.

HANUSHEK, ERIC A (2011): "The Economic Value of Higher Teacher Quality," *Economics of Education Review*, 30, 466-479.

HANUSHEK, ERIC A, JOHN F KAIN, and STEVEN G RIVKIN (1999): "Do Higher Salaries Buy Better Teachers?," National bureau of economic research.

HANUSHEK, ERIC A, MARC PIOPIUNIK, and SIMON WIEDERHOLD (2014): "The Value of Smarter Teachers: International Evidence on Teacher Cognitive Skills and Student Performance," National Bureau of Economic Research.

HANUSHEK, ERIC A, and STEVEN G RIVKIN (2007): "Pay, Working Conditions, and Teacher Quality," *The future of children*, 69-86.

HANUSHEK, ERIC A, JENS RUHOSE, and LUDGER WOESSMANN (2015): "Economic Gains for Us States from Educational Reform," National Bureau of Economic Research.

HANUSHEK, ERIC A, and LUDGER WOESSMANN (2011): "How Much Do Educational Outcomes Matter in Oecd Countries?," *Economic policy*, 26, 427-491.

HERMANN, ZOLTÁN (2017): "Does Teacher Gender Matter in Europe? Evidence from Timss Data."

HORVATH, MICHAEL, JOANNE E GOODELL, and VASILIOS D KOSTEAS (2018): "Decisions to Enter and Continue in the Teaching Profession: Evidence from a Sample of Us Secondary Stem Teacher Candidates," *Teaching and Teacher Education*, 71, 57-65.

KAHN, LISA B (2010): "The Long-Term Labor Market Consequences of Graduating from College in a Bad Economy," *Labour Economics*, 17, 303-316.

KONDO, AYAKO (2015): "Differential Effects of Graduating During a Recession across Gender and Race," *IZA Journal of Labor Economics*, 4, 1-24.

KONETZKA, R TAMARA, KAREN B LASATER, EDWARD C NORTON, and RACHEL M WERNER (2018): "Are Recessions Good for Staffing in Nursing Homes?," *American journal of health economics*, 4, 411-432.

LI, DANYAO, MICHAEL R RICHARDS, and COADY WING (2019): "Economic Downturns and Nurse Attachment to Federal Employment," *Health economics*, 28, 808-814.

MANSKI, CHARLES F (1987): "Academic Ability, Earnings, and the Decision to Become a Teacher: Evidence from the National Longitudinal Study of the High School Class of 1972," in *Public Sector Payrolls*: University of Chicago Press, 291-316.

MICHAELS, GUY, ASHWINI NATRAJ, and JOHN VAN REENEN (2014): "Has Ict Polarized Skill Demand? Evidence from Eleven Countries over Twenty-Five Years," *Review of Economics and Statistics*, 96, 60-77.

NAGLER, MARKUS, MARC PIOPIUNIK, and MARTIN R WEST (2015): "Weak Markets, Strong Teachers: Recession at Career Start and Teacher Effectiveness," National Bureau of Economic Research.

NICKELL, STEPHEN, and GLENDA QUINTINI (2002): "The Consequences of the Decline in Public Sector Pay in Britain: A Little Bit of Evidence," *The Economic Journal*, 112.

OREOPOULOS, PHILIP, TILL VON WACHTER, and ANDREW HEISZ (2012): "The Short-and Long-Term Career Effects of Graduating in a Recession," *American Economic Journal: Applied Economics*, 4, 1-29.

OYER, PAUL (2006): "Initial Labor Market Conditions and Long-Term Outcomes for Economists," *Journal of Economic Perspectives*, 20, 143-160.

RIVKIN, STEVEN G, ERIC A HANUSHEK, and JOHN F KAIN (2005): "Teachers, Schools, and Academic Achievement," *Econometrica*, 73, 417-458.

ROODMAN, DAVID, MORTEN ØRREGAARD NIELSEN, JAMES G MACKINNON, and MATTHEW D WEBB (2019): "Fast and Wild: Bootstrap Inference in Stata Using Boottest," *The Stata Journal*, 19, 4-60.

SHVARTSMAN, ELENA (2018): "The State of the Economy at Graduation, Wages, and Catch-up Paths: Evidence from Switzerland."

SIBIETA, LUKE, and JOSHUA FULLARD (2021): "The Evolution of Cognitive Skills During Childhood across the Uk."

VAN DEN BERGE, WILJAN, and ARNE BROUWERS (2017): "A Lost Generation? The Early Career Effects of Graduating During a Recession," CPB Netherlands Bureau for Economic Policy Analysis.

VIGNOLES, ANNA F, and NATTAVUDH POWDTHAVEE (2009): "The Socioeconomic Gap in University Dropouts," *The BE journal of economic analysis & policy*, 9.

WISWALL, MATTHEW (2013): "The Dynamics of Teacher Quality," *Journal of Public Economics*, 100, 61-78.

WOESSMANN, LUDGER, and MARTIN R WEST (2002): "Class-Size Effects in School Systems around the World: Evidence from between-Grade Variation in Timss," Institute for the Study of Labor (IZA).

ZABALZA, ANTONI, PHILIP TURNBULL, and GARETH WILLIAMS (1979): *The Economics of Teacher Supply*. Cambridge University Press.

Appendix

Appendix Table A1 Tuition Fees Schedule and Professional Skills Pass Threshold by year of entry

Year Started Undergrad	Year Started Postgrad[+]	Undergraduate Fees	PGCE Fees	Professional Skills Test
1998	2001	£1,000	£1,000	Low
1999	2002	£1,000	£1,000	Low
2000	2003	£1,000	£1,000	Low
2001	2004	£1,000	£1,000	Low
2002	2005	£1,000	£1,000	Low
2003	2006	£1,000	£3,000	Low
2004	2007	£1,000	£3,000	Low
2005	2008	£1,000	£3,000	Low
2006	2009	£3,000	£3,000	Low
2007	2010	£3,000	£3,000	Low
2008	2011	£3,000	£3,000	Low
2009	2012	£3,000	£9,000	Low
2010	2013	£3,000	£9,000	High
2011	2014	£3,000	£9,000	High
2012	2015	£9,000	£9,000	High
2013	2016	£9,000	£9,000	High
2014	2017	£9,000	£9,000	High
2015	2018	£9,000	£9,250	High
2016	2019	£9,000		High
2017	2020	£9,000		High
2018	2021	£9,250		High

This table shows the tuition fees schedule for graduates based on when they started their undergraduate degrees and the corresponding PGCE fees and entrance. [+] This the first year an individual would be eligible to start a PGCE after they completed a three year undergraduate course. Also note that Tuition fees for the years prior to 2012 increased with inflation.

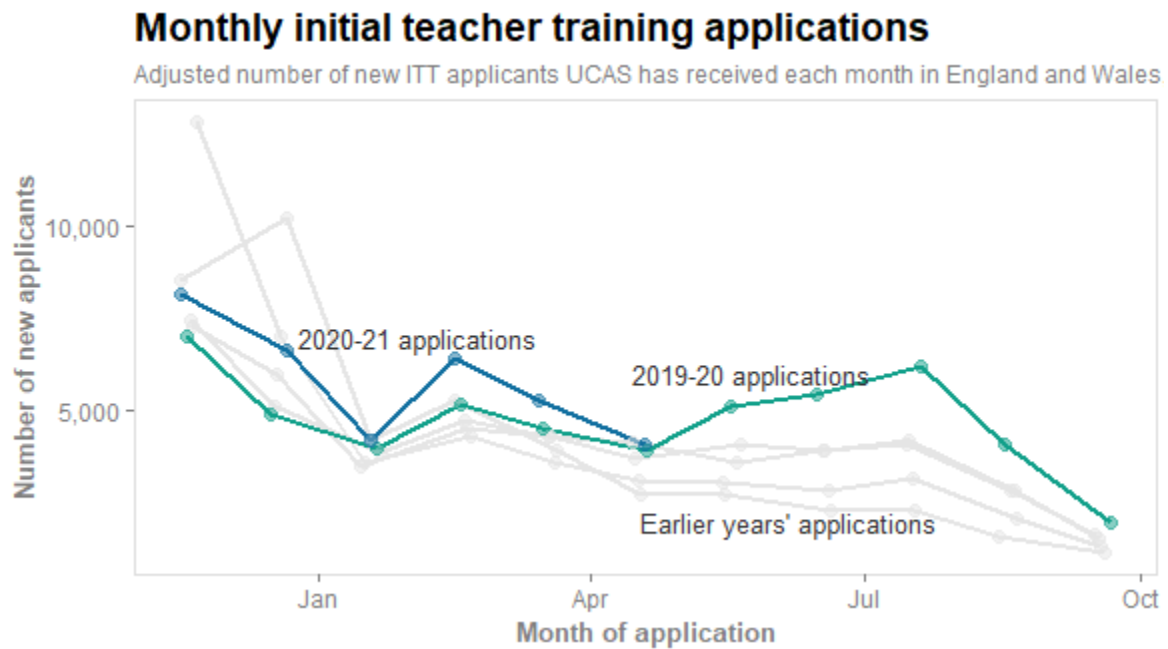Appendix Table A2 Unemployment rate by field of study

	Mean (%)	Interquartile Range[+] (%)	Range (%) (max – min)	kurtosis[++]	Skewness[+++]
Biological Sciences	2.66	1.04	1.77	1.95	-0.11
Physical Sciences	2.75	0.66	1.46	2.63	-0.12
Mathematical Sciences	3.26	2.87	3.68	1.38	0.21
Computer Sciences	3.86	1.71	5.37	3.99	0.93
Social Studies	2.90	0.44	0.89	1.95	-0.25
Languages	2.74	1.14	2.97	2.68	0.39
History/Philosophy	3.16	1.24	3.52	2.27	-0.02
Arts	4.00	1.36	4.82	3.39	1.05
Education	0.98	0.79	1.98	2.95	-0.24
Combined Degrees	0.84	1.62	3.43	2.92	1.10
All Degrees	3.02	0.99	7.20	5.49	0.88

This table shows the variation in the subject special unemployment rate, derived from the Labour Force Survey described in section 4.1 [+] p75-p25 [++] A normal distribution has a kurtosis of 3. Distributions with a kurtosis greater than 3 have heaver tails while a kurtosis less than 3 means the distribution has lighter tails [+++] Measures the degree and direction of asymmetry in a distribution, a symmetric distribution has a skewness of 0. A distribution that is skewed to the left has a negative skewness, while a distribution skewed to the right has a positive skewness.

Figure A1

Monthly initial teacher training applications

Adjusted number of new ITT applicants UCAS has received each month in England and Wales

Source: UCAS ITT Statistics. UCAS statistical release occurs at uneven intervals. Note that the UCAS statistical release occurs at uneven intervals. We have adjusted for that by reporting 30.4*the average number of applications per day during the period which allows the points in the figure to be interpreted as if they were monthly.