Department for Education

Analysis of teacher supply, retention and mobility

May 2017

Executive summary

This report builds on the statistics presented in the annual School Workforce Census Statistical First Release (hereafter the SFR)[1] by providing further analysis of trends in teacher supply, retention and mobility using data from 2010 to 2015. This follows previous analysis of local variations in the teacher workforce[2].

Given that detailed underlying data have already been published alongside each SFR; this report does not seek to provide an exhaustive or comprehensive set of fine-grained data. Instead, it aims to generate new insights and is intended to be an accessible resource to stimulate debate, improve the public understanding of our data, and generate ideas for further research, rather than to provide authoritative answers to research questions.

The report brings together different strands of new analysis and as such is structured in four distinct sections. There is also additional management information on Subject Knowledge Enhancement (SKE) in Annex 3.

Sections 1 and 2 provide more information on those entering and leaving the teacher profession over time, with a focus on different subject breakdowns.

As reported in the SFR, the overall number of full-time equivalent (FTE) teachers has increased over time. This has been due to a higher number of people entering the profession than leaving. The entrant rate for secondary increased between 2011 and 2015, driven by an increased need for teachers of EBacc subjects.

Both the returner rate and the Newly Qualified Teacher (NQT) rate were higher in EBacc subjects than non-EBacc subjects in years between 2011 and 2015. The NQT rate was highest in Mathematics, English and the Sciences in every year, with Physics having the highest rate in four of the five years. The lowest was Drama. The returner rate rose in every subject between 2011 and 2015, with Computing seeing the biggest increase.

Between 2011 and 2015, the wastage rate also increased in every subject but this was offset by rising entrant numbers. This is despite a fall in the rate of retirements in every subject in the same time period. PE had the lowest wastage rate of any subject in each year between 2011 and 2015; History had the second lowest in each year while Physics had either the highest or second highest wastage rate in each year.

[1] https://www.gov.uk/government/collections/statistics-school-workforce

[2] https://www.gov.uk/government/statistics/local-analysis-of-teacher-workforce-2010-to-2015

Section 3 explores further analysis of the characteristics associated with both in-school and in-system retention of teachers and leaders.

The analysis found that there is no single observable factor that can explain why teachers and leaders move to a different school, or why they leave the profession altogether. There are some factors that are better at predicting these career moves than others.

The data suggest that both teachers and leaders with permanent contracts have higher retention rates, both in school and in the system. Retention rates also increase with age and experience; they are higher outside London and in schools rated ‘Good’ or ‘Outstanding’. Full-time teachers are less likely to leave the system but more likely to move to a different school than part-time teachers. Holding a more senior post in school is also associated with higher in-system retention.

Section 4 looks at teacher mobility between schools and geographic areas between 2010 and 2014.

The analysis found that most teachers stay within commuting distance when moving schools, with around 70.0% of all teachers who moved between 2010 and 2014 moving 25 kilometres or less

Secondary teachers are more likely to move a greater distance than primary teachers, and men are slightly more likely than women to move a greater distance, but the variation is likely to be because primary teachers are disproportionately female. People move less as they get older.

The number of teachers moving between regions has increased in recent years as teacher turnover has increased generally. The overwhelming majority of inter-region migration takes place between adjacent regions. The highest inter-region migration rates are into and out of London.

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Introduction

This report provides more detailed analysis of the information available in the School Workforce Census (SWC). An analysis conducted by DfE in September 2016 showed that school-to-school mobility is now the biggest source of new entrants to schools – and is therefore a key driver of increased recruitment activity in schools. This increasing trend of school-to-school mobility was seen in all regions, with the highest figures in Inner London. The analysis also showed that schools in areas with a high level of deprivation had slightly higher rates of school-to-school mobility and wastage.

At the time, we committed that "further work is needed to understand the drivers" behind the findings. This report is the first of a series of analyses to explore these drivers in more detail. We would welcome feedback on the methods used and insights generated in this report, to inform future research and development of future publications using the SWC and other sources.

Please send your views to: TeachersAnalysisUnit.MAILBOX@education.gsi.gov.uk

Background and the School Workforce Census

The annual School Workforce Census was introduced in November 2010, replacing a number of different workforce data collections. It collects information on school staff from all state-funded schools in England, including local-authority-maintained (LA-maintained) schools, academy schools (including free schools, studio schools and university technology colleges) and city technology colleges, special schools and pupil referral units (PRU)[3].

The statistical first release (SFR) "School Workforce in England" provides the main annual dissemination of statistics based on the data collected, as well as details of the underlying methodology for those and the collection itself. The latest publication was released in June 2016, with results from the November 2015 census[4]. Alongside the SFRs, an underlying dataset is released, giving some of the workforce statistics at school level alongside details of regions, local authorities, wards and parliamentary constituencies. The information is used by the Department for

[3] It collects information from LAs on their centrally employed teachers but does not cover early years settings, non-maintained special schools, independent schools, sixth form colleges and other further education colleges.

[4] 'School workforce in England: November 2015', Department for Education (2016). Available at: https://www.gov.uk/government/collections/statistics-school-workforce

Education for analysis and modelling, including the Teacher Supply Model[5], as well as research purposes.

Aims of the report

Whilst underlying data are published separately each year, the workforce census data are designed in the main to provide aggregate national statistics, including time series in a subset of variables at this level. This report looks to provide a more detailed analysis of teacher supply, retention and mobility. Most of the analysis here is on a national level, with the exception of Section 4, but more local information can be found in our report on trends and geographic comparisons of the School Workforce Census[6].

The latest School Workforce Census covers November 2015, so **this report does not replace the SFR as the authoritative source of the latest school workforce statistics**.

The report is designed to look at some of the key questions around the school workforce in order to improve our understanding of these areas. These sections are designed to be standalone analyses to cover key themes, while the executive summary pulls together some of the key findings into a brief overarching narrative.

Organisation of the report.

The following section outlines the methodology used in the report along with key caveats to consider alongside the findings. Findings are then presented in four distinct sections:

Section 1 provides more information on those entering the teacher profession over time, with a focus on different subject breakdowns.

Section 2 covers trends in those who are leaving the profession over time, with a focus on different subject breakdowns.

Section 3 explores further analysis the characteristics associated with teacher retention both on a school and teacher level.

Section 4 looks at teacher mobility between schools and geographic areas between schools in England for 2010 to 2014.

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[5] More information on the Teacher Supply Model can be found at: Teacher Supply Model 2017 to 2018

[6] Schools workforce in England 2010 to 2015: trends and geographical comparisons

For each of the sections, there is supporting data in Excel format and data tables covering other findings quoted in the text. Annex 1 provides more detail and the Excel file can be found alongside the publication.

Numbers for figures in the report correspond to the relevant table number, and as such are not always sequential.

Annex 2 provides details of the methodology used in Section 3 on teacher retention.

Annex 3 provides some additional management information on Subject Knowledge Enhancement.

Methodology

This report uses data from a variety of sources to analyse the trends in teacher supply, retention and mobility. This includes the School Workforce Census, information on school characteristics and those of the local area. The School Workforce Census is an annual collection of the composition of the schools workforce in England employed in: local-authority-maintained nursery, primary, secondary and special schools; all primary, secondary, and special academy schools; and free schools. Data have been included from each of the censuses from 2010 to 2015.

For more information on how the School Workforce Census data is collected and how the statistics are produced see the statistical first release (SFR): https://www.gov.uk/government/collections/statistics-school-workforce.

These data have been supplemented with schools' data collected from EduBase, a register of educational establishments in England and Wales, maintained by the Department of Education. It provides information on establishments providing compulsory, higher and further education.

More information on EduBase is available here:

http://www.education.gov.uk/edubase/home.xhtml

This paper looks at local-authority-maintained nursery, primary and secondary schools and all primary and secondary academy schools and free schools in England. Special schools and pupil referral units have not been included in the analysis. This is because the numbers of teachers are significantly smaller for these schools, thus making comparisons across the different classifications much less reliable.

The report also uses the score for the Index of Multiple Deprivation (IMD), published in 2015, to look at the differences in schools' workforce based on the areas in which schools are situated, as defined by the Department for Communities and Local Government. The lower super output area[7] was identified for the location of each school in England, and the School Workforce Census returns were separated into five equal groups (quintiles) based on the IMD score of each school, e.g. the 20% of schools with the lowest IMD scores were placed in group 1 and so on.

[7] Lower super output areas are a geographic hierarchy designed to improve the reporting of small area statistics in England and Wales. For more information see: http://neighbourhood.statistics.gov.uk/HTMLDocs/nessgeography/superoutputareasexplained/output-areas-explained.htm

Glossary of terms used in this report

- **Wastage** – Qualified teachers who are not identified as teaching in either a primary or secondary school in a SWC, but who were teaching in either a primary or secondary school the previous year. Wastage can be broken down to into three components: those leaving to go 'out of service', those who have retired and those who have died in service. For example, the wastage in year 2015 is all those teachers who left between November 2014 and November 2015.
- **Out of service** – Qualified teachers who are not identified as teaching in either a primary or secondary school in a SWC, but who were teaching in either a primary or secondary school the previous year. They are also not claiming a pension.
- **Retirement** – Qualified teachers who are not identified as teaching in either a primary or secondary school in a SWC, but who were teaching in either a primary or secondary school the previous year. They are now identified as claiming a pension.
- **Deceased** – Qualified teachers who were in service according to the previous year's SWC return but whose deaths have since been recorded on Department datasets on teacher pensions.
- **Entrants** – Qualified teachers who are identified as teaching in either a primary or secondary school in a SWC, but who were not teaching in either a primary or secondary school the previous year. Entrants can be broken down into three components; those coming in as Newly Qualified Teachers, those who are new to the state-funded sector, and those who have returned to the profession. For example, the number of entrants in the year 2015 is all those teachers who were teaching in November 2015 but who were not teaching in November 2014.
- **Newly Qualified Teacher (NQT)** – Qualified teachers who have entered a primary or secondary school and who finished their training the year before.
- **New to the state-funded (SF) sector** – Qualified teachers who have entered a primary or secondary school but who did not finish their training the year before. They are also not recorded on the Department's datasets as having previously held a regular teaching role within a state-funded primary or secondary school in England. This includes teachers who finished their training and deferred their entry into teaching by a year or more.
- **Returners** – Qualified teachers who have entered a primary or secondary school but who did not finish their training the year before. They have been recorded on the Department's datasets as having previously held a regular teaching role within a state-funded primary or secondary school in England.

Caveats and limitations of the analysis

1. Subject level data is only available for around 75% of secondary schools, and teachers may teach more than one subject.

From the School Workforce Census, approximately three quarters of secondary teachers are covered by schools who return their curriculum data. Also, in this analysis, estimates of entrants and leavers from schools are only included from schools where we the data is considered robust. Given that the data used here is from a sample (albeit a large sample) of schools, the numbers derived in this analysis should be considered only as estimates of the entrants and leaver rates in each subject.

For more information, please see 'Analysis of 'specialist' and 'non-specialist' teaching in England'[8].

2. We can only analyse teacher mobility and retention in the state-funded sector in England.

The primary source for this analysis is the School Workforce Census, which covers the state-funded sector in England. In order to see if a teacher has stayed in the teaching profession, we look to see if we can find them in the SWC in the previous year. For this reason, our analysis runs from 2010 to 2014, looking for teachers still there in 2011 to 2015. We can match teachers to a unique reference number – the Teacher Reference Number (TRN) – in order to do this. Teachers who move to independent schools, the further education sector, or outside of England for example, will count as wastage in this analysis.

[8] Analysis of specialist and non-specialist teaching in England

1. Entrants to the teaching profession

This section provides recent trends in the number of teachers entering the profession in English state-funded schools between 2010 and 2015. The analysis focuses on the differences by subject, with emphasis on the EBacc subjects[9]. This analysis does not look into the subjects that a teacher is qualified to teach; it only looks only at the subjects that a teacher is teaching in their entry or exit year. For example, a teacher may be qualified to teach Geography but may have spent the week the SWC was taken teaching Mathematics. Therefore, in this analysis they would be identified as a Mathematics teacher.

The estimates for Science and the Humanities should be treated with particular caution. In the SWC, a significant proportion of Science teachers are identified as teaching combined Science. In the Teacher Supply Model, these combined Science hours are apportioned between the three component subjects based on the number of 'known' hours for the three subjects i.e. if 30.0% of the total hours taught in Biology, Chemistry and Physics is taught in Physics, then 30.0% of the total combined Science hours are attributed to Physics.

A similar calculation is made here for the number of entrants and leavers in each of the Science subjects; i.e. if 30.0% of the total entrants in Biology, Chemistry and Physics are Physics teachers, then 30.0% of the total combined Science entrants are attributed to Physics.

This calculation is also made to attribute entrants and leavers in Humanities (a small group) between Geography and History. These two calculations mean that the estimates for the entrants and leavers in Biology, Chemistry, Physics, Geography and History have an extra level of uncertainty.

Subjects used in this analysis are:

Subjects	Subjects	Subjects	Subjects
MFL = Modern Foreign Languages	EBacc and nonEB = EBacc and non EBacc	Sci, Bio, Che, Phy = Science, Biology, Chemistry and Physics	Hum, Geo, His = Humanities, Geography and History
Eng = English	Cla = Classics	Mat = Mathematics	Dra = Drama
Mus = Music	D&T = Design and technology	Foo = Food	Oth = Other

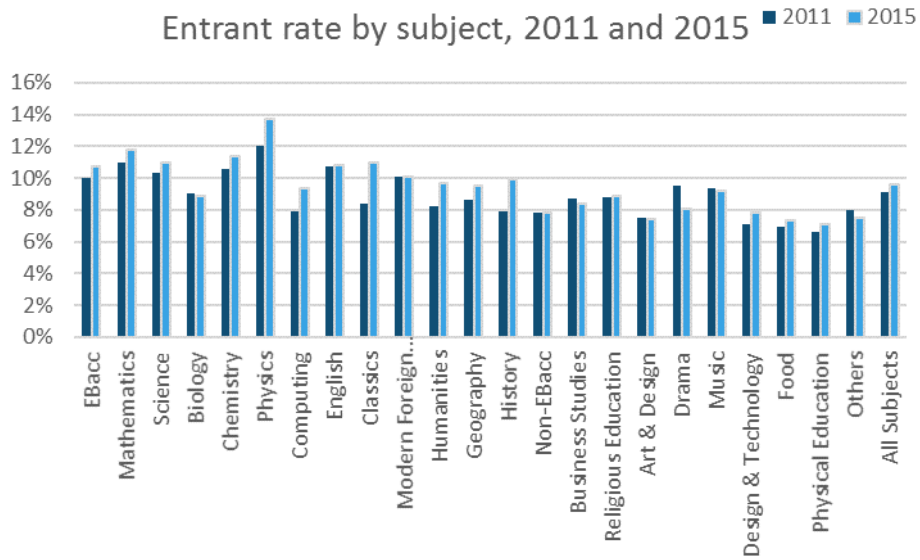
[9] English Baccalaureate (EBacc): The English Baccalaureate (EBacc) was introduced in 2010 and defined an academic core including GCSE-level examinations in English, Mathematics, Science, Humanities and languages. To enter the EBacc, pupils are required to take GCSE-level examinations in English Language and English Literature, Mathematics, two or three science subjects, History or Geography, and an ancient or a modern language.

The overall number of entrants has risen between 2010 and 2015

This section looks at the entrant rate for each subject, with a focus on Newly Qualified Teachers (NQTs) and those returning to the profession. The entrant rate is defined as the percentage of teachers in a subject identified as an entrant divided by the total number of teachers teaching the subject. Figure 1.1 below shows the change in entrant rate between 2011 and 2015; it shows that the entrant rate increased in every EBacc subject except Biology, where the rate fell by 0.1 percentage points. The most notable difference between 2011 and 2015 is the increase in the entrant rate in the Humanities (1.5 percentage points), Physics (1.7 percentage points) and Classics (2.6 percentage points); this is likely to be driven by the increased need for teachers in these subjects as the EBacc entry rate increases. The subjects which suffered the biggest drop in entrant rate in this period were Drama (1.4 percentage points) and 'Others' (0.5 percentage points). This is also likely to be driven by the increase in EBacc entry rate as the number of hours taught in non-EBacc subjects is likely to decrease and as such, there not be as much need to recruit new teachers.

In both 2011 and 2015, the entrant rate was highest in Physics (12.0 in 2011 and 13.7 in 2015) and second highest in Mathematics (11.0 in 2011 and 11.8 in 2015). These are also two of the subjects with the highest wastage rates, so it would be expected that the entrant rates would also be high to fill the gap.

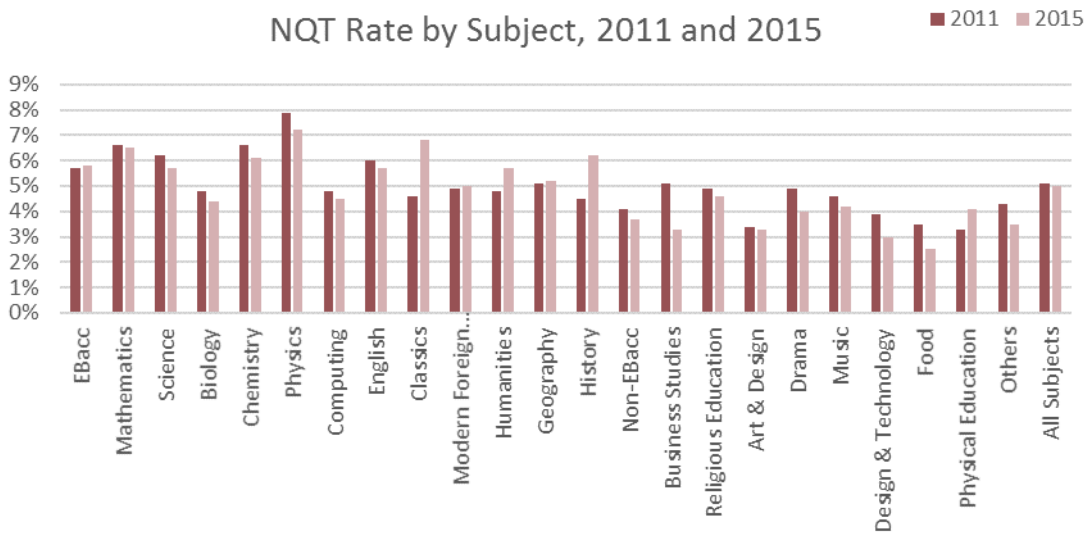
Figure 1.1



Newly qualified teachers make up more of the new entrants for EBacc subjects

This section looks at the Newly Qualified Teacher (NQT) rate for each subject. Figure 1.2 below shows the NQT rate in each subject in 2011 and 2015. It shows that the NQT rate was higher across EBacc subjects than it was in non-EBacc subjects in both 2011 and 2015. The overall NQT rate remained stable from 2011 to 2015 with a drop of only 0.1 percentage points during this period. The biggest increases were seen in the EBacc subjects which are likely to see the biggest increase in the number of hours taught as a result of the increased EBacc entry rate: Classics (2.2 percentage points) and History (1.7 percentage points). Conversely, the subjects which saw the biggest fall in the NQT rate over this period were Business Studies (1.8 percentage points) and Food (1.0 percentage points). Figures for Food should be noted with some caution, as the number of Food teachers is significantly smaller than other subjects, therefore the rates are subject to fluctuation more than other subjects. In addition, some schools will code Food teaching as Design & Technology, which may have an effect on the figures.

Figure 1.2



Entrants returning to the profession have also risen between 2011 and 2015

This section looks at the returner rate for each subject. Figure 1.3 below shows the returner rate in each subject in 2011 and 2015. It shows that the returner rate rose in every subject between 2011 and 2015. The increase in returner rate was most noticeable in Computing (1.9 percentage points) and Physics (1.8 percentage points) with Business Studies, Food and Design & Technology all seeing an increase of 1.6 percentage points over this period. This increase is likely to be closely related to the

increase in those leaving to go ‘out of service’ over the same time period. As the total number of qualified teachers who are out of service increases, so the pool of teachers who can be recruited as returners also increases.

Figure 1.3

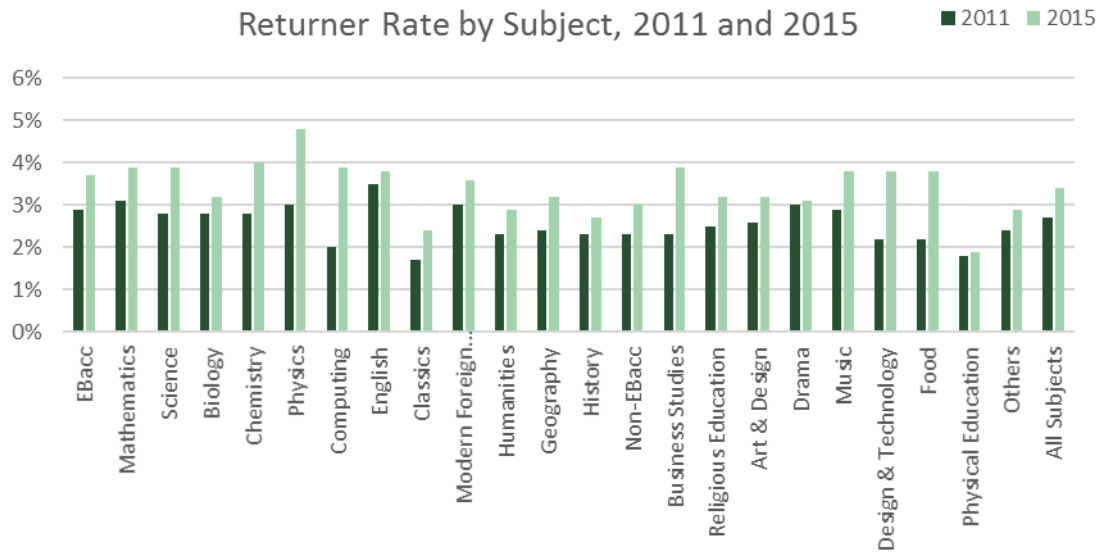
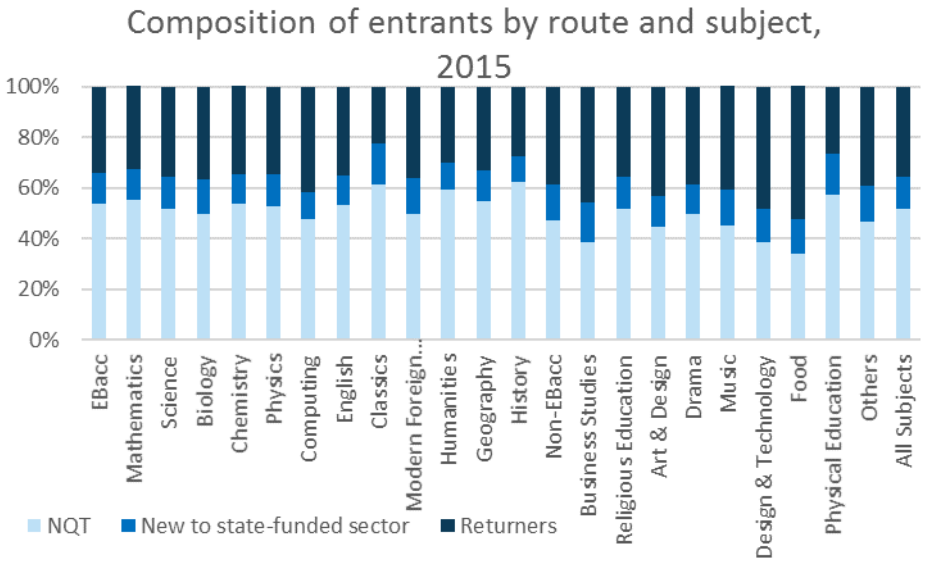


Figure 1.4 below shows the breakdown of number of entrants by entry route in 2015. It shows that the proportion of entrants who are NQTs is highest in History (62.6%) and Classics (61.6%). The subjects with the lowest proportion of entrants coming in as NQTs are non-EBacc subjects: Food (33.9%), Business Studies (38.7%) and Design & Technology (38.8%). The smallest proportion of entrants by route is those new to the state funded sector. Which ranged from 10.1% (History) to 16.2% (Classics) across the subjects.

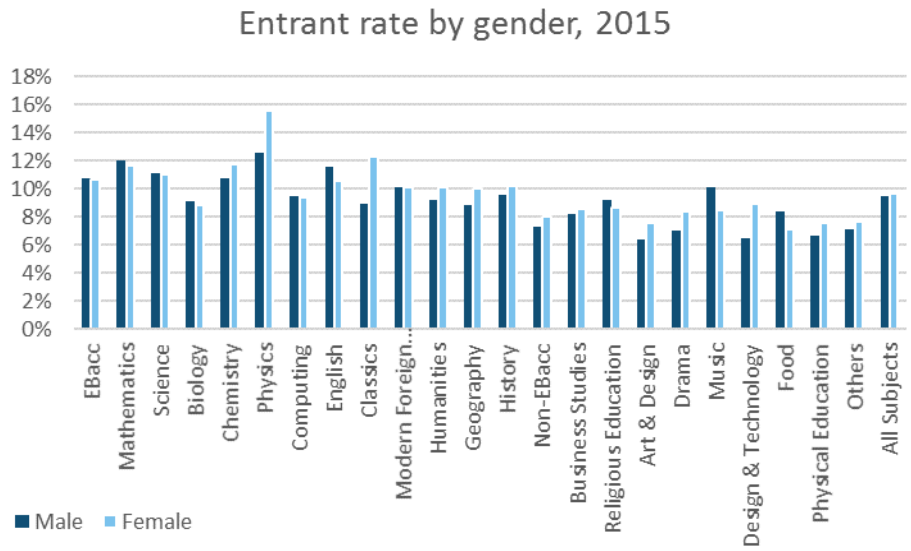
Figure 1.4



There are a number of possible reasons why subjects have different breakdowns of proportions of entrants coming from different entry routes. Teacher demographics may have a significant effect on the number of returners a subject can attract. For example, those subjects which have had a higher proportion of female teachers may naturally have a higher pool of potential returners from which to recruit, as teachers return from taking a career break to start a family. This is illustrated in the 2017/18 TSM, where 90% of all qualified Food teachers were female. This was the highest percentage of any subject.

When we look at the demographics of entrant rates by subjects we see very few significant differences between male and female teachers. Figure 1.5 below shows the differences in entrant rates for male and female teachers in 2015. This shows that the biggest differences between the male and female entrant rates came in Classics (3.4 percentage points) and in Physics (3.0 percentage points), in both cases the female entrant rate was higher than the male entrant rate.

Figure 1.5



These figures suggest that we are not seeing any major differences in the subjects that male or female teachers are teaching when they join or return to the profession, compared to how the teaching stock has historically been. So the gender balance of teachers in subjects is likely to remain relatively stable if this trend continues.

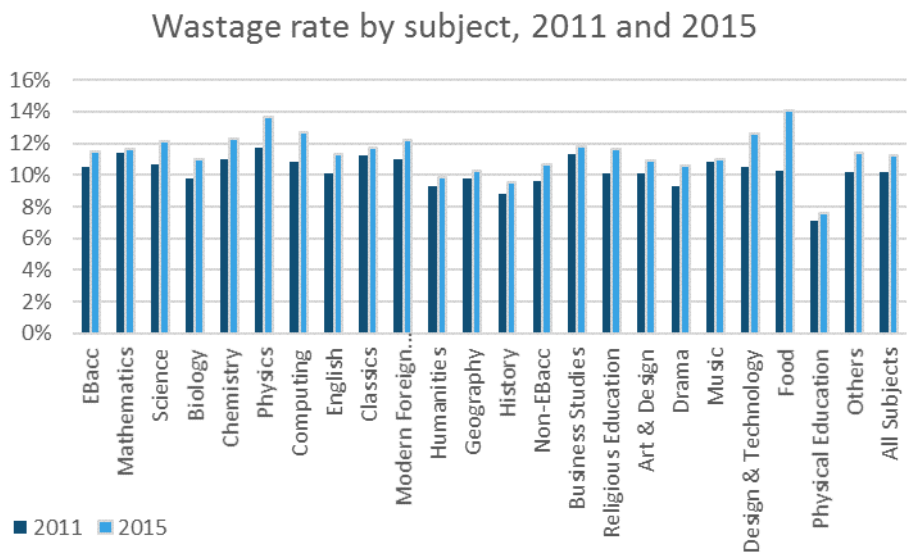
2. Wastage in the teaching profession

This section follows the same methodology as Section 1 for subject classification. Where wastage is defined as qualified teachers who are not identified as teaching in either a primary or secondary school in a SWC, but who were teaching in either a primary or secondary school the previous year. Wastage can be broken down to into three components: those leaving to go 'out of service', those who have retired and those who have died in service. This analysis focuses on those leaving 'out of service' and those who have retired. Those that have died in service is a very small proportion with the rate being between 0.4% and 0.5% in each of the five years.

Between 2011 and 2015 the overall wastage rate change for secondary schools increased by 1.0 percentage point, from 10.2% in 2011 to 11.2% in 2015. The wastage rate is defined as the percentage of teachers in a subject identified as having left the profession divided by the total number of teachers teaching the subject. The wastage rate increased in every subject over this period, with Food (3.8 percentage points) and Design & Technology (2.1 percentage points) seeing the biggest increases, while both Mathematics and Music saw only a 0.2 percentage points increase. Figures for Food should be noted with some caution, as the number of Food teachers is significantly smaller than other subjects, therefore the rates are subject to fluctuation more than other subjects. In addition, some schools will code Food teaching as Design & Technology, which may have an effect on the figures.

Figure 2.1 below shows the change in wastage rate by subject between 2011 and 2015. It shows how the wastage rate has increased in every subject in this time and it also shows how the mix between subjects has remained similar over this time period.

Figure 2.1



This increase is driven by those moving to go 'out of service', of which the overall rate increased from 6.6% to 8.7% between 2011 and 2015. Those leaving 'out of service' includes all those who left who did not either retire or die in the previous year. The biggest increase in the 'out of service' rate was also in Food (4.2 percentage points), with Physics (3.3 percentage points) having the second largest increase.

When we look only at the 'out of service' rate, we also find that the Humanities and PE have the lowest rates and that the Sciences have the highest rates. However, the Technology subjects (Food and Design & Technology) have an 'out of service' rate that is just below the average for all subjects. This suggests that the high wastage rate for these subjects is largely down to an older age breakdown of the teachers who teach these subjects, resulting in a higher proportion of teachers leaving through retirement. This is illustrated by the overall proportion of qualified secondary teachers who are over 55, which in the 2017/18 TSM is 8.8%. However, this figure is significantly higher for Design & Technology (13.3%) and Food (17.8%).

Figure 2.2

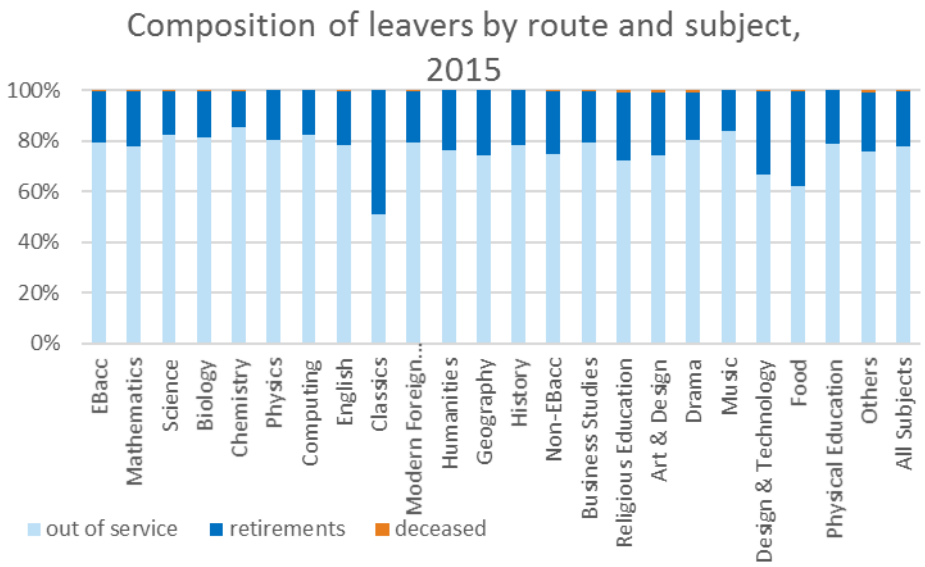


Figure 2.2 shows the wastage and 'out of service' rate for each subject in 2015. Again, Food (14.1%) had the highest wastage rate, with Physics (13.7%) second. Overall, the wastage rate for non-EBacc subjects (10.7%) is lower than for EBacc subjects (11.5%), although this result is due to the influence of Physical Education (PE), which has by far the lowest wastage rate (7.6%) of any subject. Overall, the results suggest that the Sciences and Technology subjects have the highest wastage rates, and the Humanities and PE have the lowest wastage rates. There is a higher than average retirement rate for classics, but this is based on a small number of teachers (in the 2017/18 teacher supply model, classics teachers made up just 0.15% of all qualified secondary school teachers).

Figure 2.3 below shows the wastage rate in each subject by gender. We don't see any significant differences between male and female teachers, the largest difference between the two comes in Design and Technology where the male wastage rate is 2.3 percentage points higher than the female wastage rate.

Figure 2.3

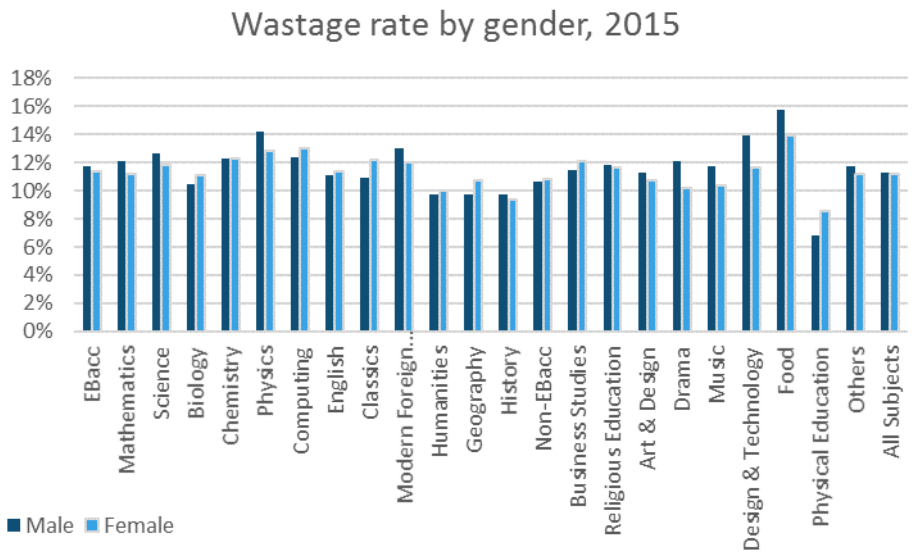
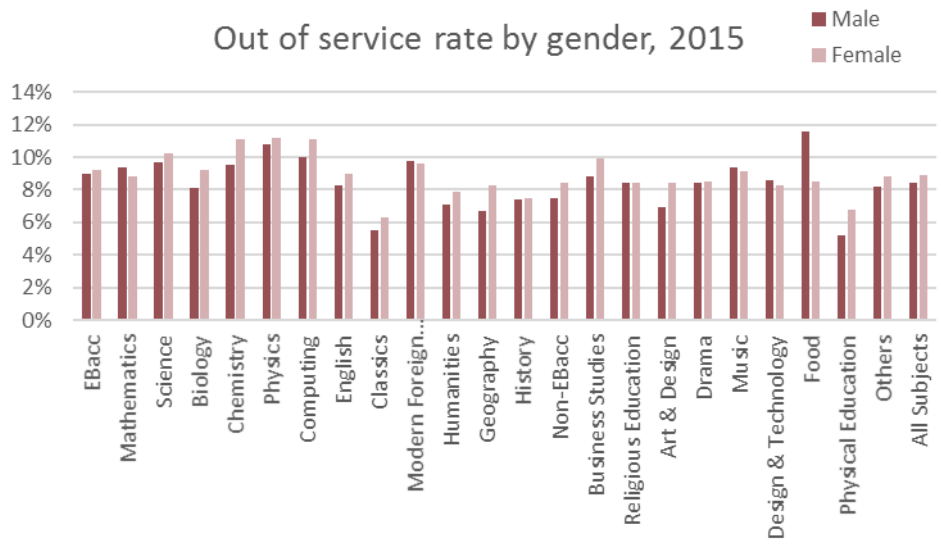


Figure 2.3 also shows that the overall male wastage rate is 0.1 percentage points higher than the overall female wastage rate, however if we discount teachers retiring and only look at those leaving 'out of service' then the female rate is 0.5 percentage points higher. This suggests that a higher proportion of male teachers are retiring than female teachers, in the 2017/18 TSM 9.6% of all qualified male teachers are aged 55 or over, whereas for female teachers this figure is 8.3%.

Figure 2.4



These figures suggest that there is no gender bias when it comes to teachers leaving the profession depending on which subject they are teaching, there is no reason to believe that a female teacher in any subject is more or less likely to leave than a male teacher.

3. Teacher retention analysis

An analysis published by DfE in September 2016 showed that between 2011 and 2015 there was an increase in school-to-school teacher mobility as well as an increase in teacher 'out of service' wastage. This Section seeks to provide new insights on the topic, with the main focus on answering three questions:

- Can we identify a specific *type* of school-to-school mobility behind the recent rise in the overall school-to-school mobility?
- Which *factors* are most predictive of teacher and leader retention?
- Which *groups of teachers* and leaders have the highest retention rate and which have the lowest retention rate?

Administrative data from the School Workforce Census (SWC) is used to answer the above questions. The data were collected annually between November 2010 and November 2015 and it is limited to the primary and secondary state-funded school sectors in England. In this analysis, unqualified teachers, teachers in the special school sector, centrally employed teachers and supply teachers were not included.

With access to six SWC collections, we can look at how teacher careers develop over time, making five year-on-year comparisons to assess whether a teacher continued working at the same school, moved to a different school within the state-funded school system or left the system completely. The SWC contains individual level information which allows us to report in detail the characteristics of those who move schools and those who leave the system as well. The box below sets out key terminology of this section.

Defining retention

All of these terms are defined in conjunction with the School Workforce Census, for making year-on-year comparisons of the consecutive annual datasets. For a teacher in service in year X we talk of:

- *In-school retention*: if they were employed in the same school in year X+1
- *School-to-school mobility*: if they were employed in a different state-funded school in year X+1 (i.e. they *moved* school)
- *In-system retention*: If they stayed in the same school or if they moved school (i.e. in-school retention or school-to-school mobility)
- *'Out of service' wastage:* it they are not found in service in the state-school sector in year X+1 and this was not because of retirement or death in service. We also say that they *left the profession*. For example, a teacher moving from a maintained school to an independent school is classified as *'*out of service wastage'.

3.1 The recent rise in school-to-school mobility is not driven by one single type of mobility

The analysis published in September 2016 shows that school-to-school mobility is now the biggest source of new entrants to schools – and is therefore a key driver of increased recruitment activity in schools. In 2015, school-to-school mobility accounted for 40.6% of all entrants to primary schools and 44.3% for secondary schools, compared to 34.0% and 29.4% respectively in 2011. Underlying this change, the number of teachers who move to another state-funded school each year is estimated to have nearly doubled between 2011 and 2015 (from 10,400 to 18,200 entrants to primary schools and from 8,300 to 16,500 entrants to secondary schools). This increasing trend of school-to-school mobility is seen in all regions, with the highest figures in Inner London.

We extend this analysis by exploring the characteristics of teachers who move schools. We compare teachers' information in the SWC in the year prior to their move with the information recorded in the SWC from the year after they moved. By doing this we can for example tell what proportion of moves were at the same level of seniority and compare other aspects of their contract as well.

Table 3.1 shows that more teacher movements occur from London schools to schools outside of London (4.7% of all movements in 2015) than the other way around (3.2% of all movements in 2015). There was a small increase over time in the proportion of moves occurring within London, but the scale of the change suggests that this was not a major driver behind the recent increase in teacher mobility.

Similarly, there was not much change between 2011 and 2015 in the proportion of moves by rurality. Most moves occurred in urban areas (73.1%) and that type of mobility also saw a relative increase over time (from 70.8% in 2011 to 73.1% in 2015). All the other types of moves in relation to the urban/rural split saw a relative decline in their occurrence since 2011.

Slightly more than half of teacher movements were to schools situated in less deprived areas than their previous school (52.5% in 2011). This percentage had increased slightly since 2011 but this change is rather modest compared to the overall rise in school-to-school mobility.

In 2011, 32.9% of moves were to a school with a better Ofsted overall effectiveness grade, 35.8% to a school with the same grade and 31.3% to a school with a worse grade. Over time, the proportion of 'better-grade' moves stayed roughly constant (32.5% in 2015), the proportion of 'same-grade' moves increased (41.7% in 2015) and the proportion of 'worse-grade' moves decreased (25.8% in 2015). This, however, is not surprising, since the proportion of 'Good' schools, and hence the expected proportion of moves between schools with the same Ofsted grade,

increased substantially over the same time period (from 51.6% to 67.5% in the primary sector and from 41.2% to 52.9% in the secondary sector).

Table 3.1: Splits of school-to-school mobility in primary and secondary schools by year.

	2011	2012	2013	2014	2015
Observations included	16,300	22,000	27,500	32,900	33,600
From London to London	12.2%	13.1%	13.5%	13.0%	13.2%
From London to outside London	4.5%	4.7%	4.5%	4.6%	4.7%
From outside London to London	3.8%	3.4%	3.8%	3.1%	3.2%
From outside London to outside London	79.5%	78.8%	78.2%	79.3%	78.9%
From urban area to urban area	70.8%	71.6%	72.1%	72.9%	73.1%
From urban area to rural area	10.0%	10.1%	9.7%	9.6%	9.8%
From rural area to urban area	8.8%	9.1%	8.7%	8.2%	7.9%
From rural area to rural area	10.3%	9.2%	9.6%	9.3%	9.3%
To less deprived area	50.5%	51.0%	51.0%	51.5%	52.2%
To more deprived area	49.5%	49.0%	49.0%	48.5%	47.8%
School with a better Ofsted grade	32.9%	35.4%	32.0%	33.6%	32.5%
School with the same Ofsted grade	35.8%	35.4%	37.7%	39.2%	41.7%
School with a worse Ofsted grade	31.3%	29.2%	30.3%	27.2%	25.8%
From permanent to permanent	64.9%	66.8%	67.5%	69.6%	70.6%
From permanent to non-permanent	12.7%	12.1%	12.7%	12.5%	12.1%
From non-permanent to permanent	11.9%	12.1%	11.6%	10.7%	10.7%
From non-permanent to non-permanent	10.5%	9.0%	8.2%	7.2%	6.6%
Full-time to full-time	80.4%	81.6%	81.5%	80.7%	79.4%
Full-time to part-time	5.9%	5.1%	5.4%	5.8%	6.5%
Part-time to full-time	7.3%	7.2%	6.9%	6.4%	6.1%
Part-time to part-time	6.5%	6.2%	6.2%	7.1%	8.0%
Higher level of post	12.0%	11.3%	11.0%	11.1%	10.5%
Same level of post	84.9%	85.8%	86.0%	86.0%	86.4%
Lower level of post	3.1%	2.9%	3.0%	3.0%	3.1%
Pay rise of at least 3%	63.2%	57.5%	58.4%	53.0%	55.8%
Pay rise lower than 3%	36.8%	42.5%	41.6%	47.0%	44.2%

The total number of teachers in the sample is slightly lower than the total number of teachers who moved school because the data needed for this analysis are not always available. London covers both Inner London and Outer London. The proportion of ‘Good’ schools substantially increased over the

same time period (from 51.6% to 67.5% in the primary sector and from 41.2% to 52.9% in the secondary sector).

The vast majority of teachers have a permanent contract[10] (approximately 90.3% in 2015) and this is reflected by the fact that most moves (70.6% in 2015) are of teachers who are on a permanent contract before they move school and also get a permanent contract in their new school. This category increased in its relative size over time, rising from 64.9% in 2011. This was mostly offset by the decrease in the relative occurrence of the moves from non-permanent contracts to non-permanent contracts (from 10.5% in 2011 to 6.6% in 2015).

Approximately 4 out of 5 moves are of teachers moving from a full-time post to a full-time post (79.4% in 2015). It is much less common for full-time teachers to move to a part-time post (6.5% in 2015). The proportion of those moving from a part-time post to a full-time post decreased from 7.3% in 2011 to 6.1% in 2015, while the proportion of those moving from a part-time post to a part-time post increased from 6.5% in 2011 to 8.0% in 2015.

In 2015, 86.4% of teachers moved school for an equivalent level role.[11] A further 10.5% of teachers moved on promotion and a small number (3.1%) moved to a less senior post than the one they previously held. There was a slight decrease in the proportion of moves accounted for by the 'promotion' category (from 12.0% in 2011 to 10.5% in 2016).

There was also a decrease in the proportion of moves which led to a pay rise of at least 3%, which fell from 63.2% in 2011 to 55.8% in 2015. However, comparisons of pay increases over time are difficult because there is no way of knowing what a teacher's salary would be had they stayed in the same school. Many teachers who move schools are young teachers paid on the main pay range, and teachers on the main pay range often receive a salary rise larger than 3% (regardless of whether they move).

To sum up, **the presented data do not single out any one factor as the main driver of the increase in school-to-school mobility between 2011 and 2015**. This is consistent with the notion that no single reason can fully explain why teachers move schools.

[10] Non-permanent contracts include fixed term contracts, temporary contracts and service agreements.

[11] The ordering of roles is defined as follows: 1 classroom teacher, 2 leading practitioner (or excellent teacher or advanced skills teacher), 3 assistant head, 4 deputy head and 5 head teacher.

3.2 In-system retention is driven by a number of factors

Using data from the School Workforce Census, we investigated which factors are associated with leaving the teaching profession. A large number of variables, such as geographical factors, school characteristics and teacher characteristics, were covered in the modelling (the full list is included in Annex 2). An effort was made to compile a list as comprehensive as possible based on the available information. A natural limitation is that administrative data cannot capture a range of personal and professional reasons that may influence someone's decision to leave the profession.

Methodology

This analysis focuses on predicting in-system retention. The response variable (also called dependent variable or outcome) we are interested in is whether a teacher *stayed* in the state-funded school system (in the same or a different school) or *left the profession* altogether. The outcome variable is therefore dichotomous.

Logistic regression is most commonly used to model the relationships between a binary response and explanatory variables and this is our choice as well. Since this analysis looks at many explanatory variables and since these variables are often strongly correlated, we used a technique known as *elastic net regularisation* in order to increase the robustness of the findings. This analytical approach is heavily driven by the patterns that exist in the data, i.e. elastic net regularisation fits a number of models and selects the one that shows the best fit with the data. Further detail about the methodology is provided in Annex 2.

In order to make the analyses more meaningful, they were run separately for teachers and leaders in primary and secondary state-funded schools in England, therefore defining four populations of interest (e.g. teachers in primary schools). The textbox below further describes how teachers and leaders are defined here.

Defining leaders and teachers

In Subsections 3.2 and 3.3, there is a distinction between *teachers* and *leaders*. The definition of *leaders* used in the analysis covers headteachers, deputy heads and assistant heads. Teachers who do not hold any of the above three posts are classified as *teachers*. Although this definition may not reflect the realities of every school perfectly, its use is determined by data availability.

In the outputs of the modelling, estimates of the individual effects are represented by **odds ratios** and the text box below explains odds ratios and how they can be interpreted. Since each data collection was analysed separately, a large number of modelling outputs were produced. Only the key findings are presented in the main

body of this section and they are mostly combined and summarised in simple charts. The interested reader can find information in the attached spreadsheets.

Understanding odds ratios

Odds ratios are intuitive and they are based the same as idea as betting odds. For example, if we believe that a certain teacher has a probability of staying in the profession of 90% that means that their *odds of staying* are 9:1. A different teacher might have the odds of staying equal to 18:1 (which is equivalent to the probability of 18/(18+1) ≈ 95%). We would say that the odds ratio for these two teachers is 2, or in other words, that the odds of leaving are twice as high for the former teacher as they are for the latter.

As noted previously, this analysis cannot account for reasons not measurable by variables recorded in administrative data, therefore the overall predictive power of the models remain modest. More detail can be found in Annex 2.

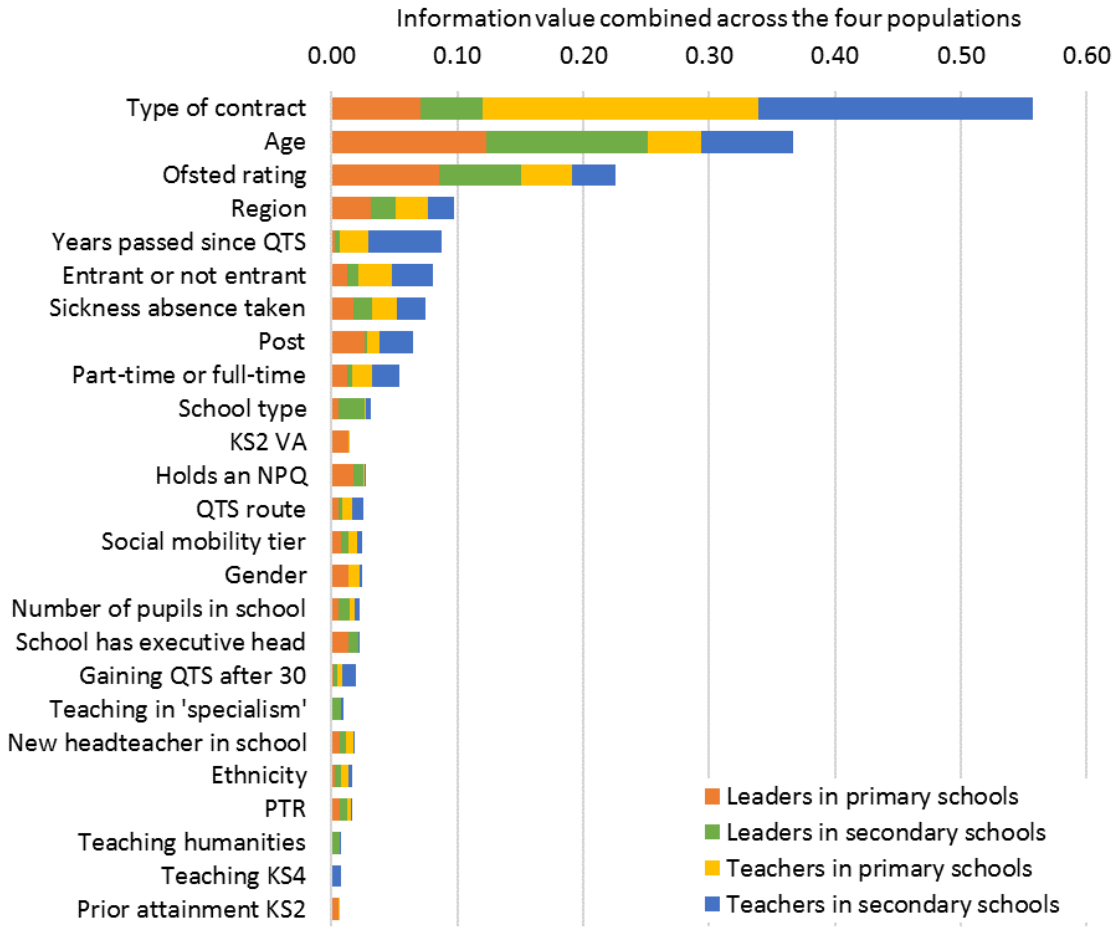
Career situation, personal circumstances, school's Ofsted grade and region are most predictive of in-system retention

Figure 3.1 includes the information value estimates for the 25 most predictive variables. The results across the four populations of teachers have been put together to provide an aggregated overview but the differences in 'variable importance' by population can also be explored using the chart and Table 3.2 which shows the top 10 predictors within each population, and these are further explored later in the section.

Analysis shows that when looking at teachers' career situation (whether they are an entrant into the system, years since gaining Qualified Teacher Status (QTS) and age, type of contract, working pattern and post), their personal circumstance (sickness absence), their school's Ofsted grade and region are among the most predictive variables.

The reader might note that many of the other included variables have a relatively small predictive power. For example, the deprivation of schools' area does not seem to be a major driver of in-system teacher retention once the other characteristics are controlled for, however, this is likely to feed in through the relationship between deprivation and other predictive factors.

Figure 3.1: Top 25 variables with the highest information value



Note: We use the estimated regression coefficients to get the predicted 'out of service' wastage rate in each category, and the 'out of service' wastage rate in the baseline category is set to 10%. The plotted values are averages of the five information values estimated on the five year-on-year School Workforce Census datasets.

Table 3.2: Top 10 variables with the highest information value in each population

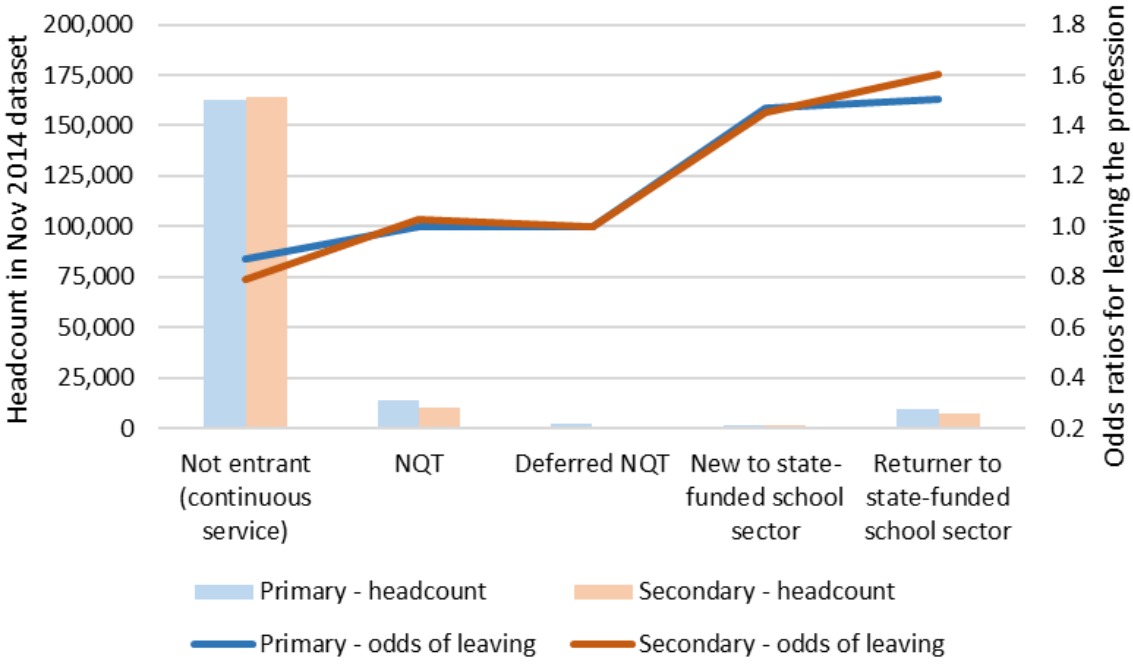
	Leaders		Teachers	
Rank	Primary schools	Secondary schools	Primary schools	Secondary schools
1	Age	Age	Type of contract	Type of contract
2	Ofsted grade	Ofsted grade	Age	Age
3	Type of contract	Type of contract	Ofsted grade	Years since QTS
4	Region	School type	Entrant or not	Ofsted grade
5	Post	Region	Region	Entrant or not
6	Sickness absence	Sickness absence	Years since QTS	Post
7	Holds an NPQ	No. of pupils in school	Sickness absence	Sickness absence
8	School has exec. head	Holds an NPQ	Full/part-time	Full/part-time
9	KS2 value added	Entrant or not	Post	Region
10	Gender	School has exec. head	Gender	QTS after 30

Note: We use the estimated regression coefficients to get the predicted 'out of service' wastage rate in each category, and the 'out of service' wastage rate in the baseline category is set to 10%. These are based on the average information values across the five year-on-year SWC datasets.

Entrants have a higher likelihood of leaving

It can be hypothesised that entrants into the state-funded school system are more likely to leave in the following year than teachers who have been teaching in the system for some time. This seems to hold in the data as well. The model predicts that 'out of service' wastage rates are lowest among teachers in continuous service, i.e. teachers who are not entrants into the profession. The odds of leaving are higher for newly qualified teachers (NQTs) and deferred NQTs (who do not start teaching until the second year following QTS acquisition). However, teachers joining at a later stage, either as teachers new to the sector or as returners to the sector, have the highest estimated likelihood of leaving.

Figure 3.2: The effect of being an entrant on the odds of leaving the profession



Note: NQTs and deferred NQTs (the reference level) have very similar odds of leaving the profession. The odds of leaving were 60% higher for returners and 20% lower for teachers in continuous service. The pattern was similar for primary school teachers. Leaders are not included. The plotted odds ratios are the medians of the five odds ratios estimated on the five year-on-year School Workforce Census datasets.

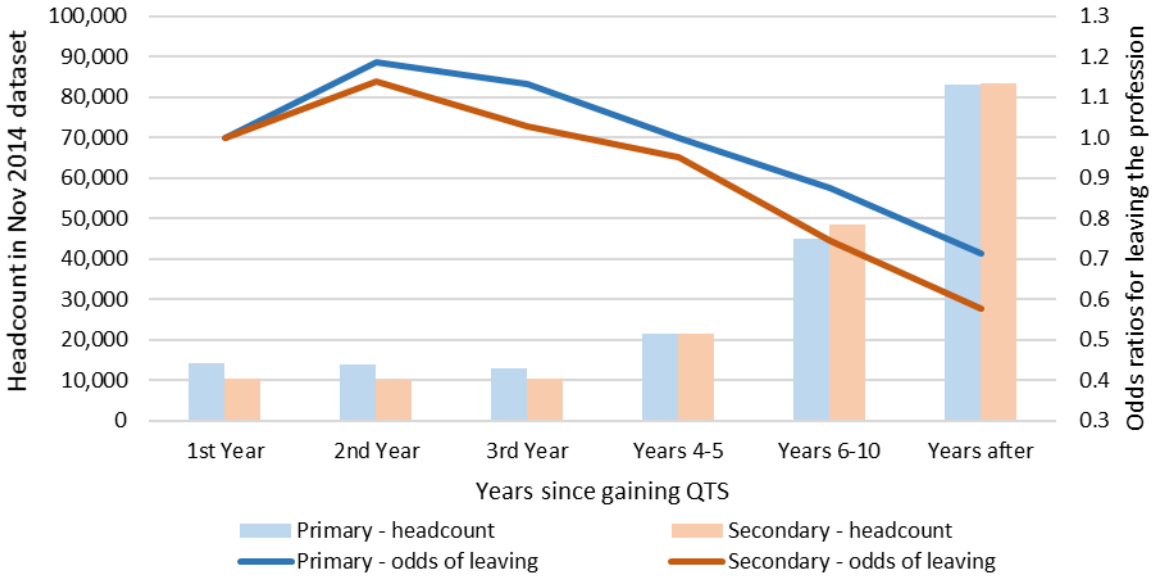
The odds of leaving were highest at the beginning of teachers' careers

It is known from the School Workforce SFR that early career teachers tend to have higher 'out of service' wastage rates than teachers later in their career. This might be due to a range of factors and this analysis covers those that can be observed from the recorded SWC data. The previous subsection looked at the effect of being an entrant. Here we present further analysis according to the number of years that have passed since teachers gained QTS (Figure 3.3). The chart shows that the odds of

leaving the profession were highest in the first five years and then dropped. The profiles of primary school teachers and secondary school teachers were similar in this respect.

In this context, it is also worth mentioning that teachers who gained QTS when they were older than 30 had higher odds of leaving the profession, although the effect was not as strong as the effect presented in Figure 3.3.

Figure 3.3: Predicted odds of leaving for teachers by the number of year since qualifying



Note: The reference level is '1st year'. By definition, every NQT is in their first year of service since gaining QTS. Because of this interaction we in the above figure combine the odds ratios for years since QTS with the odds ratios of the 'entrant' variable from the previous subsection. This reflects better a 'typical' career journey of a teacher in continuous service. For example, for secondary teachers with more than 10 years' experience, the odds of leaving the profession were 40% lower than those in their 1st year. Leaders are not included. The plotted odds ratios are the medians of the five odds ratios estimated on the five year-on-year School Workforce Census datasets.

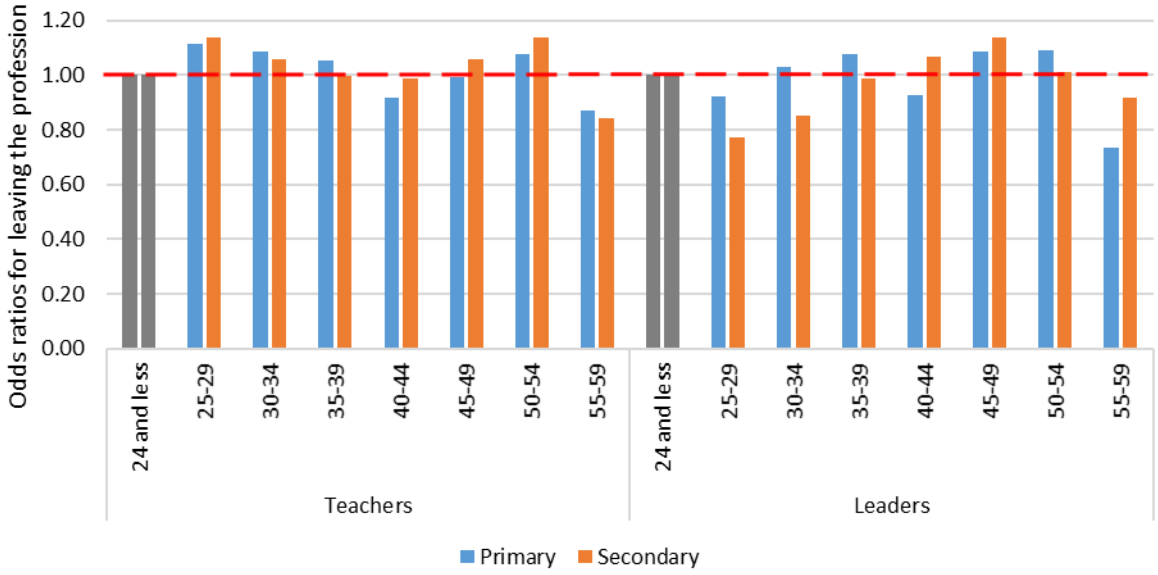
Lower likelihood of leaving the profession near retirement age

Teachers and leaders approaching retirement age are substantially less likely to leave the profession as 'out of service' wastage than those of lower ages. This is understandable because when the oldest teachers leave the profession they tend to go into retirement. This analysis excludes retirements as the primary focus is to understand which characteristics are related to the likelihood of teachers leaving.

Figure 3.4 demonstrates that once time since gaining QTS has been controlled for, the effect of age is not strong or straightforward. Younger teachers seem to be more likely to leave but the lowest odds of leaving were not found among older teachers but among mid-career teachers.

The picture is similar for primary school leaders but not secondary leaders: very young leaders in secondary schools actually display relatively low odds of leaving. Teachers who manage to secure a leadership position in a secondary school at a young age may be those who are very motivated to stay in the profession.

Figure 3.4: Predicted odds of leaving the profession by age



Note: The reference level is '24 and less' and it is coloured in grey to improve readability of the chart. The odds of leaving for the age cohort '60 and over' were approximately 70% lower for teachers and 60% lower for leaders than the reference level across both phases. These categories were removed from the chart for ease of interpretation of the other groups. The plotted odds ratios are the medians of the five odds ratios estimated on the five year-on-year School Workforce Census datasets.

Lower likelihood of leaving if on a permanent contract

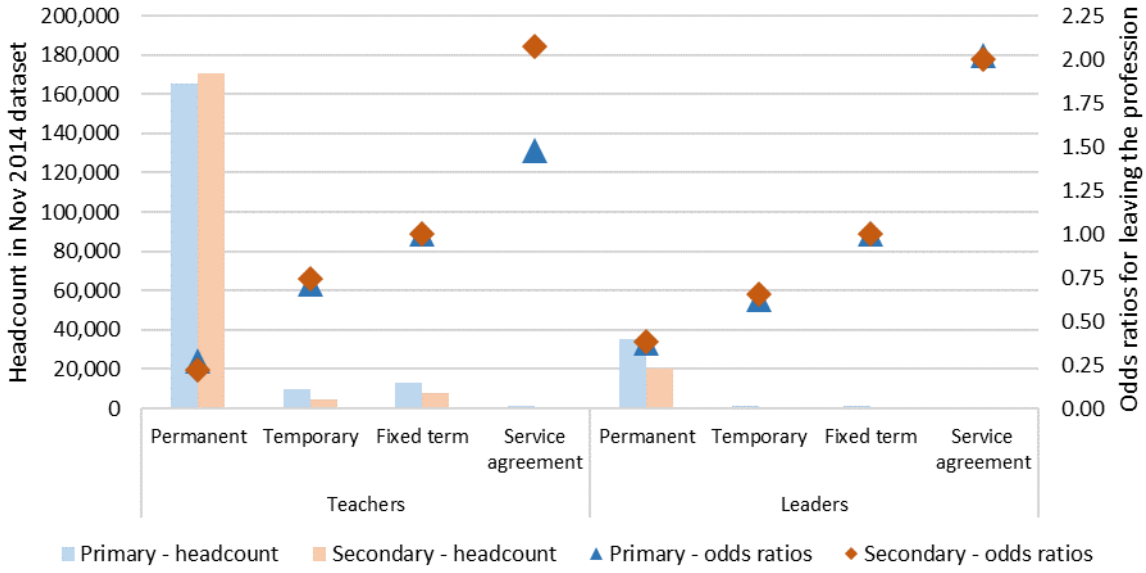
Staff with a permanent contract are the least likely to leave across both school phases and both teachers and leaders. Those on a service agreement[12] have the highest odds of leaving, followed by those on fixed term contracts and those on temporary contracts.

The differences between the predicted in-system retention rates are substantial. For example, if we believe that there is a 10% probability that a certain secondary teacher on a permanent contract leaves, then the probability would be 21% if they if they had a temporary contract, 26% if they had a fixed term contract and 46% if they were on a service agreement.

[12] Teachers on a service agreement are teachers who do not have a direct contractual agreement with the school where they teach but are instead employed by another organisation.

The predictive power of this variable is limited mainly by the fact that the vast majority of teachers and leaders are on permanent contracts (89.7% of teachers and 93.6% of leaders in 2015). It therefore cannot explain most 'out of service' wastage that we have observed. Nevertheless, it does show that the in-system retention rates of teachers and leaders on non-permanent contracts are substantially different to the rates of those on permanent contracts.

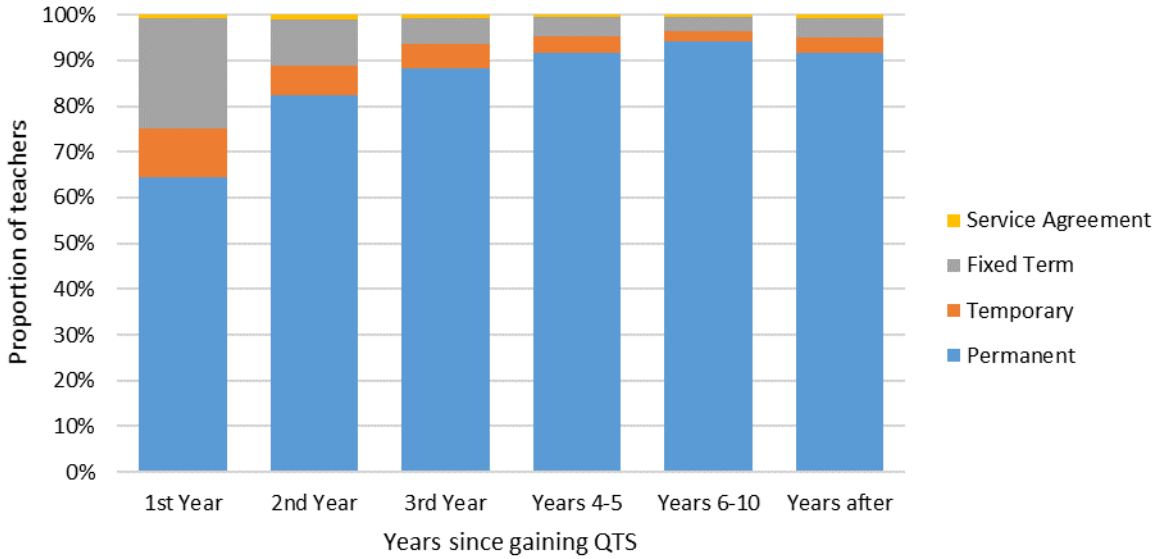
Figure 3.5: Predicted odds of leaving the profession by the type of contract



Note: For the type of contract, fixed term contracts are the reference level. The odds of leaving for teachers with a permanent contract in both primary and secondary schools are approximately 75% lower than for those with fixed term contracts. For leaders, the difference is approximately 60%. The plotted odds ratios are the medians of the five odds ratios estimated on the five year-on-year School Workforce Census datasets.

Young teachers are more likely to be on non-permanent contracts. Figure 3.6 shows, based on data from SWC 2015, the proportion of teachers by years since gaining QTS and by the type of contract they are on. Around a third of teachers in their NQT year were on a non-permanent contract, typically a fixed-term contract. This variable is therefore closely related to being an NQT and it might explain why the odds of leaving in the first year after qualifying were slightly lower than the odds in the second year. In other words, a part of the early career effect on retention was accounted for by the type of contract; once the type of contract was controlled for, second year teachers were slightly more likely to leave the profession than first year teachers.

Figure 3.6: Proportion of teachers by years since gaining QTS and contract type



Note: The proportion of teachers with a service agreement is less than 1% for all groups. For teachers in their 1st year after qualifying, 24% have a fixed term contract, 11% have a temporary contract and 64% have a permanent contract.

Likelihood of leaving was highest in schools rated 'Inadequate'

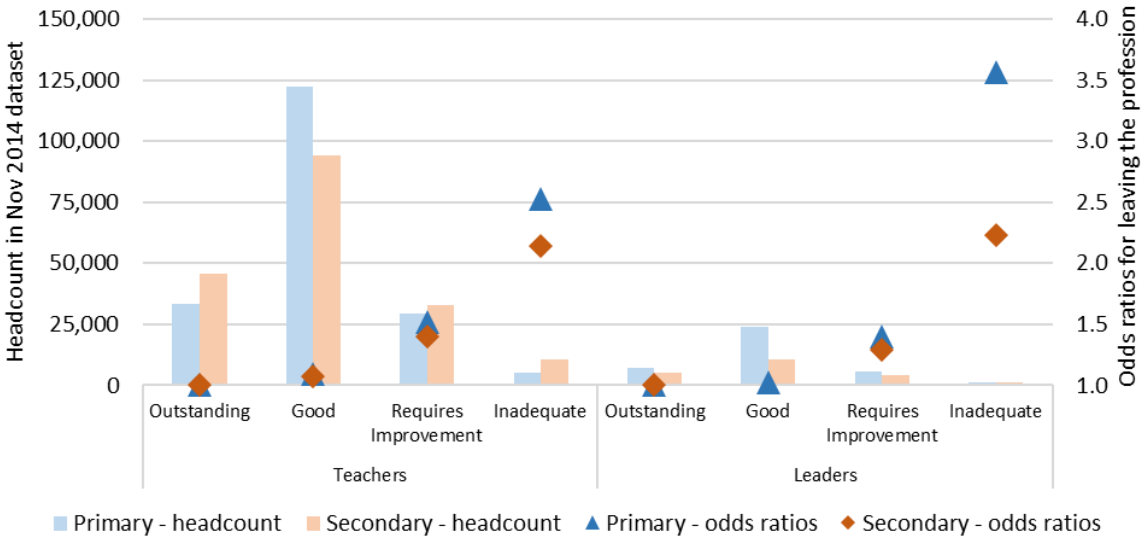
Figure 3.7 displays the predicted odds of leaving by schools' overall effectiveness Ofsted grade.[13] It shows that the likelihood of teachers leaving the state-funded sector is highest in schools rated 'Inadequate'. Regardless of whether we look at teachers or leaders, primary or secondary schools, the odds of leaving are more than twice as high in 'Inadequate' schools than in 'Outstanding' schools.

The predicted odds of leaving follow similar patterns for each of the four populations studied: the better the grade, the lower the likelihood of leaving. There is little difference between 'Good' and 'Outstanding' schools, but 'Requires Improvement' and especially 'Inadequate' schools experience much higher leaver rates.

Not all schools are inspected every year and this analysis does not control for the time that passed since the most recent Ofsted inspection. This time dependency is an important limitation to any cross-sectional statistical such as this one. **No causal conclusions should therefore be made based on the identified associations.**

[13] For more information about Ofsted grades see the Ofsted inspection handbook.

Figure 3.7: Predicted odds of leaving the profession by Ofsted grade of school



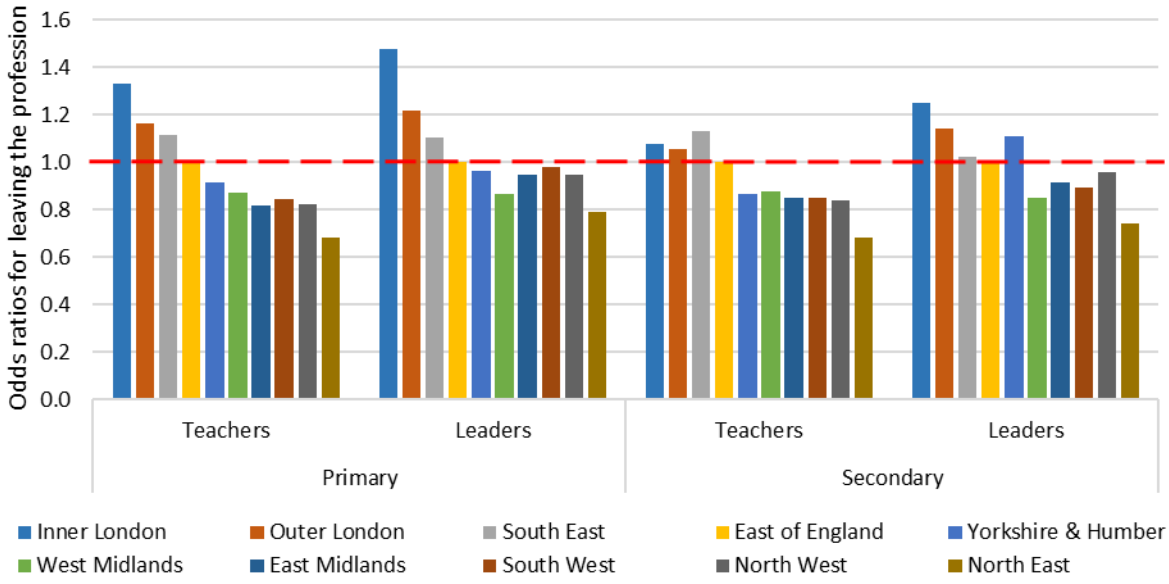
Note: The reference level when looking at the Ofsted grading is 'Outstanding'. The odds of leaving for primary school leaders were 250% higher in school rated as 'Inadequate' than those rated as 'Outstanding'. The plotted odds ratios are the medians of the five odds ratios estimated on the five year-on-year School Workforce Census datasets.

The odds of leaving were highest in Inner London

As shown in the report published by DfE in September 2016, there are regional differences in teacher retention. The added value of this subsection is that when estimating regional effects it attempts to control for as many other factors as realistically possible.

Figure 3.8 shows that regardless of the population of interest, the odds of leaving were highest in London. This was particularly the case in primary schools where regional differences are highest, e.g. the estimated odds of leaving for primary school teachers in Inner London were ~30% higher than those in the East of England which is used as the reference level. The South East is the region most similar to London in terms of the odds of leaving. On the other hand, the lowest odds of leaving can typically be found in the North East. These findings are consistent with the evidence provided in the linked report.

Figure 3.8: Predicted odds of leaving the profession by region



Note: East of England is the reference category. The plotted odds ratios are the medians of the five odds ratios estimated on the five year-on-year School Workforce Census datasets.

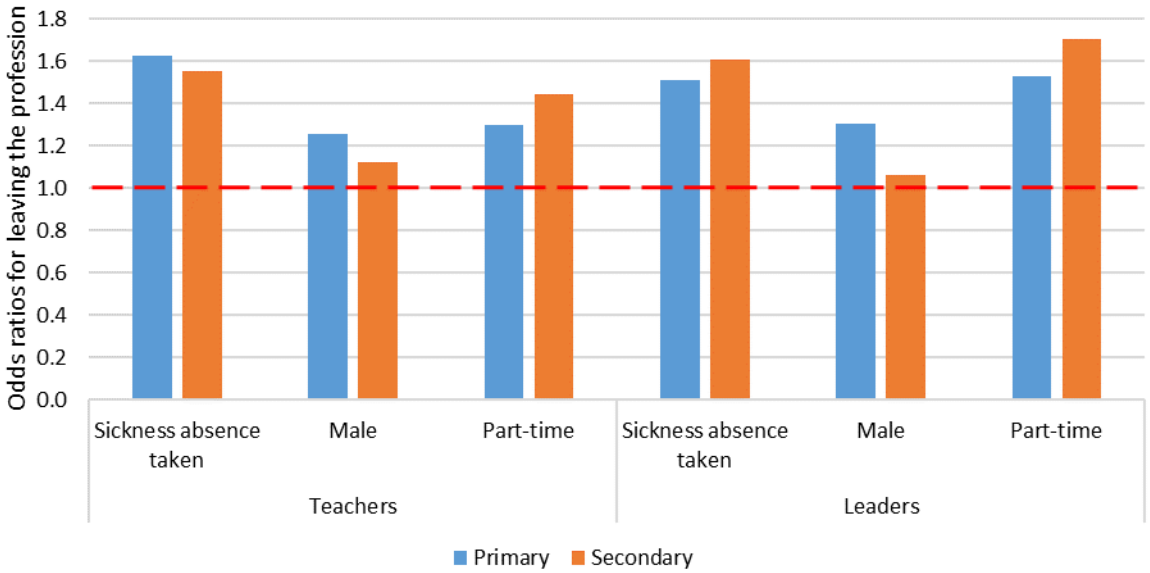
Male teachers and part-time teachers were more likely to leave the profession

In this subsection we look at some of the factors which overall did not show as high a predictive power as the above variables; yet there is evidence of their realtionship to in-system retention.

First, male teachers have higher odds of leaving the profession than female teachers. This is in line with the assumption than male teachers might be more mobile and more likely to seek work outside the profession. Second, part-time teachers are more likely to leave the system than full-time teachers. Third, teachers with five or more days of sickness leave recorded (in the previous year) are more likely to leave. This might mean that some teachers experience health problems that make it more likely that they leave the profession.

As documented in Figure 3.9, all of these findings hold for both teachers and leaders, in primary schools as well as in secondary schools.

Figure 3.9: Predicted odds of leaving by whether teacher took at least a week of sickness absence in the previous year, by their gender and working pattern



Note: All of these variables are binary and the reference level is always the one which does not appear in the chart, e.g. for gender the reference level is 'Female'. The plotted odds ratios are the medians of the five odds ratios estimated on the five year-on-year School Workforce Census datasets. Part-time secondary school leaders had 70% higher odds of leaving if they were working part-time.

Similar or smaller effects were found for a number of other factors. Middle leaders[14] were less likely to leave the profession than other classroom teachers and headteachers were less likely to leave than deputy heads and assistant heads.

Secondary school teachers with a degree in Physics, Maths and Modern Foreign Languages had lower in-system retention rates than those with degrees in other subjects. Similarly, secondary school teachers teaching English, Modern Foreign Languages and Science were more likely to leave the profession than those not teaching these subjects.

Teachers and leaders with an undergraduate degree from a Russell Group university were more likely to leave the profession than those without such a degree. Slightly lower odds of leaving were found among teachers and leaders employed in coastal areas. These relationships might be related to differences in local labour markets and in access to job opportunities outside teaching.

[14] A teachers is classified as a middle leader if they are any of the following: Leading Practitioner, Head of Year, Head of House, Head of Department, Behaviour Manager/Specialist, Data Manager/Analyst, Extended Schools Manager/Support, SEN Co-ordinator, Learning Manager or if they are in a receipt of a Teaching and Learning Responsibility payment of at least £100.

3.3 Classification Trees

This subsection aims to identify teachers with similar characteristics and classify them to one of the three outcomes: whether they stayed in the same school, moved to a different school, or left the profession altogether. This differs from Subsection 3.2 which only looked at in-system retention.

Another way of thinking about this analysis is that instead of evaluating the effects of a large number of variables, it focuses on the most important factors and explores the interactions between them. The starting list of variables used is the same as in the previous subsection. This variable selection is automatic and driven by the patterns in the data, by the proportions of teachers/leaders in each category who stayed in the same school, moved schools or left the system. Instead of the effects of individual variables, this modelling method outputs a segmentation of the workforce based on their retention profile. More information about the method is available in Annex 2.

The modelling was, similarly to the previous subsection, run separately for each year, by phase and separately for leaders and teachers. For brevity, we only focus on the main findings from the modelling but we invite the interested reader to explore the outputs in more detail. The diagrams presented in this subsection are restricted to primary school leaders and secondary school teachers based on the 2015 data but the other two diagrams are available in Annex 2 and in the attached spreadsheet. The text box below explains how information is presented in the diagrams.

It is important to say that the selected tree can vary substantially based on a variety of underlying statistical parameters in the modelling. In the discussion of the findings, we therefore focus on the main findings instead of trying to explain every single element in the model outputs.

Overall, the analysis supports the finding from the previous subsection that, for classroom teachers, having a permanent contract is strongly predictive of their retention. Alongside this, teachers' and leaders' age, Ofsted judgements of their schools, geographical region and the number of years since they gained QTS seem to be very important. School type, subject taught, previous career and other factors are also important, but they feature in the trees less often and are less prominent. Hence, they appear to be less useful for predicting teacher retention.

Understanding classification tree diagrams

Figure 3.10 summarises the classification tree for the population of primary school leaders as defined in Subsection 3.2. The whole population is represented by the top node; this is why the number at the bottom of the node says 100%. The decimal numbers mean that 89% of leaders in the sample stayed in the same school, 7% moved to a different school and 4% left the system.[15]

The top node is first split based on the Ofsted grade of the school where the leader works. Around 3% leaders worked in 'Inadequate' schools and their retention profile was very distinctive: 69% stayed in the same school, 17% moved and 15% left the system. This segment had the highest likelihood of moving or leaving the sector.

Leaders in other than 'Inadequate' schools can further be split by their age: those aged 50 and over had the stayed-moved-left profile of 92%-4%-4% while those under 50 years of age had the profile of 88%-8%-4%. This means that younger leaders in such schools were more likely to move school than the older leaders.

Each of the above groups can further be split again and again, and the final segmentation is displayed at the bottom of the diagram. The green nodes are those which are more inclined towards in-school retention and the grey ones are those with a profile more skewed towards school-to-school mobility. Each and every primary school leader fell into exactly one of these segments.

Leaders in schools with a low Ofsted grade were most likely to move school or leave the profession

Figure 3.10 shows that in 2015, in the population of *primary school leaders*, those with the **highest in-school retention** were leaders aged 55 and over working in schools which were not rated 'Inadequate' and which did not have an executive headteacher. This group comprised 12% of workforce, of which 95% stayed in the same school into the following year.

In-school retention and in-system retention was lowest among leaders in 'Inadequate' schools (this group comprised 3% of workforce, of which 17% moved school and 14% left by the following year). School-to-school mobility, but not necessarily 'out of service' wastage rate, was higher for leaders in primary schools

[15] Please note that these figures may not be the same as the national estimates reported in the School Workforce SFR. This is because the scope of this analysis differs slightly.

with an executive head teacher. This might be a proxy measure for schools with strong links to other schools.

The segments are relatively similar in *secondary schools* but there are some differences (see Figure A2.1 in Annex 2). Those **most likely to stay in their school** were leaders aged 50 and over working in 'Good' and 'Outstanding' schools (22% of workforce, 93% in-school retention).

Secondary school leaders aged 45 and over working in 'Requires Improvement' and 'Inadequate' schools were **most likely to leave the system** are (12% of workforce, 10% left the system). Younger leaders in this category constituted the segment of secondary school leaders **most likely to move school** (15% of workforce, 11% moved school).

Classroom teachers without a permanent contract were most likely to move school or leave the profession

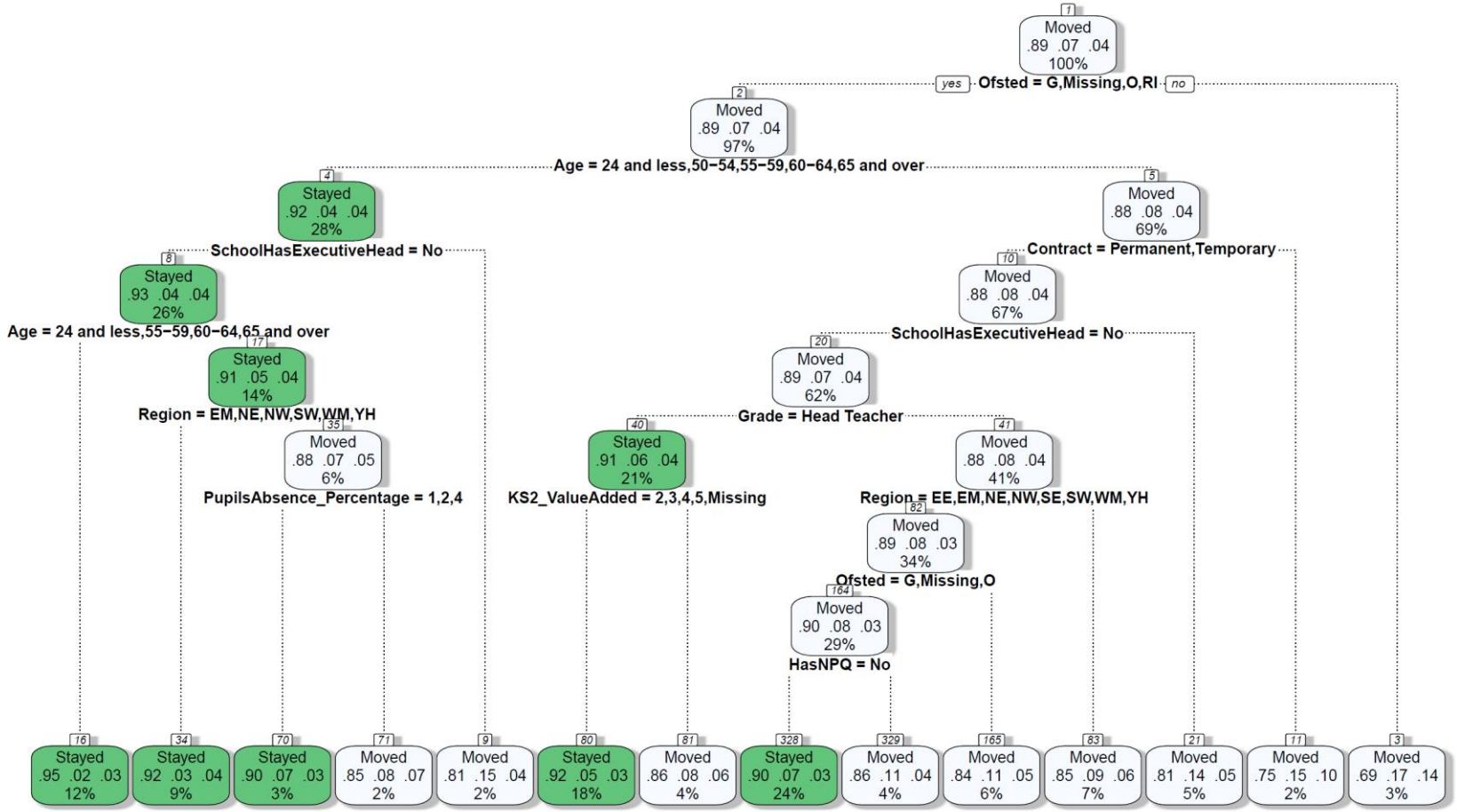
Figure 3.11 displays the classification tree for the population of *secondary school teachers*. **Highest in-school retention** was found among teachers aged 50 and over on permanent contracts, in 'Good' and 'Outstanding' schools (10% of workforce, 92% in-school retention).

Teachers with non-permanent contracts both had the **lowest in-school retention and the lowest in-system retention** (7% of workforce, 18% moved school, 25% left the profession). Part-time teachers on permanent contracts who had qualified ten years ago or less also had relatively low in-system retention (5% of workforce, 14% left the profession). On the other hand, full-time teachers on permanent contracts who had qualified five years ago or less and who worked in schools rated as 'Requires Improvement' or 'Inadequate' were also relatively likely to move school (5% of workforce, 16% school-to-school mobility).

Similarly, *primary school teachers* identified as **most likely to leave both the school and the profession** were teachers with non-permanent contracts (13% of workforce, 15% moved schools, 21% left the profession; see Figure A2.2 in Annex 2). Those with at least 10 years' experience since qualifying who were on permanent contracts in 'Good' or 'Outstanding' schools were **least likely to leave their school** (32% of workforce, 89% in-school retention).

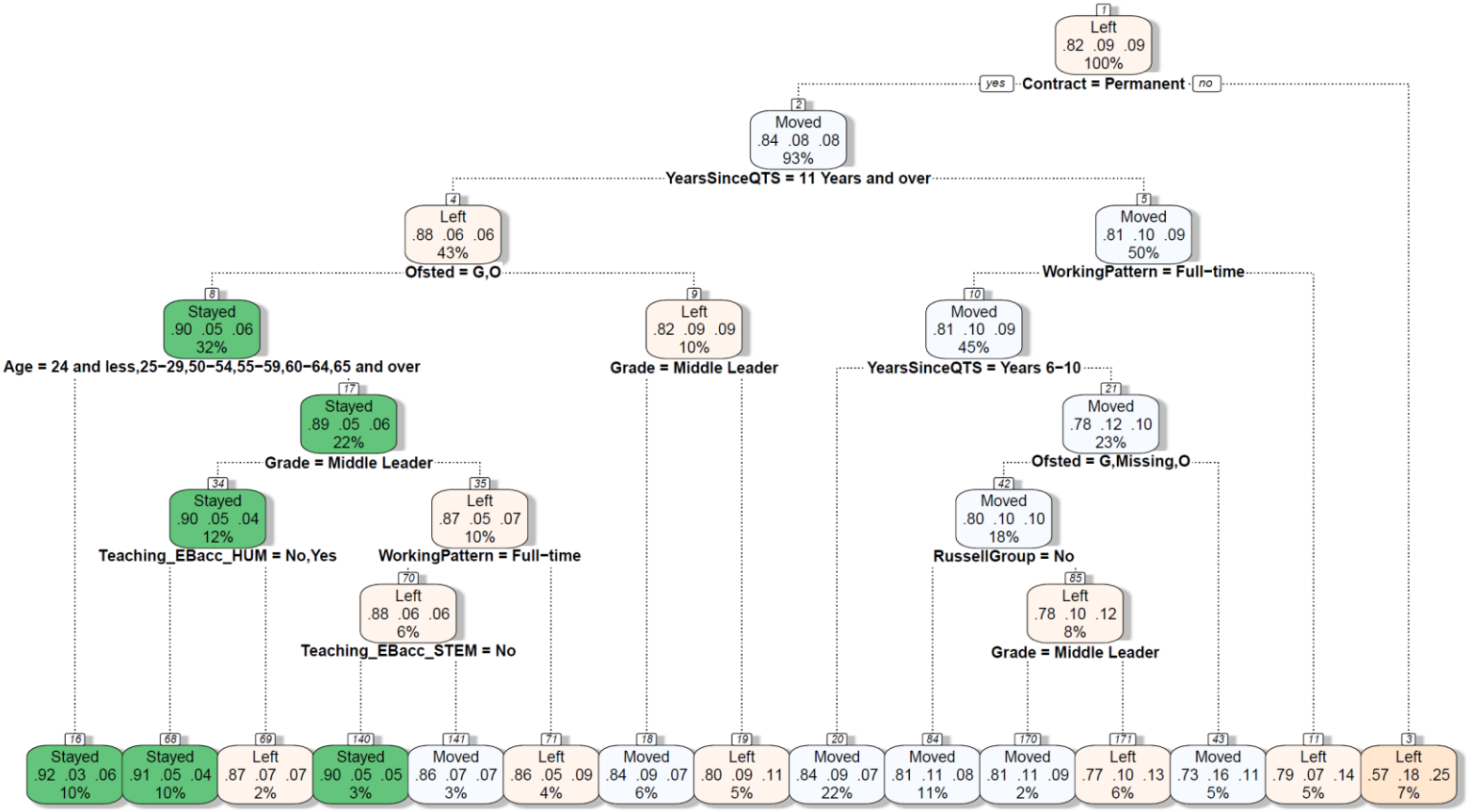
Early career primary school teachers on permanent contracts in London and the South East constitute an interesting category. If they held a degree from a Russell Group university, then they were more likely to leave the profession (5% of workforce, 10% moved school, 13% stayed in the profession). Those without such a degree were more likely to stay in the same school or just move to a different school (13% of workforce, 11% moved school, 9% left the profession). This could be due to the different career options available to them.

Figure 3.10 : Classification tree for primary school leaders



Note: The chart is based on the two latest collections of the School Workforce Census. For an explanation of how to read the diagram, see the text box at the beginning of the subsection. Ofsted grade covers four categories (O: Outstanding, G: Good, RI: Requires Improvement, I: Inadequate, 'Missing' indicates where the data is missing). Age is split into categories of 5 years. Contract type has four categories (permanent, temporary, fixed-term and service agreement). HasNPQ relates to whether a leader held a national professional qualification of any kind. Pupil absence in school and Key Stage 2 value added were categorised into quintiles (from 1-lowest to 5-highest and the missing data was covered under -1). Grade has three leadership categories: Head teacher, deputy head and assistant head. Regions are coded as follows: IL: Inner London, OL: Outer London, SE: South East, SW: South West, EE: East of England, EM: East Midlands, WM: West Midlands, YH: Yorkshire and the Humber, NE: North East, NW: North West.

Figure 3.11: Classification tree for secondary school teachers



Note: The chart is based on the two latest collections of the School Workforce Census. For an explanation of how to read the diagram, see the text box at the beginning of the subsection. Ofsted grade covers four categories (O: Outstanding, G: Good, RI: Requires Improvement, I: Inadequate, 'Missing' indicates where the data is missing). Age is split into categories of 5 years. Contract type has four categories (permanent, temporary, fixed-term and service agreement). YearsSinceQTS represents time since a teacher qualified: their 1st year, 2nd year, 3rd year, 4-5 years, 6-10 years, more than 10 years ('11 Years and over'). Grade has two teacher categories: middle leaders and other classroom teachers. WorkingPattern separates 'full-time' and 'part-time' teachers. RussellGroup='Yes' means that the teacher held a degree from a Russell Group university (and 'No' means they did not). Teaching_EBacc_HUM and Teaching_EBacc_STEM identify teachers who taught Humanities (History and Geography) and those who taught STEM subjects (Mathematics and Science subjects): value 'Yes' means they did, value 'No' means they did not and 'Missing' represents those with missing data.

4. Teacher mobility across England

This section provides new analysis of teachers' mobility between schools between 2010 and 2014. Where a move occurred between 2014 and 2015 this is refered to as a move in 2014, as the move originated in this year. Analysis of the linked School Workforce Census (SWC) allows us to see how far teachers moved when they stayed within the state-funded system in England. We are unable to see if a teacher had moved to a post outside of this system.

As noted in section 3, previous analysis of the SWC[16] showed that when considering all movements into and out of a school, school-to-school mobility is now the biggest source of new entrants to schools. The methodology to derive the values from the SWC in this report is the same as for the previous analysis. This analysis excludes all moves where the origin school is linked to the destination school through mergers or academisation, or where the new school is on the same site. Only primary and secondary school teachers were considered in this analysis and all distances are as the crow flies in kilometres (km). Distances are in kilometres as the coordinates of schools (Eastings and Northings) use the metric system.

This section has been compiled using R Markdown, as part of the Government Data Science community's work[17] to create a reproducible analytical pipeline – a way to produce analysis and statistics in a more timely manner, whilst maintaining or improving publication quality.

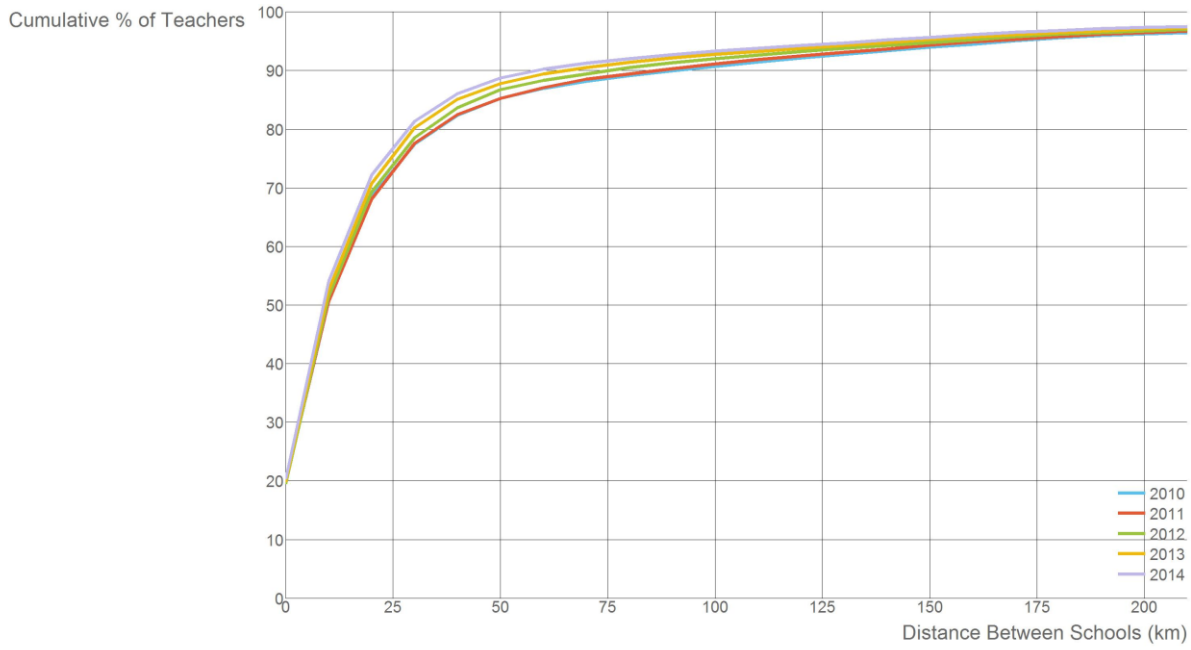
[16] Schools workforce in England 2010 to 2015: trends and geographical comparisons.

[17] Data at GDS - reproducible analytical pipelines

Most teachers stay within commuting distance when moving schools

Around 70.0% of all teachers who moved between 2010 and 2014 moved 25 kilometres or less. In fact, less than 4.0% of teachers who moved schools moved more than 200 kilometres. The maximum distance moved in the period was approximately 600 kilometres, however, for concision the graphs below will only show movement up to 200 kilometres, given that only a small percentage moved further. This pattern holds across all of the years in the analysis, as shown in Figure 4.1.

Figure 4.1



Source: School Workforce Census

Male teachers, teachers working full-time, and secondary school teachers were more likely to move a greater distance when they move

As can be seen from the table below, teachers were more likely to move further if they were male, working full-time, or if they taught in a secondary school. Teachers were more likely to move if they taught in a secondary school, reflecting that these are more spread out across the country as there are fewer of them. Variation in movement according to gender is linked to this. In November 2015, 84.8% of primary school teachers were female - this is similar to figures in previous years. Female teachers on average moved shorter distances than male teachers: 86.4% of female teachers who moved between 2010 and 2014 moved 50 kilometres or less, compared to 84.3% of male teachers.

Working patterns are also linked to gender and phase. On average, part-time teachers moved shorter distances than full-time teachers. 92.5% of part-time teachers who moved did so to a school 50 kilometres or less away. This is 7.9 percentage points higher than the figure for full-time teachers (84.6%). In 2015, female teachers were 3 times more likely than male teachers to be a part-time teacher (27.2% of female teachers versus 9.0% of male teachers), and primary school teachers were more likely to work part-time than secondary school teachers (26.1% and 18.2% respectively). The table below reinforces these clear links.

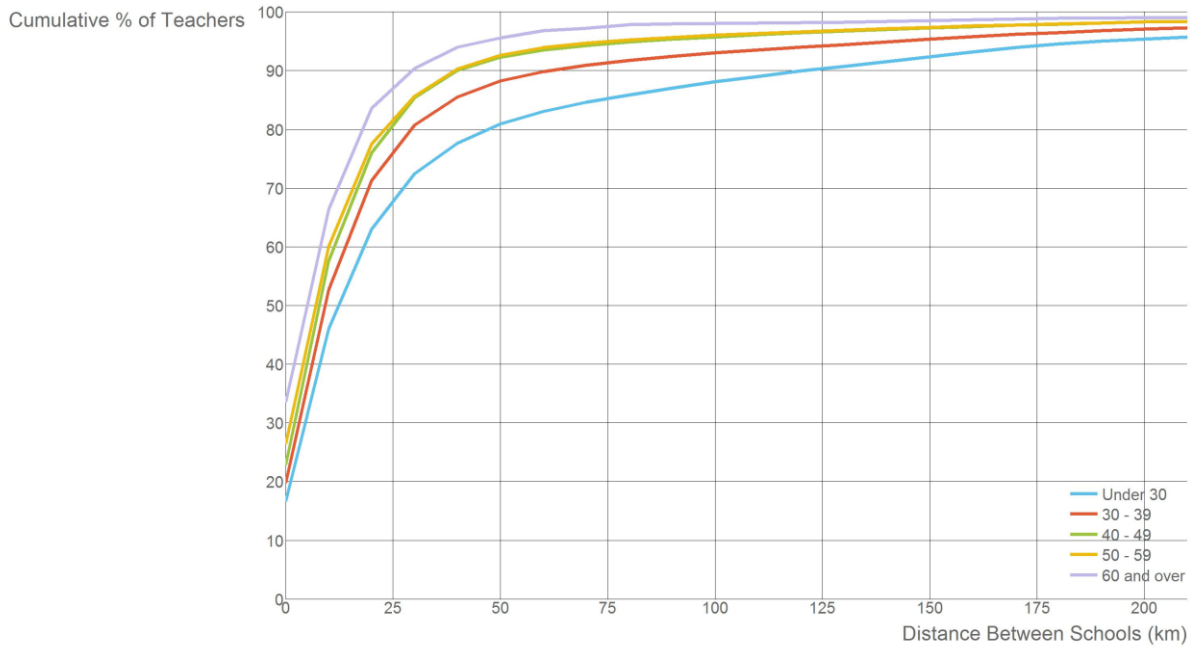
Table 4.1

Characteristic	% moving 50km or less
Primary, Female, Part-time	94.6
Primary, Female, Full-time	87.9
Primary, Male, Part-time	91.7
Primary, Male, Full-time	88.8
Secondary, Female, Part-time	89.5
Secondary, Female, Full-time	80.5
Secondary, Male, Part-time	85.8
Secondary, Male, Full-time	81.7

Younger teachers were more likely to move a greater distance when they move schools

Figure 4.2 shows that approximately 90.0% of those teachers under 30 years of age who moved between 2010 and 2014 moved 150 kilometres or less, compared to those aged 30-39 for whom approximately 90.0% moved 50 kilometres or less. The distance moved when moving schools generally decreases with age, indicating that there are factors associated with age that mean that older teachers move longer distances less frequently than their younger colleagues do.

Figure 4.2

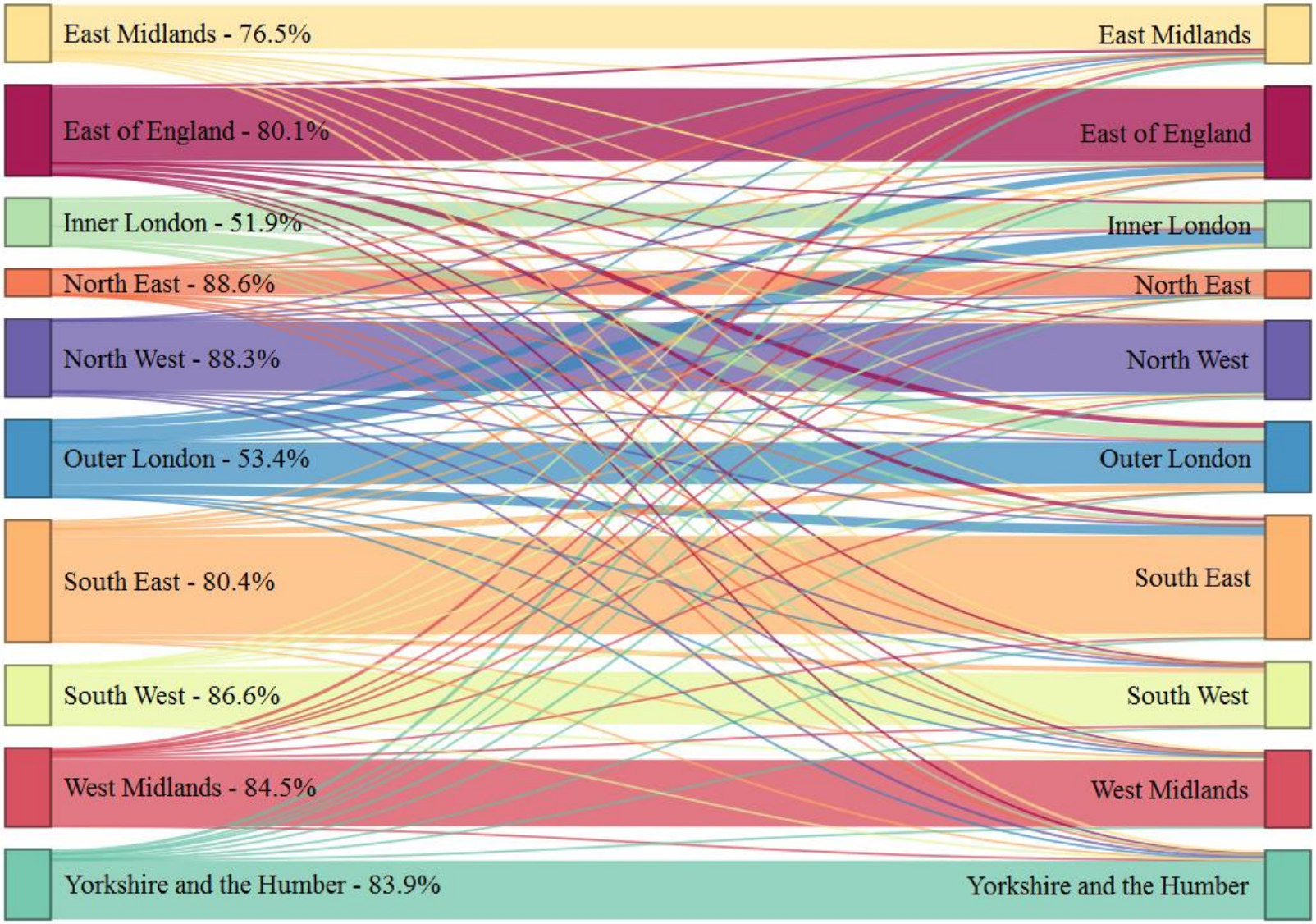


Source: School Workforce Census

There is little movement between regions

Figure 4.3 illustrates the movement of qualified teachers between regions. The thickness of the lines shows the proportion of teachers who moved from their origin region (on the left) to their destination region (on the right). The values on the left hand side show the percentage of teachers who remained within that region when they moved. For example, of teachers in the East Midlands that who moved school between 2010 and 2014, 76.5% stayed in the East Midlands. The vast majority of teachers stayed within the same region when moving school, with relatively few moving to different regions, again demonstrating that teachers seldom move large distances. The only noticeable inter-region movements are between Inner and Outer London, and both London regions and the South East.

Figure 4.3


East Midlands - 76.5%
East of England - 80.1%
Inner London - 51.9%
North East - 88.6%
North West - 88.3%
Outer London - 53.4%
South East - 80.4%
South West - 86.6%
West Midlands - 84.5%
Yorkshire and the Humber - 83.9%
East Midlands
East of England
Inner London
North East
North West
Outer London
South East
South West
West Midlands
Yorkshire and the Humber

Annex 1: List of tables and figures

The following tables used in this publication are available in Excel format on the Department's website:

When reviewing the tables, please note the following:

We round numbers.	All percentages will be rounded to 1 decimal place, with all other values being rounded to either 1 decimal place or to an integer value, depending on context (large counts such as counts of groups of teachers, are rounded to the nearest 100, for example).
We have adopted the following symbols to help with identification.	Symbols are used in the tables as follows: . not applicable .. not available - nil or negligible
Totals for England do not necessarily equal averages for regions.	Because of the differing sizes of the ten regions and the number of schools within them, averaging of the regional values will not equal the national value for England, which is calculated directly from school-level data.

Annex 2: Details of methodology on teacher retention

Predictors included in the analysis

A full list of variables analysed Sections 3.2 and 3.3 can be found below:

- **Geography:** School's region, whether school is located in urban or rural area, deprivation of school's area (as measured by the Index of Multiple Deprivation; all quintilised and treated as categorical) and whether the school is located within 5 miles of the coast.
- **Basic school characteristics:** Phase, governance type, admission criteria, denomination and whether it has an executive head.
- **Characteristics of pupils in school:** Number of pupils**,** proportion of pupils eligible for free school meals, proportion of pupils with special educational needs, proportion of sessions missed by pupils due to absence, average prior attainment (all quintilised and treated as categorical).
- **School's educational performance variables:** Value added measures: KS2 VA for primary schools and Best 8 VA for secondary schools (all quintilised and treated as categorical).
- **Schools' Ofsted grades:** Overall effectiveness grade and a year-on-year change in overall effectiveness grade.
- **School's workforce characteristics:** Pupil-teacher ratio, ratio of teaching assistants to teachers (both quintilised and treated as categorical) and whether school has a new headteacher.
- **Teacher characteristics:** Age, gender, ethnicity and whether teacher has a record of more than 5 days of sickness absence in the previous year.
- **Teacher's contract:** Permanent or not, part-time/full-time, post and whether teacher is in receipt of a recruitment and retention allowance.
- **Teacher's career:** Whether teacher is an entrant into the profession, number of years since gaining qualified teacher status (QTS), whether teacher gained QTS prior to or after the age of 30 and QTS route.
- **Teacher's qualifications:** Highest level of qualification**,** degree class, being a Russell Group graduate, subject of degree (Physics, Science, Mathematics, English, MFL, STEM, Non-STEM EBacc, Non-EBacc) and holding a national professional qualification (NPQ) of any kind.
- **Subjects taught by teacher (secondary school teachers only):** Physics, Science, Mathematics, English, MFL, STEM, Non-STEM EBacc, Non-EBacc (these are not mutually exclusive), number of subjects taught, proportion of time

taught in one's 'specialism' (i.e. subjects in which the teacher holds a post A-level qualification; quintilised).

Regression analysis

The analysis in Section 3.2 also involves a technique known as **logistic regression**. Regression involves identifying the relationships between different variables, where one of those variables can be considered to be dependent upon all the others. This variable is known as the *dependent variable* (DV); all others are classed as *independent variables* (IVs). It is assumed that the independent variables do not affect each other, and so separate effects of each variable on the dependent variable can be assessed. In logistic regression, the dependent variable categorises data into one of two categories: for example, in this paper, the categories are 'stay teaching in the school funded sector' and 'leave the profession'. This means that the technique estimates the probability that the 'units of measurement' (in this case, teachers of various categories for different regressions) exhibit one of the categories of the dependent variable (in this case 'leave' or 'stay').

Logistic regression relies on a particular technique to identify the nature of the relationship between IVs and DV. It assumes that:

- The dependent variable is related to the probability of one category of the possible outcomes, e.g. probability of leaving the profession.
- The relationships between independent variables and the probability of leaving the profession are sigmoid, i.e. that a graph showing the scores on each variable, known as a *scatterplot*, will show that an S-shaped line will best describe the overall pattern of the relationship.
- The method attempts to make the 'transition part' of the sigmoid relationship (going from probability = 0 to probability = 1) as steep as possible so that there is a clear attribution of every value to one of the two outcome categories.
- The method used to derive these categorisations is *iterative*: one set of regression relationships is selected, and the likelihood of categorisation is assessed. The technique then selects another set of relationships designed to increase the likelihood of categorisation. This process continues until the increase in likelihood reaches a small criterion value. At this point, it is assumed that no changes will increase the likelihood of the categorisation and so the procedure settles on this final solution. This method is known as *maximum likelihood* estimation.
- In most cases, the probability metric used to assess the effect of each independent variable on the dependent variable is an *odds ratio*.
- An odds ratio represents the chances of one outcome occurring, compared to the probability of the other outcome. This is done by dividing one set of 'odds' by the other. If our DV measures probability of leaving the profession, then the odds ratio represents how many times more likely a teacher is to leave the school funded sector than to stay.

Multiple regression analysis.

When more than one independent variable (IV) is included in a regression analysis, the technique is known as multiple regression. In such an analysis, it is possible to determine the separate effects of each variable without the relationship being confounded by the effects of other variables.

Multiple regressions include a suite of IVs that all have an effect on the DV of interest. In multiple logistic regression, each IV is assigned a coefficient, which assesses the odds ratio for that IV/DV relationship independent of all other relationships in the data. The size of the coefficient represents the change in likelihood that a teacher will leave their school (for example) as the independent variable changes. The exact interpretation of the coefficients depends upon the type of independent variable. For discrete independent variables (a variable made up of separate categories), a different approach must be used, as it is not possible to calculate SD for discrete variables. Instead, each variable is assigned a 'reference category'. Coefficients for those variables then estimate increases/decreases in likelihood of a teacher leaving as the IV changes from the reference category to another category. Hence, there will be a coefficient for each category making up the variable (except the reference category). This also means that the reference category naturally has a 'coefficient' of 0.

The reference category for categorical variables can be automatically assigned or chosen by the analyst, and in this case we selected most of them. Each variable might have two or more levels: for example, a school can be either coastal or not coastal, but when looking at the school's geographical region, there are more than two options. Selection of the reference level for comparison is usually done in a way that makes interpretation more intuitive. For example, when looking at schools' coastality, and when the question we are trying to answer is whether teachers in coastal schools are more likely to leave than teachers in non-coastal schools, it would make sense to choose 'non-coastal' as a reference level for comparison. In cases where variables have ordered levels, the reference level will usually be one of the endpoints. For example, when looking at the Ofsted overall effectiveness grade, the levels are 'Level 1 – Outstanding', 'Level 2 – Good', 'Level 3 – Requires Improvement' and 'Level 4 – Inadequate', and in this analysis 'Level 1 – Outstanding' was selected as the reference level. However, there are variables that have neither an intuitive reference level nor ordered levels, such as geographic region. In this case, the selection is arbitrary and this needs to be considered when examining the outputs, as all results are presented relative to the reference level and a different level selection might change the model estimations. For each of the selected variables examined, the selected reference level is clearly stated.

The overall predictive power of each variable was evaluated using a measure called information value. This combines the frequency of each value of a variable with the respective in-system retention rate and produces a single measure of predictive power for each variable. Since the values fed into the calculation come from the estimated models, this measure already controls for the effects of the other variables in the model.

It should be noted that data from schools inevitably show an effect that causes a problem for any regression analysis: *multicollinearity*.

It is assumed that the IVs in a regression do not affect each other, and hence do not correlate. In real-life data, this assumption is often broken, as many measures of interest have complex relationships; this is especially true of schools data. In order to compensate for this problem, it is possible to use a technique known as *shrinkage* of the coefficients. This method reduces the problematic effects of multicollinearity, but it does so at the expense of reducing the size of the coefficients ('shrinking' them towards zero). So, where this method is applied, the coefficients are always slight underestimates of the real relationship they represent.

In this paper, a number of shrinkage methods were applied to the regression analyses (namely, 'lasso', 'ridge' and their combination 'elastic net').

To compare these methods for every group of interest, we calculated the generalization error, which is the expected prediction on an independent and unseen data set. This is a measure of how well the model will predict future data. The simplest kind of cross validation is the *holdout method*. The data are separated into two sets, the training and the testing set. The training test is used to find the model that best describes our training set, and then the model predicts the output values for the data in the testing set. The error between the true values and the predicted output values is used to evaluate the model. This kind of evaluation can have high variance and the evaluation may depend heavily on which data points end up in the training set and which end up in the test set. Thus the evaluation may be significantly different depending on how the division is made.

To improve the result produced with the holdout method, we used k-fold cross validation. In this method, the dataset is divided into k subsets at random and the holdout method is repeated k times. Each time, one of the k subsets is used as the test and the other k-1 subsets are put together to form the training set. Then the average error across all k trials is computed. The variance of the resulting estimate is reduced as k is increases. In this analysis 5-fold cross validation is used. Some groups had a small number of leavers in particular years and this would have resulted in a lack of representatives of all the different variables in that particular holdout, meaning the resultant model would lack predictive ability. To overcome this problem, we applied the Informative Oversampling method and we replicated the teachers who left the profession four times (so that each leaver appeared in the data set five times).This solved the problem of not being able to produce a 5-fold cross-validation.

To measure the model's accuracy we used the Brier score. The Brier score is a function that measures the accuracy of probabilistic predictions. The best possible Brier score is 0%, for total accuracy, and the least possible accuracy is represented by a score of 100%, which means that the predicted probabilities were inaccurate. The generalisation error then is calculated as the mean of the five Brier scores produced in each of the 5-fold holdouts during the cross validation process. In the latest data, the generalisation error of the chosen models for each of our groups of interest was 22% for primary school

teachers, 21% for secondary school teachers, 17% for primary school leaders and 18% for secondary school leavers respectively.

All the methods mentioned above produced similar results; therefore the 'elastic net' technique, combining the lasso and ridge regression with the same weight, was applied. It was neither too conservative nor too ineffective against the multicollinearity.

Classification tree analysis

The analysis in Section 3.3 splits up the data into groups with differing rates of in-system retention and school-to-school mobility using classification trees. This technique uses a simple algorithm to split a dataset into subsets (groups of people) who have similar retention rates and ensures these subsets are as homogenous (similar) as possible. The algorithm is iterative, meaning that after a first split has occurred, the groups are further split into similar groups using a different property variable, and so on until several criteria are reached. A few of these criteria are set by the analyst to ensure that the tree produces groups that are meaningful and not too small for interpretation.

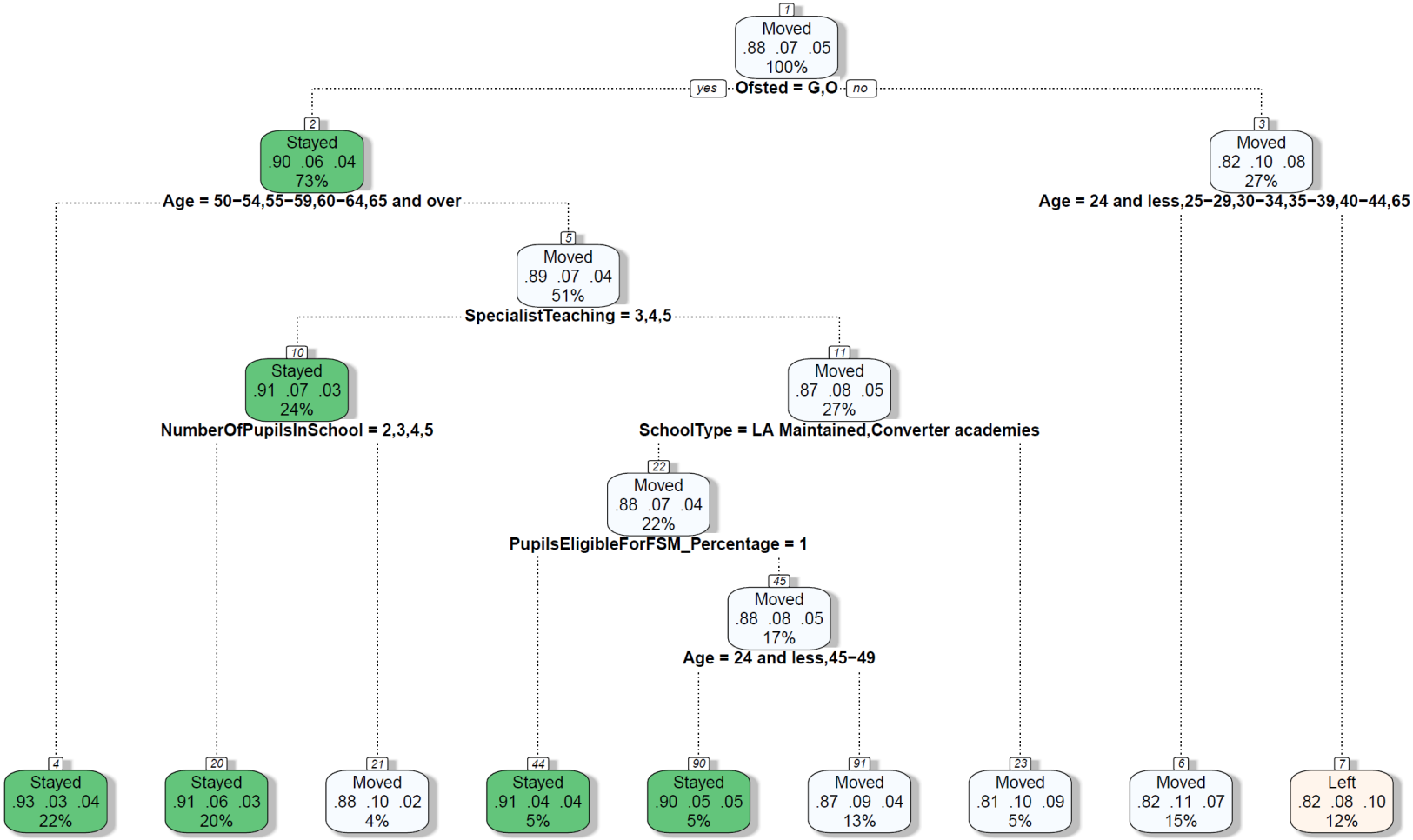
Parameter settings defined by the analyst comprise of:

- *Minimal size for split.* The minimum number of values in a node that must exist before a split is attempted. We set that criterion to be 500 for leaders and 2000 for teachers. This differs due to the different group sizes.
- *Max Depth.* Controls the maximum depth (number of levels) of the tree that will be created, which we set to be 10. It can also be described as the longest path from the tree root to a leaf (final node in a branch). The root node is considered to have the depth of 0.
- *Complexity (cp).* Complexity is used to establish a control level that determines whether a split contributes to a better model. Any split that increases the model fit by a factor greater that the defined complexity factor is attempted. We set cp to be 0.00001.
- *Loss matrix.* Weights the outcome classes differently. We apply different costs to different misclassification errors, with the misclassification of 'out of service' wastage and school-to-school mobility being penalised more. For example, the cost of misclassifying a teacher who 'moved' as 'stayed' is higher than the cost of misclassifying a teacher who 'stayed' as 'moved'.

The technique aims to split the dataset into groups that are as similar as possible on the outcome measures of interest. In other words, it maximises the difference between the groups it creates, while ensuring that the people within the groups are as similar as possible. Effectively, this means that the most important variables for driving (in this case) teacher retention measures appear at the top of the tree and lower branches contain less important factors (ones with less impact on retention rates). However, it is important to note that lower groups need to be interpreted carefully as the impact of a particular variable in one branch of the tree is not the same as the impact of the same variable in another branch. The categorisation that results from this technique is essentially a set of

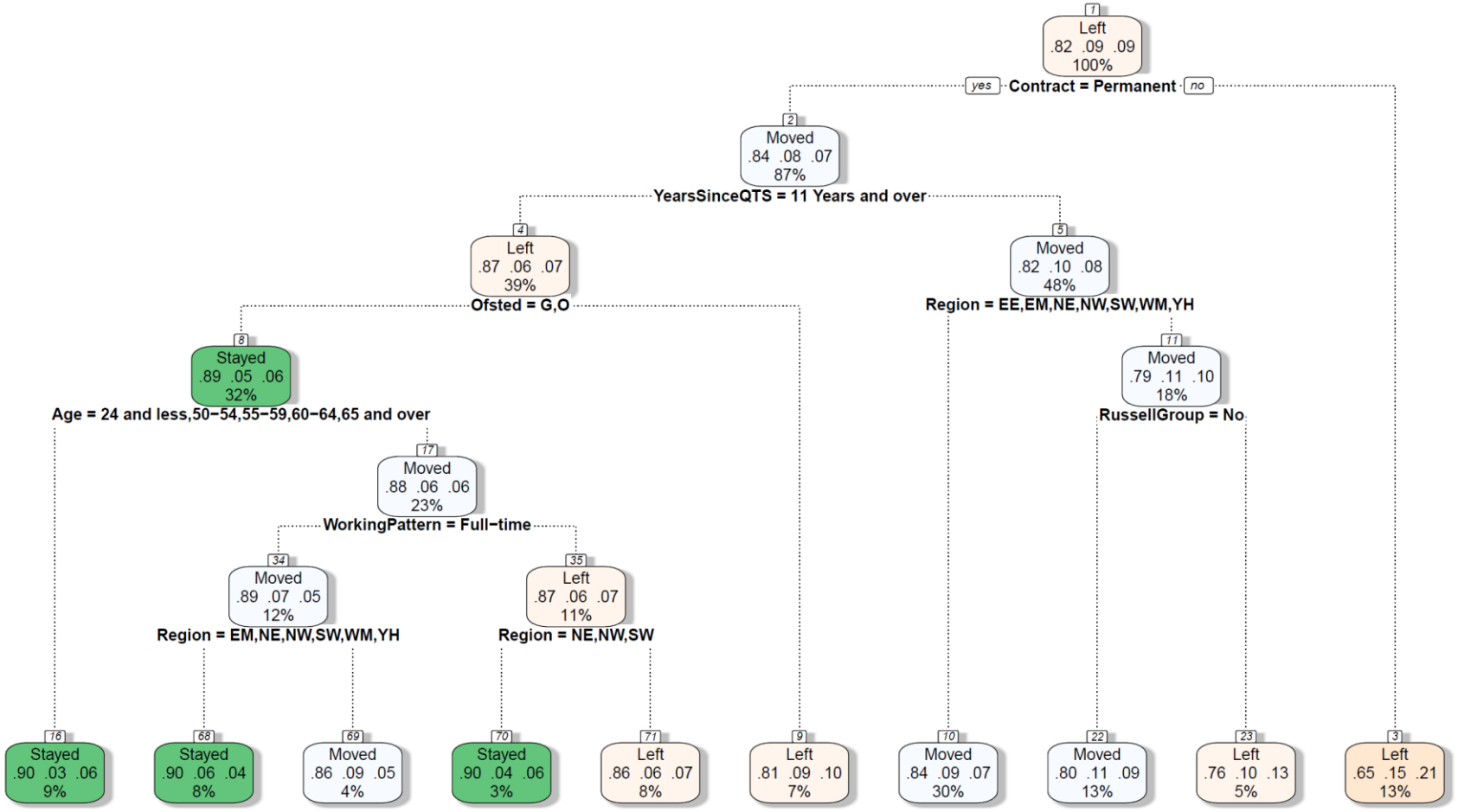
groups defined by a conjunction of properties, each group having similar retention characteristics.

Figure A2.1: Classification tree for secondary school leaders



Note: The chart is based on the two latest collections of the School Workforce Census. For an explanation of how to read the diagram see the text box at the beginning of Subsection 3.3. Ofsted grade covers four categories (O: Outstanding, G: Good, RI: Requires Improvement, I: Inadequate, 'Missing' indicates where the data is missing). Age is split into categories of 5 years. NumberOfPupilsInSchool is the FTE number of pupils in school, PupilsEligibleForFSM_Percentage is the proportion of pupils in school eligible for free school meals and SpecialistTeaching is the proportion of teachers' contact time spent teaching a subject in which they hold a post A-level qualification; all these variables were categorised into quintiles (from 1-lowest to 5-highest and the missing data was covered under -1). School type separates LA maintained schools, sponsor led academies, converter academies, free schools and a combined category of studio schools, university technical colleges and city technology colleges.

Figure A2.2: Classification tree for primary school teachers



Note: The chart is based on the two latest collections of the School Workforce Census. For an explanation of how to read the diagram, see the text box at the beginning of Subsection 3.3. Ofsted grade covers four categories (O: Outstanding, G: Good, RI: Requires Improvement, I: Inadequate, 'Missing' indicates where the data is missing).Age is split into categories of 5 years. Contract type has four categories (permanent, temporary, fixed-term and service agreement). YearsSinceQTS represents time since a teacher qualified: their 1st year, 2nd year, 3rd year, 4-5 years, 6-10 years, more than 10 years ('Years after'). WorkingPattern separates 'full-time' and 'part-time' teachers. RussellGroup='Yes' means that the teacher held a degree from a Russell Group university (and 'No' means they did not). Regions are coded as follows: IL: Inner London, OL: Outer London, SE: South East, SW: South West, EE: East of England, EM: East Midlands, WM: West Midlands, YH: Yorkshire and the Humber, NE: North East, NW: North West.

Annex 3: Subject Knowledge Enhancement

This section provides new information on the number of people undertaking Subject Knowledge Enhancement (SKE) in the academic year 2016/17.

SKE programmes give potential trainees the depth of knowledge needed to teach a priority subject and meet the Teachers' Standards. Schools and ITT providers can now select their preferred SKE provider, and choose to nominate them to receive funding on their behalf, or develop and deliver their own SKE. The SKE programme continues to be well used, with 39% of new entrants to ITT courses in eligible priority subjects supported by SKE in the academic year 2016/17.

Table A3.1 shows that SKE uptake varies by subject, with the largest (47% of all trainees) being in computing, modern foreign languages and physics. The lowest (21% of all trainees) was in geography.

Table A3.1: Subject Knowledge Enhancement by subject, 2016/17

	2016/17		
SKE Subject	**Total SKE Candidates**	**Total trainees in Census for SKE subjects**	**%**
Biology	397	1,352	29%
Chemistry	392	1,030	38%
Computing	230	492	47%
Design & Technology	99	420	24%
Geography	193	904	21%
Mathematics	1,196	2,586	46%
Modern Foreign Languages	669	1,432	47%
Physics	396	844	47%
All EBacc	3,473	8,640	40%
Grand Total for subjects above	3,572	9,060	39%

Sources:

Total SKE Candidates - NCTL Management Information

Total in Census - Table 1: Provisional data on PG ITT new entrants (including forecast new entrants) and training places by subject, Initial teacher training trainee number census 2016 to 2017

The SKE programme expanded in 2017/18 to include English as a new subject, in line with our commitment to supporting recruitment in priority EBacc subjects.

Department for Education

About this publication:

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