Economica (2007) **74**, 69–96
doi:10.1111/j.1468-0335.2006.00528.x

Recruiting and Retaining Teachers in the UK: An Analysis of Graduate Occupation Choice from the 1960s to the 1990s

By ARNAUD CHEVALIER,† PETER DOLTON‡ and STEVEN MCINTOSH§

†*University of Kent* ‡*Royal Holloway, University of London*
§*University of Sheffield*

Final version received 8 June 2005.

This paper examines the market for teachers in the UK from 1960 to 2002 using six graduate cohort data-sets. We find that, while there is no strong evidence that teachers are underpaid, the relative wages in teaching compared with alternative professions have a significant impact on the likelihood of graduates choosing to teach. This wage effect is strongest at times of low relative teachers' wages, or following a period of decline in those wages. It is also strongest for those individuals who have more recently graduated, and for men.

INTRODUCTION

Difficulties in recruiting teachers are prevalent in many countries. In the United Kingdom they remain a matter of continuing concern for public policy. The figures from the Department for Education and Skills can be interpreted as suggesting a shortfall in the supply of teachers of some 34,000 in England and Wales, divided approximately equally between primary and secondary teachers. Such a figure represents about 8% of the total teacher workforce (DfES 2004). Particular subjects, such as maths and the sciences, and particular areas, such as London and the South-East, have suffered severe shortages of teachers in recent years. Recent research has suggested that there is also a problem with the quality (or ability) of the graduates opting to become teachers. Moreover, the population of teachers in the United Kingdom is ageing. Within the next ten years, nearly 50% of current teachers will have retired.[1] Since the number of pupils is not forecast to decrease, at the current level of recruitment into teaching the supply shortfall is likely to become even more acute.

The demand for teachers is simply defined by the number of school-age children and the government's own desired pupil–teacher ratio (Zabalza *et al.* 1979). Clearly, if the government were willing to accept higher class sizes it could cut the demand for teachers immediately. In the current political climate, with numerous pressures on the government to cut class sizes and improve key stage examination performance, this option is unlikely to be adopted.

The main factor determining the level of demand for teachers, namely the number of children who require teaching, is outside the government's control. It would therefore appear that the most feasible route for reducing the excess demand for teachers is via an increase in their supply. The supply of teachers can be broken down into all those currently in teaching, plus those currently not teaching but qualified to teach,[2] and who would consider teaching if the conditions were right. The supply issues at stake are therefore recruitment

into teacher training programmes, the retention of trained teachers in the classroom, and the return of qualified but non-teaching individuals. In 2003 returning teachers represented about one-quarter of all entrants (DfES 2004). Frijters *et al.* (2004) note that in 2002 there were almost 240,000 qualified teachers in the United Kingdom who were not teaching.

Given the above, in this paper we focus on the supply of teachers. In particular, our aim is to investigate the occupational status of graduates a number of years after graduation, in order to identify the factors associated with the decision to be in teaching. Thus, we do not consider the original decision to invest in teacher training, but focus on choices made after graduation upon entry into the labour market. We cannot therefore separately identify factors associated with recruitment to the profession and retention in the profession, and so cannot differentiate between policies that affect these two aspects of teachers supply. What our analysis does is to identify the factors associated with being a teacher at a certain point in graduates' careers. Such factors may include relative earnings on offer in teaching and other careers, other labour market opportunities, and varying relative non-pecuniary conditions of work. To a certain extent, some of these factors can be controlled by the government, for example the earnings that teachers receive, and so public policy can influence supply.

Previous research on this topic has identified such determinants of teaching status. Higher wages received by teachers, often relative to some alternative wage, have consistently been identified as increasing the likelihood of individuals' teaching, or reducing the likelihood of teachers' exiting the profession (see Zabalza *et al.* 1979; Dolton 1990; Dolton and van der Klaauw 1995a,b, 1999; and Dolton and Mavromaras 1994 in the UK, and Stinebrickner 1998; Brewer 1996; Rees 1991; Mont and Rees 1996; Murnane and Olsen 1989, 1990; Theobald 1990; and Theobald and Gritz 1996 for the United States). The estimated impact of wages on the supply of labour to teaching is frequently large, with the exception of a recent study by Frijiters *et al.* (2004), which finds a lower impact. Other frequently observed results include the finding that wage effects are larger for men than for women. In addition, results generally show that teachers with higher-level qualifications, or living in areas with higher average non-teaching wages, are more likely to leave their teaching jobs. A limited number of studies have also considered the quality of teachers, with the general finding being that higher wages paid to teachers raises quality, whether measured by teachers' SAT scores[3] (Manski 1987; Ballou and Podgursky 1995; Stinebrickner 2001) or pupils' test scores (Hanushek *et al.* 1999).

The analysis presented here also considers factors associated with being a teacher, but builds on the existing literature in a number of ways. First, a number of cohorts of graduates from the 1960s to the 1990s are considered. The use of such multi-cohort data allows cross-cohort, rather than simple cross-sectional, analysis to be undertaken. Thus, as well as considering characteristics that vary across individuals within a particular cross-section, as is the case in most research, the multi-cohort data also allow a consideration of factors that are common to all individuals in a particular cohort but which have varied over time, such as the state of the graduate labour market, or the general level of teachers' salaries. A second source of value added in this paper is the use of recent cohort data, which have not as yet been used for the

research of teachers' labour supply. In particular, data are used from a survey of the 1995 cohort of graduates, questioned in 2002. Another feature of this paper is that it provides simulations of the impact of policies that vary teachers' wages. Finally, the paper includes a consideration of the teacher quality issue, with a new indicator of quality being proposed. The issue of quality among public-sector workers has been addressed by Nickell and Quintini (2002), who use childhood test scores to measure quality, and assess changes across two cohorts of individuals born in 1958 and 1970, respectively. Their results show, for males though not for females, that the average position of teachers in the overall distribution of test marks is significantly lower for the 1970 cohort, entering the labour market at the end of the 1980s, than it was for the 1958 cohort, entering the labour market at the end of the 1970s. This decline in quality of male teachers, so measured, over the 1980s is attributed by the authors to declining relative wage measures. In this paper therefore we investigate whether there is a decline in quality, using our own measure.

The focus of our analysis, however, will be on wages, reflecting the strategy adopted by the current UK government, which has increased the financial incentives to become and remain a teacher. It should be noted that non-pecuniary factors such as workload, job stress and physical surroundings, as well as individual preferences, are also likely to play an important role in the decision to enter teaching. Indeed, as reported in Smithers and Robinson (2003), such conditions are adversely perceived by current and potential teachers, which can have a real effect on reducing the supply of labour to teaching. Unfortunately, our data-sets do not contain measures of such working conditions, and so our focus is on more quantifiable determinants such as levels of remuneration.[4]

To provide a context for the discussion that follows, the evolution of relative earnings of teachers compared with average nonmanual earnings (T/NM) and national average earnings (T/ave) between 1955 and 2003 is reported in Figure 1.[5] The figure also shows at which point each of our cohorts of graduates are observed, i.e. a 1960 cohort in 1966, a 1970 cohort in 1977, a 1980 cohort in 1987, a 1985 and 1990 cohort in 1996 and a 1995 cohort in 2002.

The highest relative wages were paid to teachers in the mid-1960s, followed by a considerable deterioration in the period up to 1973. There followed a series of dramatic adjustments after the Houghton Report in 1974, and in 1980 the Clegg Commission recommended that teachers' pay had been allowed to decline too far. More recently, most of the 1990s saw a continuous decline in the relative wage of teachers, although to a less dramatic extent than the decline of the late 1960s and early 1970s. Since 2001, performance related pay has been introduced for teachers at the top of the pay scale. (See Burgess and Croxson 2001, or Dolton *et al*. 2003, for further details and evaluations of this scheme.) The figures for the most recent years since then suggest fairly flat relative wages. These fluctuations in the relative level of pay for teachers are important when interpreting the empirical results that follow.

The following sections describe the graduate cohort data-sets and outline the methodology used for analysing the supply decisions of teachers. The results of the statistical analysis are then presented in Section IV, and Section V uses these results to address policy questions, such as the effect of a 10% relative pay rise for teachers. A final section concludes.

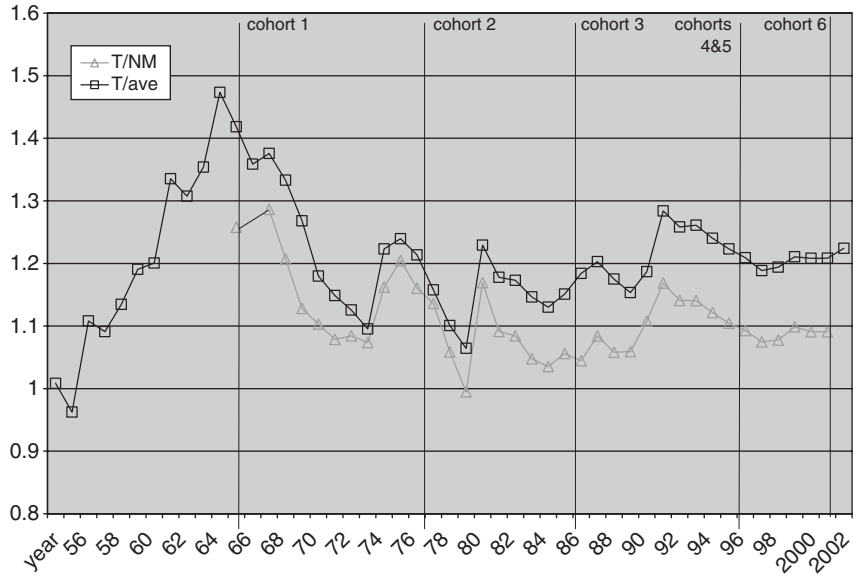

FIGURE 1. Relative wages and excess demand for teachers: 1955–2003

I. DATA

The data-sets used in this study provide information on six cohorts of individuals: those who graduated from UK higher education institutions in 1960, 1970, 1980, 1985, 1990 and 1995. We focus on graduates, since a teaching qualification is usually obtained after a four-year university degree in education or after a one-year postgraduate qualification following a university degree in any subject. Thus, teaching is competing with all other professional occupations open to graduates. Each cohort was surveyed approximately six years after graduation, apart from the 1985 cohort, for whom 11 years passed between graduation and the date of the survey.

The 1960, 1970 and 1980 cohorts have been used extensively. These surveys are nationally representative of the graduate population sampled from all universities. The more recent cohorts are also representative, but are based on a different sampling design, whereby individuals from a representative selection of institutions were contacted through their institution's alumni office. Comparisons across surveys are also complicated by the modifications to the higher education sector in the United Kingdom. From the mid-1960s until the early 1990s, two types of higher education institutions coexisted: universities and polytechnics, the latter providing a more vocational education. This distinction was abolished in 1992. Concomitant to this institutional change, the proportion of a cohort attending higher education has also increased dramatically over the period, from about 6% in the 1960s to around 35% in 2002, with the bulk of the increase occurring between 1988 and 1993.

The surveys provide data on a range of key variables, including standard labour market outcomes, which allow us to derive a measure of relative earnings in teaching. This is accomplished by computing, for all individuals, predicted wages in teaching and out of teaching. Additionally, the data-sets are also rich in

educational variables, allowing controls for A-level scores, subject and class of degree, type of institution attended and any higher qualifications obtained. Subject of study is an important control, since subjects such as engineering and science are particularly unlikely to lead to a teaching career because of the availability of other options for holders of such degrees. Similarly, postgraduate and professional qualifications should also open up new possibilities in the labour market, reducing the likelihood of an individual's teaching.[6]

The results for these educational achievement variables are potentially of as much interest as the wage impact results, since there is currently a fear that the most academically able graduates do not choose to become teachers. Interpretations of the results are, however, affected by the recurrent debate on the evolution of academic standards over time. For example, using degree results as a measure of graduate quality may not provide consistent standards through time, since the numbers achieving a first class or upper second class degree have increased from 28% in 1960 to 58% by 1995 (see Table A1 in the Appendix). At the same time, there has been an increase in the proportion of young people going to university, and the proportion of pupils acquiring A levels has increased dramatically over this period, raising concerns about the ability of the marginal candidate.

As a solution to this problem, we therefore developed two new variables designed to measure an individual's position in the ability distribution, based on their degree results and A-level results respectively, rather than simply relying on qualifications attained to signal ability. These new variables are used at various points in the analysis, instead of the use of actual grades achieved. To derive these new variables, it is necessary to know the proportion of the total population who acquire the two qualifications of interest, and the distribution of marks within the group of acquirers. Knowing a particular individual's results then allows us to identify that individual's position in the full population ability distribution. For example, if only 10% of the population acquire a degree, and of those only one-fifth achieve first or upper-second class honours, then only 2% of the population, assumed to be the top 2%, are obtaining such qualifications, and so the average position in the ability distribution of someone with such a degree is the 99th percentile; however, if 50% of the population acquire a degree, and of these two-fifths achieve a high-rated degree, then 20% of the population are obtaining such qualifications, and the average position in the ability distribution of someone with such a degree falls to the 90th percentile. In this way, the proposed measure of ability controls for both the increase in the numbers reaching a given academic level and the increase in the number of pupils obtaining better grades within each level. As the numerical example just given suggests, a general declining trend for these ability measures inevitably emerges for both A-level results and degree grades, as shown separately in Figure 2(a) and (b).

For present purposes, of greater interest than this general decline is the difference between the average position of teachers and non-teachers in the ability distribution. As Figure 2 makes clear, the relative position of teachers declined during the 1970s and 1980s, with teachers' lines falling below non-teachers' lines during these decades. This is the case for both the degree variable and the A-level variable, though particularly for the latter. The figures also make clear that the fall in the relative quality of teachers during the 1970s

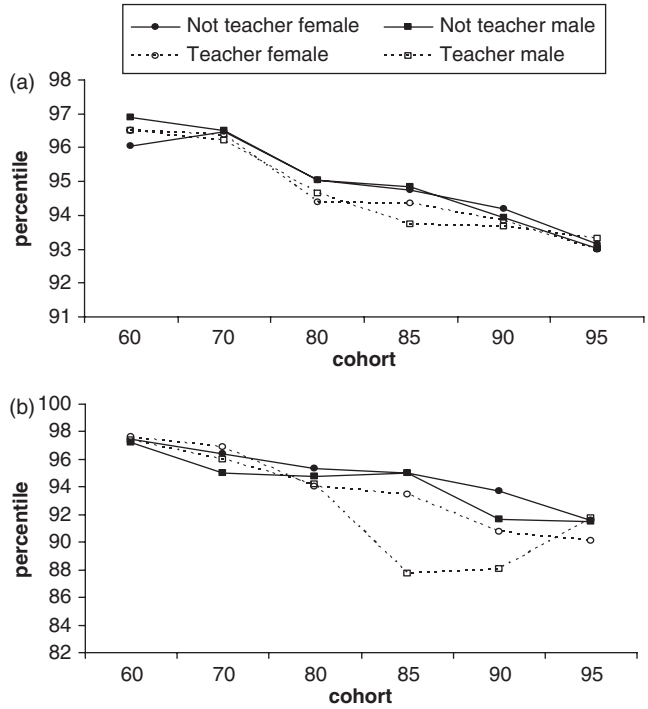

FIGURE 2. Difference in implied ability between teachers and non-teachers

(a) Measured by percentile position in the distribution of degree attainment
(b) Measured by percentile position in the distribution of A level attainment.

and 1980s was greater among men (squares) than women (circles). This finding is consistent with the results of Nickell and Quintini (2002). However, the figure also makes clear that, beginning with the 1990 cohort, the relative quality of teachers improved again, so that there was no difference in the quality of teachers and non-teachers among the 1995 cohort observed in 2002 (and therefore after the time-frame considered by Nickell and Quintini).

The remaining variables included in the analysis control for various demographic factors. In particular, we include variables for being a mature student, marital status, type of school attended and the socioeconomic background of the individuals' families. A dummy variable for whether the individual lives in the South-East, including London, is added to control for local labour market conditions, because of the vastly different labour market in this area of the country.[7] Additionally, in order to capture the labour market conditions at the start of their career, we include average unemployment and wages of teachers relative to other graduates by faculty of study. Finally, dummy variables indicating the cohort to which each individual belongs are used in the analyses conducted on the pooled data-set. The analysis is conducted for all graduates and also separately by gender, so as to capture the differences in alternative wages available to men and women.

Table A1 provides descriptive statistics separately by cohort and by teaching status. Annual wages have varied over time for graduates, but not in a

clear pattern. This may be due in part to differences in the time since graduation and the collection of the data. While the 1960, 1970 and 1980 cohorts report actual earnings, for the last three cohorts' earnings were reported as a categorical variable. Also, the earnings variable used is a real measure of earnings (1970£), deflated by the index of nonmanual earnings, which have grown more rapidly than the usual 'all earnings' or retail price index (RPI) deflators. Over the period, earnings for teachers are 22% lower than for non-teachers, although this difference is likely to be affected by the characteristics of the two populations, since most characteristics are significantly different between the two groups. For first job earnings there is a general positive trend, with the exception of the 1980 cohort, which entered the job market during the 1980s recession. This increase in real graduate earnings is consistent with increasing returns to degrees (Harkness and Machin 1999). Surprisingly, no starting wage differential is observed between teachers and non-teachers, which suggests that initial salaries for teachers are competitive.

The proportions of each cohort working as a teacher in their first job and at the time of their survey are also reported in Table A1. Almost 30% of the 1960 cohort had worked as teachers for six years after graduation, but in later cohorts this proportion fell to 11%–15%. Of course, this is due largely to the rapid increase in the number of graduates, which far outstripped the growth in the demand for teachers, implying that we should expect a lower proportion of a graduate cohort to enter teaching now, *ceteris paribus*. There is also inertia in occupational choice: 80% of graduates currently teaching were teachers in their first job. The probability of being a teacher actually increased with time in the labour market for the 1980, 1985 and 1990 cohorts.[8]

Differences in the background of the cohorts can be noted. In the earlier cohorts a male majority is found, but by 1990 this is no longer the case. The proportion of mature students has also increased over the period, from 7% to 16%. Both of these facts could be associated with an increase in the teacher supply, as, *ceteris paribus*, female and mature graduates are more likely to choose a teaching occupation. Despite the increase in the proportion of a cohort reaching higher education, graduates from the most favoured backgrounds (as measured by paternal social class and attending a private school) are still over-represented. Finally, a higher proportion of recent cohorts has graduated from a (former) polytechnic institution.

II. Empirical Methodology

We turn now to the estimation strategy used, which is similar to that used in Dolton (1990). That paper and Dolton (2005) provide a full description of the theoretical occupational choice framework that gives rise to the reduced-form estimation model we adopt here.[9] The key equation is a probit equation for whether or not graduates are currently in teaching. Algebraically, the equation can be represented as

$$(1) \qquad T_t = \beta_0 + \beta_1(\ln W_t^T - \ln W_t^a) + \beta_2 T_1 + \underline{\beta_3}\underline{X} + u_1,$$

where T_t is a dummy variable, taking the value of 1 if the individual is a teacher at time t, the time of the survey, and 0 otherwise. The key explanatory variable

is the relative wage that the individual can expect to earn at time t, expressed as the difference between the wages that could be earned as a teacher, W_t^T, and the wages that could be earned in an alternative job as a non-teacher, W_t^a. The variable T_1 takes the value of 1 if the individual's first job following graduation was as a teacher and 0 otherwise, and thus controls for possible inertia effects, e.g. that individuals are more likely to be teachers now if they originally chose to be teachers. Finally, the X vector includes all of the other variables discussed above.

The variable indicating those who chose to teach in their first job is clearly endogenous, and hence a reduced-form probit equation for choice of first job is estimated, and the predicted values are used in the estimation of the structural equation given above. To identify this equation, we rely on labour market conditions at the time of graduating, which should affect the first job choice but not the current job choice.

To obtain the wage variables, we estimate two wage equations, one for all current teachers and one for all non-teachers in the sample, and take the predicted values of these as the wages that individuals could earn at time t in the teaching and non-teaching state. Of course, we observe teachers' wages only for those who chose to be teachers, and we observe non-teachers' wages only for those who chose not to teach. It is therefore necessary to allow for this selectivity.[10] We therefore estimate a reduced-form version of equation (1), omitting the wage and first job choice variables, and then place the inverse Mills ratio from this equation into the estimated wage equations:

$$\ln W_t^T = \delta_0^T + \underline{\delta_1^T X'} + \sigma^T \rho^T \lambda + u_2, \tag{2}$$

$$\ln W_t^a = \delta_0^a + \delta_1^a \underline{X'} + \sigma^a \rho^a \lambda + u_2, \tag{3}$$

where λ is the inverse Mills ratio, and $\underline{X'}$ is a subset of the vector of variables in the occupation choice equation. In particular, the type of school and socioeconomic background variables are omitted from the wage equations, in order to provide the identifying restrictions for the selection equation. The choice of these instruments is determined principally by the available variables in the graduate cohort data-sets, and it should be acknowledged that they are far from perfect. Nevertheless, the results reveal that these variables have a significant effect upon occupational choice, while there is no theoretical reason for including them in the wage equations. Finally, $\underline{X'}$ also includes some variables that are not in the occupation equations but are frequently found in wage equations, namely work experience and its square, and part-time status. Since the wage differential variable, as well as the probability of teaching in the first job, is an estimated variable, standard errors calculated in the usual way would be biased. We therefore bootstrap the estimates (500 times) in order to get unbiased standard errors.

III. Factors Affecting the Decision to Work as a Teacher

This section describes the results of the empirical model described above. The analysis begins with the derivation of the predicted values for the endogenous variables in the current occupation choice equation, namely occupation choice

in the first job, and relative wages. These are derived from a reduced-form equation for first job choice and equations for wages earned by teachers and non-teachers, including a selection term into these states, as described in the previous section. Since the impact of the variables on first job choice are quite similar to those on current job choice, while the results in the wage equations are standard, neither of these preliminary stages will be presented here for reasons of space, though full details are available from the authors.

Mention should be made here of the identifying variables in these equations, however. Two sets of identifying variables are used in the first job choice regression: labour market conditions in the year of graduation, which are obviously specific to the first job decision, and social background, which is common to both periods. The former includes subject-specific unemployment rates and mean relative wages for teachers calculated, respectively, from the First Destination Survey and surveys from a sample of university alumni offices. Unemployment has a positive effect on the probability of becoming a teacher, although this is only marginally significant. Importantly, the effect of unemployment is seven times greater for women than for men, perhaps reflecting greater risk aversion or a lower set of alternatives for women when labour market conditions are poor. Relative wages of teachers were not found to have a statistically significant effect. The second set of restrictions is composed of the father's social class when the respondent was aged 14, and the type of school attended (whether private or public). Individuals from lower social backgrounds and those who did not attend a private school are more likely to choose the teaching profession.

As for the wage equation part of the model, the inverse Mills ratio from the selection equation, which was identified only from the social background variables, is found to be statistically significant in both the teacher and the non-teacher wage equations, revealing the importance of controlling for selection into occupations.

Our main results, however, relate to the choice of current occupation, as displayed in Table A2 in the Appendix. Of prime importance is the coefficient on the predicted wage differential variable (the predicted wage in teaching minus the predicted wage in non-teaching): the marginal effect in the final column reveals that a 10% rise in teacher earnings, relative to non-teacher graduate earnings, will increase the probability of an individual's becoming a teacher by 7.0 percentage points.[11] Given that the teaching probability ranges from approximately 10% to 15% (with the exception of the 1960 cohort), this is a very sizeable effect. However, the effect is much reduced when the sample is separated by gender: a change in the wage differential of 10% would increase the probability of being a teacher by 1.7 and 3.7 percentage points for women and men, respectively. As in the rest of the literature, the occupational choice of men seems to be more sensitive to the wage differential.

The other key variables of interest for this study are those measuring the A-level and degree scores of the graduates, which allow an investigation of the issues mentioned above relating to the quality of those graduates who choose to become, and remain, teachers. The results show that graduates with a first class or upper-second class degree are less likely to teach than those with lower degree classes, holding the other factors in the equation constant. However, the marginal effect is quite small (a 0.9 percentage point lower probability of

teaching), and is statistically insignificant. When the sample is divided by gender, the results suggest that quality is an important consideration for males but not for females, with top-scoring male graduates, but not top-scoring female graduates, being less likely to teach. This gender difference is consistent with the results of Nickell and Quintini (2002), described above. Among men, then, having a 'good degree' has an effect on occupational choice over and above the one resulting from its effect on earnings, and there appears to be some non-pecuniary cost to teaching for those males with a good class of degree. Perhaps such male graduates believe that their high-level skills are better suited to alternative employment. The other variables included in the equation to try to capture ability effects, namely the A-level scores of the respondents and whether they attended a university or polytechnic, are generally statistically insignificant when either first or current teaching status is considered, with the exception of A-level scores in the current occupation choice equation, which actually attract a positive and statistically significant coefficient in the pooled regression across both genders.[12]

We mentioned in the Introduction that the excess demand for teachers was particularly large in certain subject areas, such as maths and the sciences. The variables indicating subject of degree in the occupation choice equations allow us to analyse whether graduates in these areas are less likely to become teachers. Unsurprisingly, all of the subject coefficients are negative, indicating that graduates who studied for an education degree, which formed the omitted category, are more likely than those of all other subjects to enter teaching. However, the absolute size of the coefficients are larger for engineering, sciences and social sciences than for arts and languages, implying that graduates of subjects in the former group are particularly less likely to become teachers. Note also that the effects are smaller for men, suggesting that males are less likely to make a decision to become a teacher before joining university, whereas the dominant route into teaching for women is via an education degree. This result also relates to the fact that male teachers are much more likely to be found in secondary education, where individuals with non-education degrees are in high demand.

Considering postgraduate qualifications, individuals with PhD degrees are less likely to work as teachers. The effect of having an MSc is also negative, though much smaller in absolute size. Given that the opportunity cost of such postgraduate study is high, and that these qualifications are not required for teaching, it is not surprising that on the whole such individuals have followed the career paths implied by their higher qualifications, rather than gone into teaching.

Turning to the cohort effects, all cohorts are significantly less likely to teach than the 1960 cohort. The largest change in the probability of teaching seems to have occurred between the 1960 and 1970 cohorts, with a 7.7 percentage point fall in the probability of becoming a teacher, holding other things constant, between these dates. There was also a 4.2 percentage point fall in this probability between the 1985 and 1990 cohorts, but this could partially be due to the 1985 cohort being observed at a latter point in the life cycle. Thus, there appears to have been a trend away from teaching as a profession, even if other factors had not changed.[13] This trend is marginally more marked for women than for men, which indicates that alternative career paths have opened for

female graduates over time. The fact that relative wages in teaching have, on the whole, fallen over this period merely reinforces this trend away from teaching. Note that there is some evidence that graduates' decisions to teach are affected by the state of the labour market. The smallest cohort effect among the post-1960 cohorts is observed for the 1980 cohort, who entered the labour market during a very deep recession in the United Kingdom. Thus, the high levels of unemployment and subsequent lack of alternative employment may have persuaded graduates at this time to look for a job in a relatively recession-free profession such as teaching. As can be seen in Figure 2, this decision was taken mostly by graduates with lower academic credentials, thereby lowering teachers' average position in the ability distribution.

The remaining statistically significant effects in Table A2 suggest that men are about 3 percentage points less likely to teach than women, and that married graduates are 5 percentage points more likely to teach than single graduates, particularly women. There is some evidence that social class influences the decision to teach, as individuals who attended a private school, and those who came from a family with a professional head of household, are both less likely to choose teaching than state-educated and non-professional family graduates. Graduates living in London and the South-East are over 5 percentage points less likely to teach than individuals in other areas, even after accounting for wage differentials. This is most probably as a result of the wide range of alternative professional occupations available in London, compared with other areas, although it is also a possibility that working conditions in London's schools are perceived to be worse than in more provincial areas. Women's occupational choice is much more affected by regional variations than men's. Finally, the coefficient on the first job variable shows that, unsurprisingly, those individuals who initially chose teaching as a career immediately after graduation are more likely to still be teaching than those who chose an alternative first job; the difference in the probabilities are about 19 percentage points for men and 33 for women. Non-pecuniary benefits or individual characteristic traits that originally attracted graduates to teaching continue to have an effect six years later. The result also reflects the fact that the costs of switching occupations might be high.

These results, based upon the pooled data, describe the average impact of the explanatory variables on the teaching decision over the period covered. However, to exploit the usefulness of the series of graduate cohort data-sets more fully, we need to estimate the system of equations for one cohort at a time, in order to reveal how the impact of particular variables has changed over time.

The discussion here will again focus on the results of the current occupation choice equation, presented in Table A3 of the Appendix, rather than the preliminary stages in which the first job choice and wage equations are estimated. The variation in impact of relative wages across cohorts will be examined in detail in the next section. Considering the other variables, non-education—particularly engineering, science and social science graduates—are consistently less likely to teach in all cohorts. Those who were educated at a private school are also always less likely to teach. The impact of many other variables, however, differs across cohorts, revealing the importance of considering such cross-cohort data-sets. Some of these changes actually

suggest a resolving of some recruitment problems in the most recent cohorts. For example, one of the key variables in this analysis is graduate quality. The results suggest that, although graduates with a first or upper-second class degree used to be less likely to teach in earlier cohorts, among the 1990 and 1995 cohorts such graduates are more likely to teach. A similar change over time is observed for the impact of A-level scores.[14] If the quality variables used in Table A3 are replaced by the variables measuring position in the ability distribution, similar outcomes are observed. The 'quality problem' may therefore have become less of an issue among recent graduates, than it was in the 1980s when fears about the quality of teachers, as described by Nickell and Quintini (2002) and mentioned above, seemed justified. Similarly, difficulties of recruiting teachers in London may also be receding, since again the negative impact of living in London on choosing to teach, observed in earlier cohorts, is reversed among the 1990 and 1995 cohorts. Less favourably for the labour supply of teachers, however, is the result in Table A3 that the marginal effect of being a teacher in the first job has declined regularly over the period, and for the 1995 cohort is eight times smaller than for the 1960 cohort. This highlights one of the main changes in the supply of teachers: that retention of teachers has become more problematic.

Rather than discuss all of the other background characteristics and their changing influence over time, a useful way to summarize such effects is to calculate the probability of becoming a teacher for a person of fixed characteristics, and then to see how this probability has changed over time and as we vary certain characteristics. Thus, we define a base individual (individual 1) as a man, with an A-level score of 10, graduating in an arts subject at a university with a 2/1 or above degree and not living in London. The other characteristics of this individual will be held constant across all of our stylized individuals (see Figure 3 note). We then define another four individuals, who differ from individual 1 in having lower ability: A-level score $= 6$ and graduated with a 2/2 or below (individual 2); graduating in science (individual 3); living in London (individual 4); or a woman (individual 5). The predicted probabilities of being a teacher over time for these individuals are reproduced in Figure 3.[15]

For all types of individual, the probability of currently being a teacher has clearly declined since the 1970s. This is partly due to the dramatic expansion of higher education over the years. Hence what is of most concern to us in Figure 3 is the difference between our 'stylized individuals', rather than the declining probability over time. Across most of the period covered, individuals with lower academic results and women are more likely to be teachers than our base individual, while for individuals with a science degree or living in London the probability of being a teacher is lower.

Before leaving the discussion of the impact of the various characteristics on the teaching probability, one interesting question is the extent to which the changes in the characteristics of individuals have been responsible for the declining probability of teaching observed above in the raw data. We therefore set the estimated parameters to their 1966 values and, using the mean cohort characteristics in each cohort, predicted what the probability of being a teacher would have been for the mean individual if she had graduated in 1960. The results are depicted in Figure 4.

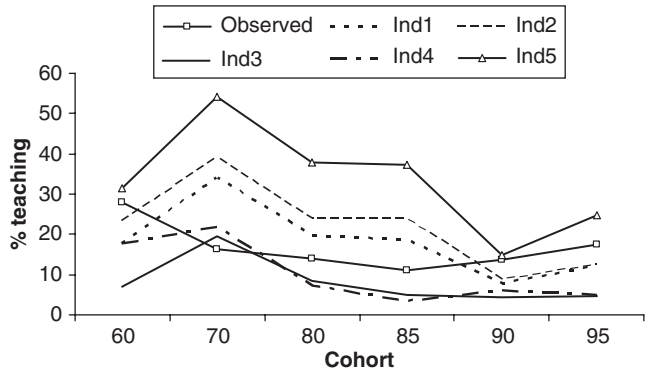

FIGURE 3. Predicted probability of being a teacher for different types of graduates

Note: Characteristics held constants for all individuals: university graduate, married, father in interim occupation, no other qualification, state funded school
*Ind*1: Man, arts graduate, A-level score = 10, 2/1 or above, not in London
*Ind*2: Man, arts graduate, A-level score = 6, 2/2 or below, not in London
*Ind*3: Man, science graduate, A-level score = 10, 2/1 or above, not in London
*Ind*4: Man, arts graduate, A-level score = 10, 2/1 or above, live in London
*Ind*5: Woman, arts graduate, A-level score = 10, 2/1 or above, not in London.

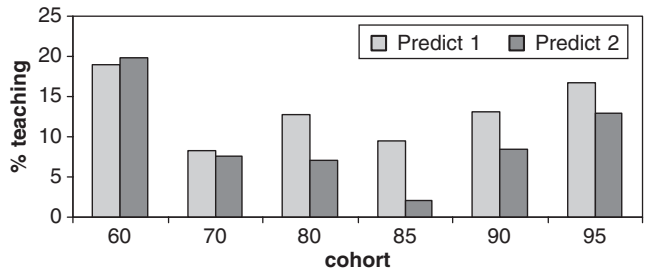

FIGURE 4. Predicted probability of being a teacher at 1960s cohort determinants

Note: Predict 1 based on a specification not including predicted 1st job teaching status nor predicted wage differential. Predict 2 is based on the estimates reported in Table A3.

For each cohort, we report two sets of predictions, the second of which is based on the estimates reported in the first column of Table A3 while the first is based on a regression omitting the predicted teacher status in the first job and wage differential. All cohorts have a resulting predicted proportion of teachers that is lower than the 1960 cohort, suggesting that changes in the characteristics of students would have led to a reduction in the probability of their becoming teachers, even if the environment (parameters) had remained at its 1960s values,[16]

Finally in this section, we report that an extended questionnaire for the 1995 cohort was available, and provided a greater number of potential instruments for the analysis of that cohort. For example, whether an individual's father had been a teacher is a potential exogenous determinant

of whether the individual herself would choose to teach, and was therefore included in the reduced-form first job choice and occupation selection equations, where its coefficient was indeed positive. Such an expanded instrument set did not significantly change the results, suggesting that the results obtained so far are not dependent upon the choice of instruments.

IV. Matching Estimates and Simulations of the Impact of Wages

This section focuses specifically on the impact of wages on teacher labour supply, because of its policy relevance. We begin by examining the extent to which teacher wages have lagged behind non-teacher wages over time, using both a linear model correcting for selection and the matching methods pioneered by Rosenbaum and Rubin (1983). In effect, what the latter method does is to find, for each teacher in the sample, the non-teacher who looks most similar on the basis of observable characteristics, and examine the difference in earnings. Specifically, we estimate the propensity of being a teacher. The technique offers an alternative identification strategy to determine the conditional difference in teacher/non-teacher pay. The technique simply conditions on all the observable characteristics and does not rely on exclusion restrictions or functional form to control for the underlying differences in the teacher and non-teacher sub-groups. Using different matching methods (nearest neighbour or Epanechnikov kernel) and calliper[17] gives us similar estimates, some of which are reproduced in Table 1. The table presents the mean current pay differential between teachers and their matched contemporaries. A negative estimate shows the percentage by which teachers earn less than a comparable group of non-teachers.

The top panel of Table 1 reveals that, while on average teachers are paid almost as much as non-teachers, this hides large differences by gender and cohorts. Female teachers are paid 10%–15% more than identical women in other professions, while the position is the opposite for men. Comparing cohorts, predictions based on the Heckman estimates presented in the second panel suggest that, for all cohorts bar the 1995 one, teachers are underpaid. However, this is no longer the case when propensity score matching is used. In fact, such results suggest teachers are paid *more than* individuals with similar characteristics in all cohorts except the 1980 and 1985 ones. The cohort of teachers who began their careers in 1980 earn 2%–4% less than similar non-teachers in 1986. This is most likely due to the five years (according to Figure 1) of declining relative wages that teachers had recently endured, giving them the lowest relative teacher wages at the time of survey of all the cohorts. The position for the 1985 cohort is interesting, given that they are observed at the same time (1996) as a later cohort of graduates from 1990. Although the latter group, with only six years' experience, earn more than similar non-teachers, the teachers in mid-career who have been teaching for 11 years are being underpaid by up to 10%. This comparison therefore highlights a further important dimension to the issue of relative pay: namely that such comparisons vary at different points in the career life cycle. As for the positive pay differential for teachers in the 1990s, this is consistent with Frijters *et al.* (2004), who report that during that decade teachers in the public sector earned about 22% more than in their transitional jobs.

TABLE 1
MATCHED ESTIMATES: CURRENT PAY DIFFERENTIALS BETWEEN TEACHERS AND SIMILAR NON-TEACHERS

Panel (a)	All cohorts	Female	Male
Wage differential	− 0.020	0.145	− 0.189
(Heckman)[b]	(0.001)	(0.001)	(0.001)
One to one match	− 0.006	0.118	− 0.114
	(0.020)	(0.026)	(0.019)
Kernel match	0.010	0.105	− 0.114
	(0.014)	(0.021)	(0.013)
% matched (.001)	98	97	98

Panel (b)	Cohort 60	Cohort 70	Cohort 80	Cohort 85	Cohort 90	Cohort 95
Year sampled	1966	1977	1986	1996	1996	2002
Relative wage (NES)[a]	1.41	1.21	1.15	1.22	1.22	1.21
Wage differential	− 0.076	− 0.134	− 0.262	− 0.894	− 0.043	0.082
(Heckman)[b]	(0.002)	(0.002)	(0.002)	(0.007)	(0.003)	(0.003)
One to one match	0.016	0.036	− 0.041	− 0.114	0.101	0.051
	(0.035)	(0.031)	(0.037)	(0.111)	(0.055)	(0.048)
Kernel match	− 0.001	0.028	− 0.020	− 0.104	0.121	0.063
	(0.030)	(0.025)	(0.026)	(0.102)	(0.048)	(0.039)
% matched (.005)	99	99	98	83	89	95

[a]Relative wage (NES): Mean wages calculated from the National Earning Survey: Teacher/national average
[b]Wage differential (Heckman): Calculations based on wage equation estimates described above.
Notes: Standard errors obtained from bootstrap (500). Propensity score function includes all the variables reported in the selection model.
The procedure was also conducted with larger callipers so that 100% of treated observations were matched; the estimated effects were remarkably similar to those reported above and are obtainable from the authors.

Given that there has been such variation in the relative level of teachers' earnings over time, it is interesting to examine how this variation has affected the numbers entering the profession at each point in time. Many authors researching the teachers' labour market have performed simulations using their data to answer questions concerning the potential effect of a pay rise on the supply of teachers. However, nearly all of these studies have performed such simulations at a given point in time. By using a series of cohorts, we are in the fortunate position of being able to carry out such simulations across time. The predicted probability of being a teacher is calculated for each individual from the probit coefficients estimated above, which included the estimated wage differential between teacher and non-teacher status and the probability of being a teacher in the first job, this later characteristic being assumed independent of the pay increase (Table 2). Teachers' relative earnings are then increased by 10%, with the change in the probability following this pay rise shown in the fourth row. Overall, and for all cohorts, we estimate that a 10% pay increase would raise the proportion of graduates becoming teachers by 9%. Men are more likely than women to react to an increase in teachers' pay,

TABLE 2
PROBABILITY OF TEACHING BEFORE AND AFTER A RISE IN TEACHERS' RELATIVE PAY

Panel (a)	Pool	Female	Male
Predicted probability of teaching before pay change	0.176	0.288	0.114
Predicted probability of teaching after 10% rise in teacher pay	0.264	0.303	0.165
Difference (Std dev.)	0.087 (0.051)	0.015 (0.006)	0.051 (0.036)

Panel (b)	Cohort 60	Cohort 70	Cohort 80	Cohort 85	Cohort 90	Cohort 95
Predicted probability of teaching before pay change	0.278	0.152	0.138	0.110	0.137	0.174
Predicted probability of teaching after 10% rise in teacher pay	0.296	0.185	0.244	0.125	0.268	0.238
Difference (Std dev.)	0.018 (0.009)	0.033 (0.021)	0.106 (0.077)	0.015 (0.013)	0.131 (0.087)	0.064 (0.035)
Implied extra teachers[a]	400	1666	9200	1523	14,734	12,434

[a]The implied number of extra teachers is calculated using the number of graduates leaving university (and polytechnics) in 1960, 1970, 1980, 1985, 1990 and 1995, i.e. 22,223, 50,494, 86,800, 101,515, 112,475 and 194,275 respectively.

since as already mentioned men's career choices are more sensitive to financial rewards. There are also large variations in the effect of a pay rise by cohort. For example, a 10% pay rise would increase the proportion of graduates becoming teachers by less than 2% for the 1960 and 1985 cohorts but by more than 10% for the 1980 and 1990 cohorts.

These findings are consistent with the national underlying trend in relative teachers' wages. The reason for the large potential effect in 1986 (for the 1980 cohort) is that the relative wage of teachers was at an historically low value of 1.15 against average earnings. Our suggestion for the 1996 effect (for the 1990 cohort) is that it has less to do with a low relative wage (1.22 against average earnings) but more to do with five uninterrupted years of declining relative wages. In this context, teachers were leaving the profession in large numbers and a large pay rise would have had a more marked effect. Note, however, that the 1996 effect is much smaller for the 1985 cohort than for the 1990 cohort, which were both surveyed in 1996. This is perhaps surprising, particularly as Table 1 reveals that the earnings of the 1985 cohort lag behind those of their non-teaching counterparts by more than any of the other cohorts. If we are arguing that wage increases have the largest effect on the decisions to teach when teachers' relative earnings are falling or low, why then do we not observe a large effect of earnings on the decisions of the 1985 cohort to teach?

We can hypothesize that this is due to the amount of time spent in the labour market at the point of observation by the 1985 cohort, i.e. 11 years as opposed to 6 of 7 years for all other cohorts, resulting in the observed teachers in this cohort differing in some unobservable ways from those in the other cohorts. For example, it may be that individuals who are still teaching in 1996, i.e. 11 years after graduating, at a time when teachers' relative earnings have declined for a number of consecutive years and at a point in their careers at which teachers' earnings are falling still further behind those of other graduates with similar job tenure, have a particular desire to teach, or are particularly suited to teaching, or have poor outside options. Varying wages may have little impact on the decisions to enter, remain or quit teaching among such individuals. Thus, we can argue that the effect of a wage increase will be most pronounced on the occupation decisions of recent graduates. Such varying impacts of a wage increase on individuals at different points in their life cycle highlights the difficulties in predicting the full effect of a pay increase for teachers on the total supply of teachers across all age and experience groups.

From a policy perspective, perhaps the most important question is not how the probability of remaining in teaching changes as wages rise, but how many extra graduates would be in teaching if the wage increase were adopted. Unfortunately, this is very difficult to answer, given that we have modelled the teaching decisions of only a small proportion of all the past graduates who could potentially still become teachers, and that we have modelled not the wastage of teachers over their career life cycle, but merely the teacher/non-teacher decision at given points in time. All we can approximately calculate is how many additional teachers there would be *among those who graduated in a given year*. We do this by simply multiplying the probabilities of individuals teaching by the known number of graduates in each of the years. Thus, for example, if relative teachers' wages had been 10% higher, an additional 12,000 of 1995 graduates would be teaching in 2002. This gives us some idea of how a recent cohort of graduates would react if relative wages were to rise now, although even this prediction must be treated with caution, based as it is on the behaviour of a cohort that graduated ten years ago. How older cohorts of graduates who have already chosen alternative careers would react to an increase in teachers' wages now is impossible to predict from the above analysis, although we can assume that the increased numbers choosing to switch into teaching would be a negative function of the duration on the labour market, since the results above for the two cohorts observed in 1996 suggested that experience reduces the likelihood of career switches among those already in work. Overall, however, it is impossible, based on the above analysis, to give a precise answer to the question of by how much would teachers' pay have to rise to generate the 34,000 extra teachers that would eliminate the excess demand for teachers.

Finally, as a robustness check, the whole model was re-estimated using two selected populations of graduates as being in the most likely alternative occupations for teachers. First, only teachers and other public-sector workers are considered, with the results reported in panel (a) of Table 3. Then, using the Quarterly Labour Force Survey, we identify the occupations in which qualified teachers are the most likely to work[18] and keep only graduates in these occupations for our analysis of the graduate cohort (panel (b) of Table 3). The

TABLE 3
CURRENT WAGE DIFFERENTIAL AND TEACHING STATUS USING ALTERNATIVE CONTROL POPULATIONS

Sample	Wage premium for teachers relative to comparison group	Impact of predicted wage differential on decision to currently be a teacher
(a) Teachers compared with other public sector workers only		
All	–0.044	0.419
	(0.002)	(2.757)
Female	0.027	–0.744
	(0.003)	(1.367)
Male	–0.101	2.591
	(0.002)	(0.998)
Cohort 60	–0.151	0.654
	(0.006)	(0.634)
Cohort 70	–0.117	1.238
	(0.004)	(1.571)
Cohort 80	–0.080	1.961
	(0.005)	(0.694)
Cohort 85	N.A.	N.A.
Cohort 90	0.015	2.596
	(0.006)	(2.252)
Cohort 95	0.111	0.840
	(0.006)	(1.658)
(b) Teachers compared with those in the most popular alternative occupations of qualified teachers		
Cohort 95	0.074	0.705
	(0.019)	(0.614)

Note: Expected wage differentials are modelled using the same specification as the base model described above, except the wage equations do not include selection terms. Standard errors are computed from a bootstrap with 200 replications. Results for the 1985 cohort were based on 398 observations and are not reported owing to the small sample size. The presented results are marginal effects from a probit on the probability of being currently a teacher.

table reports the estimated wage differential between teachers and the control group, and then the marginal effect of a change in the wage differential on the probability of being a teacher at the time of the survey.

As in the main analysis, we find that female teachers are paid more than they would be if they were to switch to an alternative public-sector job, while male teachers suffer from a large wage penalty. When looking at the separate cohorts, the wage penalty has been decreasing over time—so much so that for the most recent cohort teachers are paid about 11% more than they would be if they were to switch to another job in the public sector. The effects of changes in these wage differentials on the probability of being a teacher, presented in the last column, are large but imprecisely estimated. Focusing on the comparison group, which contains the most likely alternative occupations for teachers, in the lower panel, we again see a positive pay premium for teachers in the 1995 cohort and a smaller, though still large, impact of the relative wage on the

teaching probability. In general, these alternative control group specifications do not substantially alter the conclusions of the main analysis above.

V. Conclusion

At present the demand for teachers in the United Kingdom exceeds the supply by approximately 34,000 individuals. Given the limited control that the government has over the demand for teachers, mostly a function of the number of pupils, the best hope for narrowing this gap between demand and supply is to increase supply. Yet our results show that, with the exception of the recession years of the early 1980s, each cohort in our study has been successively less likely than the cohort before to choose teaching, holding other things constant. This trend shows signs of reversing with the most recent cohort, maybe as a result of current policies encouraging recruitment (grants, golden hellos) and retention (higher wages). However, the government still faces a shortage of teachers. The simplest way to reduce this shortage, if funds allowed, would be to relax expenditure limits and pay teachers higher wages, as we have seen that the supply of teachers is responsive to relative wages. The results suggest that, had teachers' relative pay been 10% higher in 2002, over 12,000 more graduates of the 1995 cohort would be teachers. What we cannot tell from our analysis, however, is the impact of a pay rise now on the current graduate cohort, as well as the effect on earlier graduates who have chosen alternative careers, or indeed on the quit behaviour of those who chose to be teachers. As a minimum, our results suggest that the extent to which a pay rise for teachers will solve the problem of shortage will depend on the state of the labour market at the time. More specifically, if relative teacher earnings are low (as in 1986) or if teachers have experienced several successive years of decline (as in 1996), then the potential for shifting a shortage by raising teacher pay is greatly increased. However, on the basis of the results for the 1995 cohort, there is no evidence that teachers are actually underpaid at present, using any of the above described methods for comparing teachers and non-teachers, and so the rationale for an across-the-board pay increase is somewhat reduced.

The other key results from this study relate to possible supply deficits in particular subjects and geographical areas. The results reveal that graduates in engineering, sciences and social sciences are particularly unlikely to choose teaching as a career. Even if earnings were the same, the alternative professional occupations available to such graduates would be likely to tempt them away from teaching if working conditions in teaching were not well regarded; the fact that wages are probably higher in these alternative professions simply acts to reinforce this propensity. The trend manifests itself in the well publicized lack of maths and science teachers. Theoretically, it should be possible to equate the demand and supply of teachers in each of the different subjects if the government were willing to allow, and could persuade the teaching unions to accept, the payment of different wages to different teachers. Again, however, the empirical results above cannot predict exactly what the wage differences between subjects would have to be to eliminate specific shortages, since our analysis has dealt with aggregates rather than specific sub-groups, owing to small sample sizes in the various data cells that define these groups. Tentatively, however, using the full sample across both

genders, the response to a 10% increase in teachers' pay is about 50% lower for graduates from engineering, science and social sciences than for other graduates.[19]

The final results of interest reveal some good news for the supply of teachers. There exist fears that it is difficult to recruit and retain teachers in London and the South-East, and fears that the quality of teachers is declining in all regions. The results presented here suggest that, while both of these fears may have been justified in the past, the results for the most recent cohorts studied here, i.e. the 1990 and 1995 cohorts, observed in 1996 and 2002 respectively, suggest that, *ceteris paribus*, individuals living in London and the South-East, and those who graduated with a first or upper-second class degree are actually more likely to be in teaching at the time of the survey.

Finally, it is worth repeating the point made in the Introduction: although this paper has concentrated mainly on wages as the policy lever to influence the supply of labour to teaching, in actual fact, when questioned teachers report that many things other than their remuneration can influence whether or not they want to continue in their work. Prime among these other factors at present is workload, while other factors could include physical surroundings, pupil behaviour, government involvement and bureaucracy. All of these factors need to be addressed, in addition to those identified in this paper, if the shortage of teachers is to be removed.

APPENDIX

Table A1 presents the summary statistics of our study. Tables A2 and A3 present the determinants of current teaching status, by sex and by cohort.

TABLE A1
SUMMARY STATISTICS

Cohort	1960	1970	1980	1985	1990	1995	Pool	
Year observed	1967	1977	1986	1996	1996	2002	Other	Teacher
Ln(current wage)	8.235	8.253	8.094	8.526	8.256	8.408	8.318*	8.100
	(0.516)	(0.394)	(0.408)	(0.523)	(0.407)	(0.403)	(0.481)	(0.356)
Ln(wage, first job)	7.757	7.828	7.662	7.976	8.084	7.900	7.824	7.809
	(0.439)	(0.337)	(0.345)	(0.412)	(0.378)	(0.320)	(0.403)	(0.368)
Teacher	0.279	0.153	0.139	0.112	0.138	0.159		
Teacher, first job	0.306	0.156	0.129	0.090	0.110	0.171	0.044*	0.801
Male	0.700	0.809	0.634	0.592	0.502	0.438	0.691*	0.417
First and 2/1 degree class	0.284	0.309	0.358	0.399	0.476	0.576	0.391*	0.301
A-level scores (out of 15)	9.635	8.287	7.718	9.113	7.412	9.458	8.626*	8.477
	(2.919)	(4.164)	(4.088)	(4.337)	(4.497)	(3.60)	(4.00)	(3.77)
Degree class distribution	96.74	96.46	94.96	94.73	94.01	93.08	95.36	95.33
	(1.24)	(1.47)	(2.14)	(2.29)	(2.57)	(2.62)	(2.40)	(2.14)
A-level distribution	97.32	95.41	94.83	94.61	92.23	91.36	94.79	94.90
	(2.35)	(5.26)	(4.85)	(7.82)	(9.34)	(4.17)	(5.28)	(5.63)
A-level score missing	0.014	0.094	0.071	0.093	0.148	0.159	0.067*	0.049
Professional qualification	0.136	0.195	0.221	0.299	0.220	0.174	0.228*	0.040
PhD	0.096	0.073	0.053	0.019	0.008	0.032	0.066*	0.015
MSc	0.049	0.065	0.068	0.131	0.098	0.094	0.080*	0.047
Mature student	0.071	0.055	0.070	0.100	0.161	0.165	0.087*	0.117
London and South-East	0.130	0.241	0.260	0.220	0.214	0.256	0.239*	0.108

TABLE A1
CONTINUED

Cohort	1960	1970	1980	1985	1990	1995	Pool	
Year observed	1967	1977	1986	1996	1996	2002	Other	Teacher
Attended a university	1.000	0.704	0.668	0.828	0.454	0.416	0.710*	0.723
Work experience	60.79	67.14	64.80	125.49	67.00	74.22	70.86	72.89
	(16.26)	(16.99)	(13.88)	(12.27)	(8.50)	(14.68)	(22.67)	(17.30)
Work part-time	0.049	0.018	0.019	0.069	0.038	0.062	0.031*	0.068*
Engineering	0.139	0.229	0.148	0.168	0.164	0.090	0.188*	0.019
Science	0.241	0.347	0.268	0.315	0.254	0.227	0.300*	0.228
Social science	0.172	0.252	0.269	0.262	0.299	0.354	0.281*	0.138
Language	0.112	0.098	0.081	0.104	0.072	0.044	0.074*	0.152
Arts	0.163	0.050	0.105	0.076	0.089	0.173	0.096*	0.184
Education	0.130	0.024	0.128	0.076	0.121	0.112	0.060*	0.277
Married	0.681	0.695	0.547	0.628	0.377	0.591	0.597*	0.640
Private school	0.211	0.273	0.113	0.206	0.153	0.207	0.207*	0.135
Dad: no skill	0.053	0.009	0.006	0.082	0.093	0.126	0.048	0.060
Dad: semi skilled	0.087	0.045	0.033	0.050	0.043	0.008	0.042	0.071
Dad: skilled manual	0.187	0.228	0.091	0.136	0.157	0.169	0.158	0.197
Dad: skilled nonmanual	0.265	0.142	0.267	0.079	0.084	0.080	0.173	0.212
Dad: interim occupation	0.216	0.397	0.422	0.301	0.293	0.356	0.346	0.287
Dad: professional	0.192	0.178	0.181	0.351	0.328	0.261	0.233	0.172
No. of observations	4877	4492	4782	1529	2312	2569	16870	3633

Note: standard deviations in parentheses for the continuous variables.
*indicates significant difference between teachers and non-teachers at the 95% confidence interval.

TABLE A2
THE DETERMINANTS OF CURRENT TEACHING STATUS

	All graduate	Female	Male
Male	− 0.034		
	[0.009]		
First and 2/1 class degree	− 0.009	− 0.006	− 0.015
	[0.006]	[0.014]	[0.004]
A-level score	0.004	− 0.001	0.002
	[0.001]	[0.002]	[0.001]
A-level score missing	0.010	− 0.035	0.009
	[0.012]	[0.022]	[0.016]
Professional qualification	− 0.112	− 0.176	− 0.061
	[0.018]	[0.050]	[0.008]
PhD	− 0.088	− 0.102	− 0.051
	[0.016]	[0.054]	[0.012]
MSc	− 0.036	− 0.056	− 0.022
	[0.022]	[0.034]	[0.017]
Mature student	− 0.024	0.026	− 0.031
	[0.013]	[0.036]	[0.010]
London and South-East	− 0.051	− 0.122	− 0.020
	[0.017]	[0.021]	[0.012]
Attended a university	0.002	− 0.014	0.011
	[0.020]	[0.015]	[0.013]
Cohort 70	− 0.081	0.022	− 0.039
	[0.013]	[0.014]	[0.004]
Cohort 80	− 0.091	− 0.058	− 0.037
	[0.014]	[0.043]	[0.009]
Cohort 85	− 0.072	− 0.042	− 0.033
	[0.011]	[0.046]	[0.008]
Cohort 90	− 0.117	− 0.078	− 0.046
	[0.010]	[0.059]	[0.009]
Cohort 95	− 0.108	− 0.064	− 0.046
	[0.011]	[0.041]	[0.006]
Engineering	− 0.176	− 0.225	− 0.086
	[0.013]	[0.027]	[0.018]
Science	− 0.158	− 0.187	− 0.047
	[0.032]	[0.091]	[0.026]
Social science	− 0.164	− 0.214	− 0.048
	[0.030]	[0.103]	[0.009]
Language	− 0.114	− 0.112	− 0.033
	[0.019]	[0.087]	[0.018]
Arts	− 0.114	− 0.125	− 0.037
	[0.022]	[0.102]	[0.017]
Married	0.049	0.049	0.013
	[0.014]	[0.011]	[0.010]
Private school	− 0.029	− 0.023	− 0.019
	[0.013]	[0.017]	[0.008]
Dad: semi-skilled	0.026	0.039	0.010
	[0.032]	[0.054]	[0.024]
Dad: skilled manual	0.007	0.007	0.004
	[0.016]	[0.028]	[0.016]

TABLE A2
CONTINUED

	All graduate	Female	Male
Dad: skilled nonmanual	0.002	0.018	− 0.003
	[0.014]	[0.026]	[0.014]
Dad: interim occupation	− 0.021	− 0.029	− 0.009
	[0.013]	[0.026]	[0.017]
Dad: professional	− 0.025	− 0.029	− 0.016
	[0.012]	[0.016]	[0.016]
Prob. teacher in first job	0.136	0.328	0.188
	[0.084]	[0.164]	[0.065]
Expected wage differential	0.741	0.166	0.365
	[0.148]	[0.107]	[0.045]
Pseudo R^2	0.254	0.211	0.229

Notes: $\text{Exp}(W(T = 1) - W(T = 0))$ is the expected wage differential for the individual between teaching and non-teaching occupation.
All standard errors are obtained by bootstrapping (200 replications).

TABLE A3
THE DETERMINANT OF CURRENT TEACHING STATUS, BY COHORT
(MARGINAL EFFECTS)

	Cohort 60	Cohort 70	Cohort 80	Cohort 85	Cohort 90	Cohort 95
Male	− 0.011	0.001	0.029	− 0.037	0.024	− 0.066
	[0.033]	[0.017]	[0.010]	[0.017]	[0.015]	[0.019]
First or 2/1	− 0.042	− 0.011	− 0.002	− 0.007	0.071	0.035
	[0.016]	[0.011]	[0.007]	[0.012]	[0.016]	[0.014]
A-level score	− 0.001	0.002	− 0.000	0.003	0.013	0.013
	[0.003]	[0.002]	[0.001]	[0.003]	[0.003]	[0.004]
A-level missing	–0.128	–0.005	− 0.033	0.040	0.139	0.051
	[0.035]	[0.024]	[0.009]	[0.048]	[0.053]	[0.124]
Professional qual.	− 0.194	− 0.070	− 0.043	− 0.013	− 0.040	− 0.045
	[0.026]	[0.019]	[0.010]	[0.016]	[0.011]	[0.019]
PhD	− 0.164	− 0.048	− 0.065	N.A.	N.A.	0.033
	[0.028]	[0.014]	[0.005]			[0.048]
MSc	− 0.115	− 0.017	− 0.030	− 0.002	0.213	0.010
	[0.022]	[0.018]	[0.011]	[0.016]	[0.056]	[0.027]
Mature student	− 0.032	− 0.029	− 0.051	− 0.017	− 0.019	− 0.033
	[0.024]	[0.018]	[0.006]	[0.018]	[0.018]	[0.017]
London	− 0.163	− 0.033	0.024	− 0.049	0.114	0.025
	[0.012]	[0.011]	[0.014]	[0.013]	[0.034]	[0.030]
University	N.A.	0.020	0.005	− 0.006	− 0.009	0.002
		[0.012]	[0.008]	[0.023]	[0.013]	[0.017]
Engineering	− 0.181	− 0.084	− 0.072	− 0.061	− 0.071	− 0.161
	[0.033]	[0.022]	[0.008]	[0.023]	[0.020]	[0.015]
Science	− 0.055	0.004	− 0.058	− 0.062	− 0.077	− 0.218
	[0.027]	[0.028]	[0.011]	[0.043]	[0.034]	[0.042]
Social science	− 0.040	− 0.015	− 0.065	− 0.067	− 0.099	− 0.319
	[0.030]	[0.026]	[0.012]	[0.038]	[0.040]	[0.076]

TABLE A3
CONTINUED

	Cohort 60	Cohort 70	Cohort 80	Cohort 85	Cohort 90	Cohort 95
Language	0.033	− 0.020	− 0.068	− 0.032	− 0.082	− 0.120
	[0.025]	[0.026]	[0.005]	[0.029]	[0.009]	[0.011]
Arts	0.018	− 0.022	− 0.029	− 0.036	–0.084	− 0.197
	[0.023]	[0.027]	[0.009]	[0.025]	[0.010]	[0.027]
Married	–0.038	0.028	0.036	0.018	0.016	0.077
	[0.014]	[0.010]	[0.007]	[0.011]	[0.012]	[0.017]
Private school	–0.038	− 0.003	–0.017	0.005	− 0.022	− 0.013
	[0.025]	[0.011]	[0.010]	[0.017]	[0.013]	[0.016]
Dad: semi-skilled	0.120	− 0.027	0.040	− 0.027	− 0.007	− 0.077
	[0.044]	[0.035]	[0.073]	[0.018]	[0.025]	[0.040]
Dad: skilled manual	0.058	− 0.016	0.049	− 0.010	− 0.028	− 0.021
	[0.033]	[0.037]	[0.071]	[0.020]	[0.013]	[0.021]
Dad: skilled non-manual	0.042	− 0.026	0.044	0.053	− 0.041	0.012
	[0.030]	[0.034]	[0.060]	[0.043]	[0.012]	[0.030]
Dad: interim occupation	0.032	− 0.044	0.016	− 0.001	− 0.031	− 0.038
	[0.032]	[0.037]	[0.049]	[0.020]	[0.014]	[0.021]
Dad: Professional	0.011	− 0.052	0.011	− 0.006	− 0.031	0.010
	[0.036]	[0.029]	[0.052]	[0.020]	[0.014]	[0.023]
Prob. teacher in 1st job	0.397	0.334	0.129	0.159	0.152	0.050
	[0.165]	[0.081]	[0.053]	[0.099]	[0.104]	[0.179]
Exp($W(T=1)$ − $W(T=0)$)	0.198	0.287	0.686	0.114	0.886	0.616
	[0.055]	[0.068]	[0.060]	[0.064]	[0.128]	[0.115]
Pseudo R^2	0.254	0212	0.315	0.350	0.388	0.318
Observations	4877	4492	4782	1502	2296	2569

Note: Exp($W(T=1)$ − $W(T=0)$) is the expected wage differential for the individual between teaching and non-teaching occupation.
All standard errors are obtained by bootstrapping (200 replications).

ACKNOWLEDGMENTS

We thank participants at various seminars whose comments have improved the presentation of this paper. We also thank Peter Elias for providing access to the 1995 cohort data-set. All remaining errors are solely our own.

NOTES

1. See Chevalier and Dolton (2005) for details on the calculation of the shortage and ageing of the teachers' population.
2. Prospective teachers have to be awarded a qualified teacher status (QTS) in order to become permanent teachers. Overseas-trained teachers can teach for four years before a QTS is required. QTS can be obtained through various routes but mostly through initial teacher training (ITT), of which the government controls the supply. In 2002/03 there were 17,790 available positions for all subjects (science and technology accounting for 2850 and 2500 respectively). ITT openings are not always taken up: the shortage of students was especially pronounced in the 1999s but has been reduced to about 6% in recent years, perhaps as a consequence of the introduction of grants. In 2003 shortages were the largest in religious education (− 18%), languages (− 16%), and maths and geography (− 14%). Moreover, Smithers and Robinson (2003) report that 88% of registered trainees pass the final

examination and only 59% teach a year after. After three years, only 53% of the original trainees are still in the classroom.

3. Whether teachers' SAT scores are an accurate measure of teaching quality has been a point of considerable debate. Rivkin *et al.* (2004), using panel data, find that individual teacher unobserved heterogeneity is an important determinant of pupils' achievements. However, it does not appear to be correlated with teachers' academic achievement.
4. In a related paper (Chevalier *et al.* (2004) we consider reported satisfaction with a number of aspects of working life, from data from the 1985, 1990 and 1995 Graduate Cohort Datasets used below. The results suggest that teachers are less satisfied than other graduates with key aspects of their jobs, such as pay and hours worked.
5. Data on earnings are available from two sources: the October survey of earnings and, from 1968 to 2003, the New Earnings Survey (NES). With respect to average earnings of all employees, the two surveys give similar estimates over the period when they are both in existence, and so the reported average earnings is a simple average of the two estimates. For specifically nonmanual earnings, the DfES's *Labour Market Trends* (formerly the *Employment Gazette*) reports an index based on the October Survey up to 1970, and from then onwards based on the NES. However, the resulting estimate is considerably above the estimate of nonmanual earnings supplied by the NES, and so in Figure 1 we display teachers' earnings relative to the nonmanual average only from 1968 onwards using the NES. We estimate the position relative to nonmanual earnings for 1966 (to gauge the situation for our first cohort), by adding the average difference between the October Survey and NES estimates of teachers' earnings relative to nonmanual earnings (approximately 20 percentage points), to the October Survey estimate of the relative position for that year.
6. The decision to invest in postgraduate studies, as well as the choice of subjects studied, is potentially endogenous to the decision to become a teacher; however, we do not deal with that issue in this paper.
7. More precise regional controls cannot be used consistently, as this is the only measure available for the 1970 cohort.
8. But note that for the 1985 and 1990 cohorts the change may be due in part to differences in data collection. While for other cohorts a full history is available, for these two cohorts only occupation one year after graduation is available, thus there is a potential for mismeasuring the teaching status in the first job for some graduates studying for a teaching qualification (PGCE) before going to the classroom.
9. The essence of the model is the maximization of lifetime earnings in different paths. In the static choice that we investigate, we essentially use starting wages (or current earnings) and growth in earnings to capture the whole lifetime profile of earnings in the different alternative occupations, thereby ignoring how earnings actually vary over the life cycle. This question is tackled in Dolton and Chung (2004).
10. Strictly speaking, wages are observable only for individuals participating in the labour market, and so a model of double selection could be computed. See e.g. Heimueller (2004) for a model of inter-sector wage differentials (private/public) correcting for selection into employment and sector selection. The first component is important in his case, as he looks at the full population, among whom a substantial proportion of non-participating individuals can be found. Among the population of graduates in this study, participation in the labour market is high, reaching at least 95%, so the bias introduced by not modelling participation is likely to be small. Additionally, there is no clear case for an identifying variable determining participation in the labour force but not wages.
11. Since the equation includes the probability of being a teacher in the first job, the interpretation of this and all other effects can be seen as the impact on the probability of remaining a teacher for individuals who were teachers in their first job, or the probability of becoming (and remaining) a teacher for those who were not in this occupation.
12. The analysis was also conducted using our measures of position in the ability distribution, and led to the same conclusions. These regressions are available upon request.
13. An alternative interpretation is that since the 1960s, given that the number of graduates has increased much more quickly than the number of teaching positions, we would naturally expect a fall in the probability of any particular graduate becoming a teacher. However, the continuing excess demand for teachers does not suggest that graduates are increasingly choosing an occupation other than teaching because of a lack of available teaching positions.
14. This increase in the relative quality of teachers in the 1990s and 2000s is consistent with the raw data presented in Figure 2.
15. For these calculations, we do not want to use the conditional estimated coefficients presented in Table A3, where the probability of teaching is conditioned on the predicted relative wage and the probability of teaching in the first job, because the characteristics considered are likely to affect relative wages and first job choice. Hence, to obtain the full effect of changes in the

various characteristics on the probability of teaching, we use the estimated coefficients from an unconditional probit, full details of which are available from the authors.

16. From the 1980 cohort onwards, a large gap in the two predicted probabilities is observed. Since the probability of being a teacher in the first job has remained relatively stable from the 1970s onwards, the difference in probabilities for each of these later cohorts reflects a deterioration in teachers' wages, thereby lowering the probability of teaching when factored into the model.
17. Calliper is the maximum difference in propensity score between a treated and a control observation that is allowed for a match to be completed. If no control observation is found within this maximum value, the treated observation is not used to compute the estimates. This problem of lack of common support is likely to generate bias. The percentage of used treated observations is reported in the final row of Table 1.
18. These are specialist manager, manager and proprietor in service industry, literary, artistic and sports professionals, and other associate professionals for males; and specialist manager, manager and proprietor in service industry, health associate professional, secretary/personal assistant and childcare for women.
19. Results available from authors on request.

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