October 2002/43
Issues paper
This report is for information

This report investigates how many academic staff will need to be recruited over the next 10 years. It estimates overall leaving rates, and particularly whether there will be a significant increase in rates, because of staff retiring. Findings show that, overall, current recruitment rates are sufficient to maintain current staff numbers. However, this varies by subject. Further, if staff numbers are to increase, there will need to be a marked increase in recruitment.

Academic staff: trends and projections

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Summary

What has been investigated?

1. In this report we address the question, 'what levels of recruitment for academic staff will be needed over the next 10 years?'. In answering this, we have to take account of two main aspects: the number of academic staff that will be required, and the future leaving rates that can be expected. The first aspect leads us to questions about the future scale of higher education activities, and the staffing levels they will require. These issues go beyond the scope of this report, so we have provided estimates of recruitment needs for a range of staffing levels.

2. The key task we have undertaken is to estimate overall leaving rates. In particular we have addressed the question as to whether the current age profile of academic staff is such that a growing number will be reaching retirement age, thus causing a marked overall increase in the leaving rate, the so-called 'demographic time-bomb'.

3. There is a closely related, but distinct, set of questions relating to the difficulties and costs of meeting recruitment levels. In this study, we have not attempted to assess these difficulties, though references are made to investigations which do.

Results

4. Our approach was firstly to see what has happened in the recent past, and then to construct projections through to 2010.

5. The time series between 1995 and 2000 of numbers of academic staff (lecturer grade and above) revealed a number of trends. We found that the proportion of staff on temporary contracts was stable at around 14 per cent. For staff on permanent contracts we found that over this period:

a. There was a 6.5 per cent overall increase in numbers over the five years.

b. In a few subject areas, numbers were decreasing. These were mathematics, physics, chemistry and engineering.

c. The proportion of staff on lecturer grades declined, while the proportion on professorial grades increased from 12 per cent to 17 per cent.

d. The proportion of staff aged 50 or over increased from 35 per cent to 41 per cent.

e. The proportion of staff who were female increased from 26 per cent to 31 per cent.

6. Staff numbers were then projected through to 2010, showing what would happen if the current promotion and leaving rates – specific to the age, sex, grade, subject area and research status of the staff, and the current recruitment profiles – continued into the future.

7. With these assumptions the projections indicate that:

a. The current age profile will not lead to a marked increase in the overall leaving rates; so current recruitment is sufficient to maintain current numbers.

b. The overall picture does not apply to all subject areas. Mathematics, physics and engineering will need to increase recruitment rates to maintain current numbers. This is to be expected, since with current recruitment levels the numbers of staff in these subject areas have declined in recent years.

c. The number of recruits required is very sensitive to any required growth in total numbers. So, for example, in order to achieve an increase in staff numbers of 1 per cent per annum, average recruitment rates over the next decade would need to increase by about 17 per cent above what would be required to maintain staff numbers.

d. The trend towards increasing proportions of staff in higher grades will continue.

e. The proportion of staff aged 50 or over will stabilise.

f. The trend towards increasing proportions of female staff will continue, reaching 37 per cent by 2010.

Conclusion

8. The current profile of academic staff does not, of itself, imply that higher overall recruitment rates are needed to maintain current staff numbers. Of course, any marked increase in leaving rates, specific to age and the other factors included in the modelling, would mean an increase in recruitment to maintain numbers.

9. If staff numbers are to increase, there will need to be a significant increase in recruitment rates. Given that universities and colleges already have problems recruiting staff, there are likely to be severe difficulties in increasing staff numbers unless specific measures are taken.

Further work

10. We plan to monitor rates of recruitment, promotion and leaving, and to update our projections. This should give an early warning of any departure from the trends we have identified.

11. Initial presentations of this work have generated interest and questions beyond the scope of the original inquiry. So, for example, having demonstrated that the proportion of professors who are females is likely to increase, we were asked whether similar changes might be expected in the number of professors from ethnic minorities. We plan to address these and other questions in further analysis.

Queries

12. Comments or questions about this study should be sent to: Mark Gittoes, tel 0117 931 7052, e-mail m.gittoes@hefce.ac.uk

Introduction

What has been investigated?

13. In this report we address the question, 'what levels of recruitment for academic staff will be needed over the next 10 years?'. In answering this, we have to take account of two main aspects: the number of academic staff that will be required, and the future leaving rates that can be expected. The first aspect leads us into questions about the future scale of teaching, research and other activities, and the staffing levels such activities will require. These issues go beyond the scope of this report, so we have provided estimates of recruitment needs for a range of staffing levels.

14. The key task we have undertaken is to estimate overall leaving rates. In particular we have addressed the question as to whether the current age profile of academic staff is such that a growing number will be reaching retirement age, thus causing a marked overall increase in the leaving rate, the so-called 'demographic time-bomb'.

Supply of academic staff

15. There is a closely related, but distinct, set of questions relating to the difficulties and costs of meeting recruitment levels. To assess the extent of problems in recruiting and retaining staff, and to understand the factors that can create difficulties, we have commissioned a series of surveys, with the Universities and Colleges Employers Association (UCEA), and the sector's representative bodies, UUK and SCOP.[1] In making an overall assessment of the situation, the results reported here and the outcomes of these surveys need to be taken together.

16. It would be helpful to have a better idea of the future supply of potential recruits to academic posts. To this end we looked at the number of students qualifying with doctorates, along with proxies for their 'quality',[2] and considered the trends in recruitment from overseas.[3] As far as we can tell from this limited analysis, there should be enough potential recruits, but the picture is far from complete.

17. The situation is further complicated if we consider the supply of staff to a particular institution rather than to the sector as a whole. Movement of staff within the sector, as well as local recruitment difficulties, can affect individual institutions. In order to plan recruitment at the institutional, or even departmental, level, a much more detailed picture is needed than is presented here. However, we hope that the results of this investigation can provide a context which may help institutions in assessing their own futures.

Age profile of academic staff

18. A key element in projecting future recruitment needs is estimating leaving rates. Potentially, an increase in the numbers of staff retiring could of itself produce an increase in the overall leaving rate. Such an increase could be driven simply through the ageing of staff in post without any change to the pattern of retirement.

19. The UK academic labour force has a high proportion of over 50s, and many have speculated that we are approaching a ‘demographic time-bomb’. The implication is that, even to maintain current staff numbers, we would need a dramatic increase in recruitment. Put another way, simply maintaining current recruitment levels would lead to a fall in staff numbers.

20. A study by Professor Brian Ramsden[4] found that academic staff in Australia, Canada, New Zealand and the US have a similar age profile to that in the UK. The position in Canada seemed to be the most extreme. The study concluded that there would need to be a two- to three-fold increase in recruitment rates to replace the large numbers of staff approaching retirement age in Canada, while at the same time achieving the required 20 per cent growth in staff numbers.[5]

21. These were the findings and speculations that led us to undertake this investigation. Contrary to our initial expectations, we found that the current age structure of academics in UK higher education institutions will not lead to an overall increase in leaving rates between now and the end of the decade.

Methodology

22. The investigation involved two sets of analysis: a time series of staff numbers since 1995, and a projection of staff numbers to 2010. Both used the same data source and essentially the same data definitions.

Data source

23. Data are drawn from the Higher Education Statistics Agency (HESA) individualised staff record. Information is collected annually for academic staff who have a contract of employment with a UK higher education institution (HEI), and whose research and teaching activity is 25 per cent or more of a full-time equivalent (FTE) person.

Selection of population for investigation

24. In this study, the population was further restricted to staff with an FTE of 40 per cent or more, on lecturer or equivalent grades and higher, and with permanent contracts. (For simplicity, we have referred to these staff as 'permanent academic staff' or as the 'core population'.) The reasons for these restrictions were in part practical. Creating the longitudinal database which underpins the projection analysis was only just possible for these core staff, and quite impracticable for others.

25. Fortunately, this core group is closest to the populations on which the international comparisons were made. Staff in this group are generally older than other staff included in the HESA coverage, so if there were a demographic 'time-bomb' it should apply to them more than the others. These permanent academic staff are also a critical group for management within the sector trying to ensure that they have the right staff levels.

26. We have provided statistics to set this particular group of academic staff in the context of the total population covered by the HESA record (see paragraphs 33-35).

Stages to the investigation: outline of the report

Time series: 1995 to 2000

27. We first explored the trends in staff number between 1995 and 2000 by looking at both head counts and FTEs of academic staff. The key results are reported in the section, 'UK academic staff: 1995 to 2000', paragraphs 33-55.

28. An introductory section, 'Academic staff and assistant academic staff' (paragraphs 33-42) presents key statistics for all staff included in the HESA returns. This gives the trends in short-term contracts and part-time employment.

29. The main section, ' Permanent academic staff – lecturer and above' (paragraphs 43-55) looks in more detail at this group of staff, by considering five attributes: age, sex, grade, subject area and research status.

Projections: 2000-01 to 2010-11

30. We then carried out projections to see what is likely to happen up to 2010-11. They were based on the assumption that the current promotion and leaving rates – specific to the age, sex, grade, subject area and research status of the staff and the current recruitment profiles – continue into the future. A description of the modelling and the results are set out in the section, 'UK academic staff: 2000-01- to 2010-11' (paragraphs 56-99).

31. The results of the modelling are grouped in three parts:

a. The consequences of continuing current recruitment, and the recruitment required to maintain current staff numbers (paragraphs 74-81)

b. The projected change in the profile of staff with respect to grade, age and sex (paragraphs 82-88).

c. The recruitment and cost implications of increasing the numbers of academic staff (paragraphs 89-99).

Conclusions and plans for further work

32. Our overall conclusions and plans for further work are set out at paragraphs 100-105.

UK academic staff: 1995 to 2000

Academic staff and assistant academic staff

33. This investigation has concentrated on permanent academic staff on lecturer grades and above who have an FTE of 40 per cent or more. However, research assistants and others on lower grades, as well as all staff without a permanent contract, are included in the HESA returns. In this section we provide some contextual information, relating the more senior permanent staff to other academic staff. We refer to academic staff on lecturer grades and above as 'academic staff', and those on lower grades as 'assistant academic staff'. Table 1 sets out the numbers and FTE of all the staff types included in the HESA returns.

Table 1 Numbers and FTE of staff included in the HESA individualised record

Grade	Contract	1995		2000	
		Number (%)	FTE (%)	Number (%)	FTE (%)
Lecturer and above	Permanent	62,896 (61%)	60,389 (65%)	66,985 (59%)	64,012 (63%)
	Non-permanent	9,461 (9%)	8,209 (9%)	11,160 (10%)	9,553 (9%)
Below lecturer	Permanent	1,276 (1%)	1,179 (1%)	1,590 (1%)	1,485 (1%)
	Non-permanent	25,599 (25%)	22,070 (24%)	29,276 (26%)	25,010 (25%)
Low activity		3,156 (3%)	836 (1%)	4,915 (4%)	1,286 (1%)
Total		**102,388 (100%)**	**92,683 (100%)**	**113,926 (100%)**	**101,346 (100%)**

Notes
All staff with FTE less than 40% are excluded from all categories except 'low activity'.
Staff in medical cost centres excluded.
Definitions used are set out in Annex A.
More detailed results are in Annex B, File 1.

34. The statistics in Table 1, and the figures and tables of historic data that follow, are census counts as of 1 December, with duplicate records removed. In general, they will not

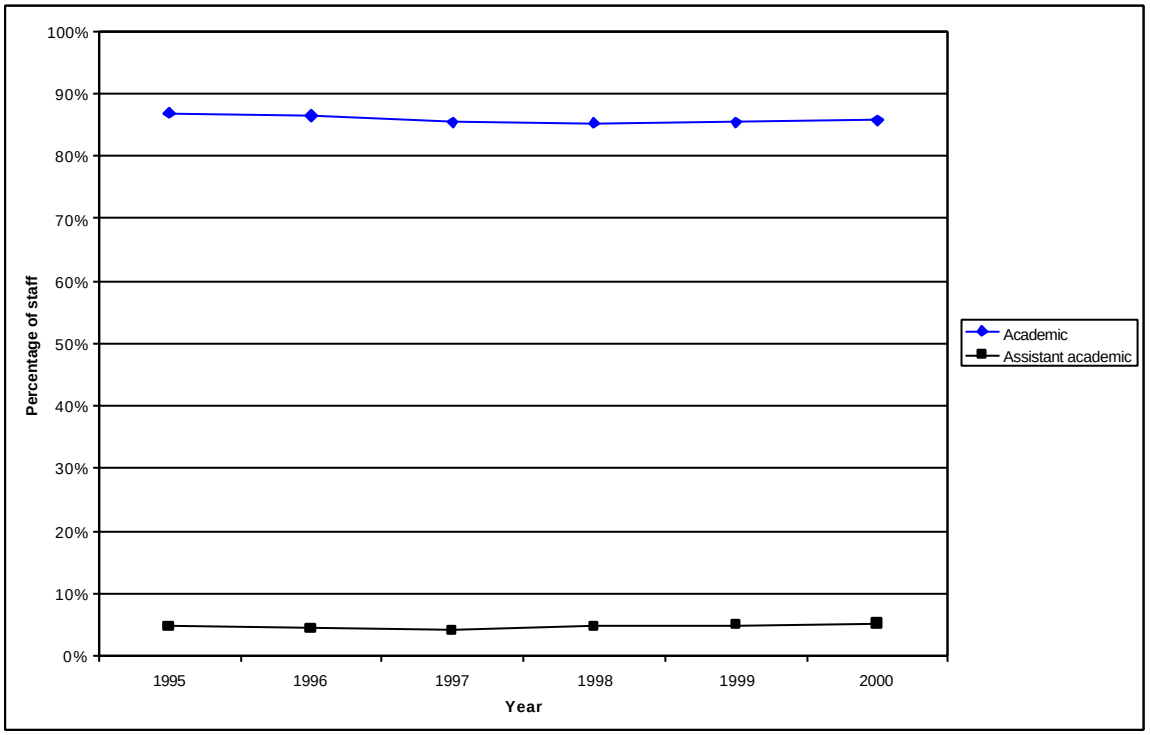
be the same as those published by HESA, which include all records apart from those returned as leaving before the relevant academic year.

35. Further, all staff returned with medicine as their academic discipline have been excluded. Some of these staff may have a contract of employment with the NHS rather than an HEI and, as such, are not part of the coverage of the HESA record. Initially, analysis and enquiries suggest that changes in staff contracts for these staff have made time series based on HESA records unreliable. Though the HESA record is available from 1994-95, uncertainties about the data quality for the first year of collection make it difficult to interpret in the context of a time series. Figures for 1994-95 are included with the detailed information at Annex B, though care should be taken in interpreting them. For full technical details, along with definitions of grades and other attributes, see Annex A. (All annexes are available with this report on the web, www.hefce.ac.uk under 'Publications'.)

Short-term contracts

36. Figure 1 below shows the proportion of staff who are permanent for both academic grades (lecturer and above) and assistant academic (below lecturer) grades.

Figure 1 Percentage of staff who are permanent



Notes

All staff with FTE less than 40% are excluded.

Staff in medical cost centres are excluded.

Definitions used are set out in Annex A,

More detailed results are in Annex B, File 1.

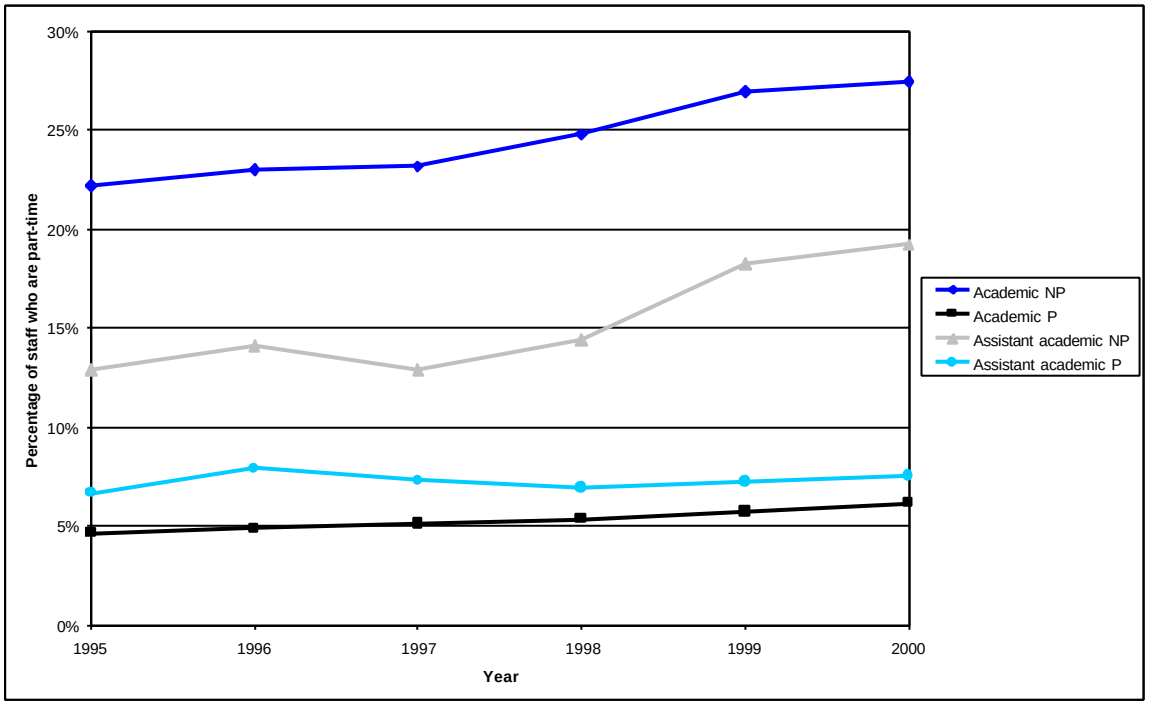
37. Very few assistant academic staff are on permanent contracts, and the 4-5 per cent shown in Figure 1 may be due in part to the uncertainties in assigning grades, or to data entry errors. Conversely, 85-87 per cent of academic staff are on permanent contracts. There was a small decrease in the proportion on non-permanent contracts between 1995 and 1997, but since then the situation has been stable.

38. There is considerable interest in, and some concern about, staff without permanent contracts. It would be interesting to know how many get a permanent position, and how many short-term posts they take before securing one. Unfortunately, we were unable to create secure links between the records relating to non-permanent staff, and are therefore unable to shed much light on these questions.

Part-time working

39. Figure 2 shows the proportion of part-time staff for academic and assistant academic grades and for those on permanent (P) and non-permanent (NP) contracts.

Figure 2 Percentage of part-time staff



Notes

All staff with FTE less than 40% are excluded.
Staff in medical cost centres are excluded.
Definitions used are set out in Annex A.
More detailed results are in Annex B, File 1.

40. In interpreting Figure 2 it should be noted that the numbers of part-time permanent assistant academics are small, and the decrease in the proportion from the peak in 1996 is not significant. Also, the large increase in the proportion of part-time non-permanent

assistant academic staff between 1998 and 1999 is mainly due to the return from one institution.

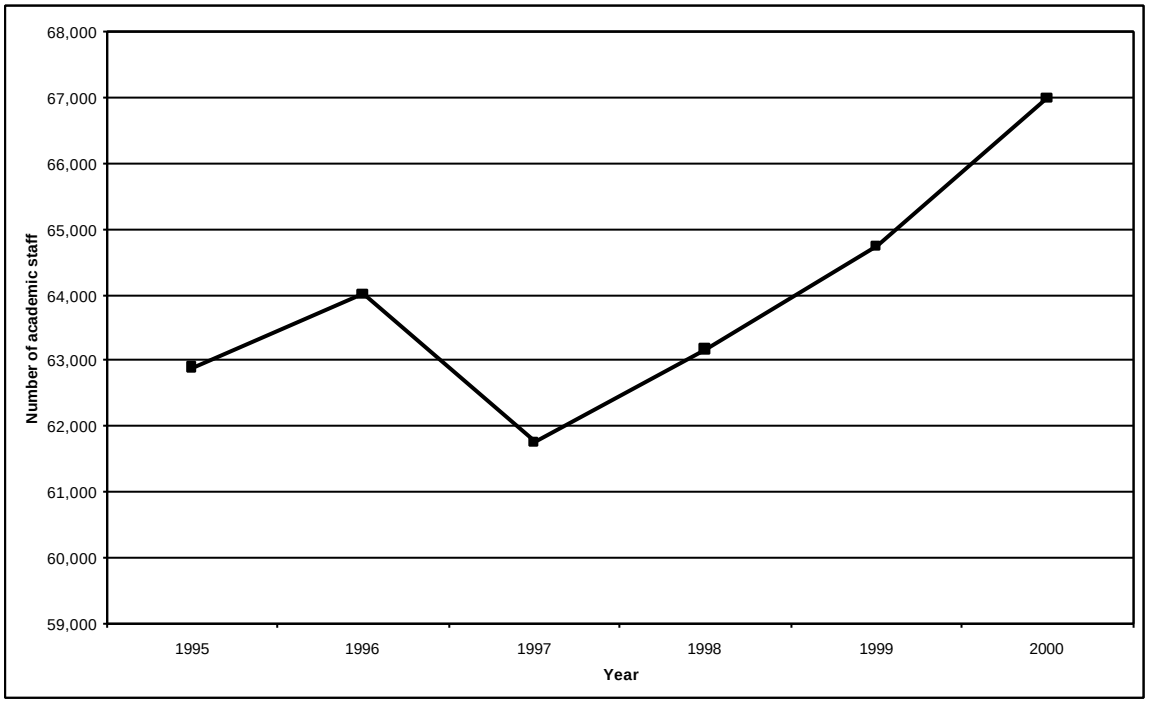
41. The overall conclusion is that full-time work still predominates, though the proportion of staff in part-time positions is increasing.

42. A breakdown by sex shows that these trends are common to men and women, and that the overall pattern shown in Figure 2 is not due to the growth in the proportion of female staff.

Permanent academic staff (lecturer and above)

43. Here we look more closely at the academic staff with permanent contracts – the core population. Figure 3 shows the numbers of these staff between 1995 and 2000.

Figure 3 Numbers of permanent academic staff: 1995 to 2000



Notes
All staff with FTE less than 40% are excluded.
Staff in medical cost centres are excluded.
Definitions used are set out in Annex A.
More detailed results are in Annex B, Files 2-5.

44. Figure 3 shows a steadily rising number of staff, with a dip in 1997. The reasons for this are unclear. It may be a result of the fall out from the 1996 Research Assessment Exercise (RAE) with, for example, some staff postponing retirement until after the exercise. However, as we shall see, this interruption of a general trend is common whether or not staff are associated with research.

Attributes of permanent academic staff

45. We considered five aspects of academic staff through time, along with some interactions between these aspects. The aspects are:

a. Research association – whether a majority of staff in the associated department attracted research funding after the 1996 RAE.

b. Subject – 17 groupings.

c. Grade – professor, senior lecturer or lecturer.

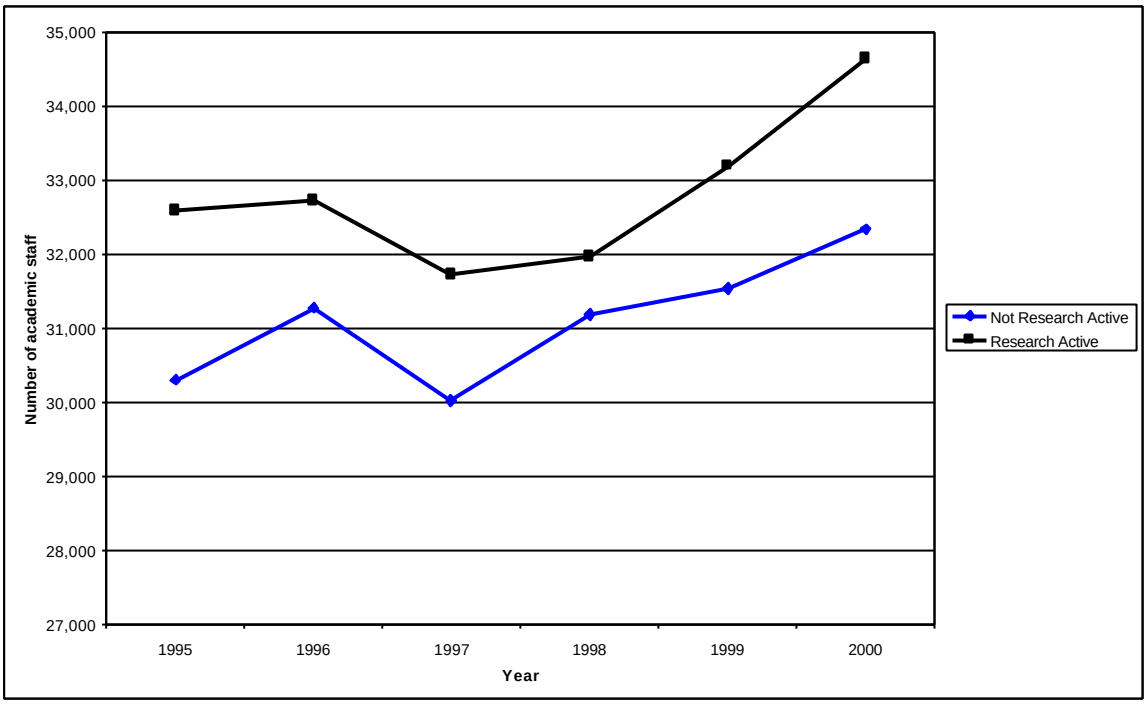
d. Age.

e. Sex.

Research associated

46. Staff are characterised as ‘research associated’ if they are returned to a cost centre in which we estimate that at least half the staff were submitted to a unit of assessment that attracted a rating of 3a or above in the 1996 RAE. This is a proxy for 'working in a research environment'. It is closely associated with the distinction between pre- and post-1992 universities. Thus while 89 per cent of permanent academic staff at pre-1992 universities are research associated, this is true of only 26 per cent of staff at other HEIs. Figure 4 shows the numbers of research associated, and non-research associated staff. It can be seen that the dip in numbers in 1997 applies to both groups.

Figure 4 Numbers of permanent academic staff by research association: 1995 to 2000



Notes

All staff with FTE less than 40% are excluded.

Staff in medical cost centres are excluded.

Definitions used are set out in Annex A.

More detailed results are in Annex B, Files 3-5.

Subject

47. Table 2 shows that the numbers of staff have increased within all subjects apart from chemistry, physics, engineering and mathematics. In these subjects demand for places from students has been weak. (We believe that the decline in numbers for 'unknown and combined subjects' reflects improvements in data quality rather than any real trend.) The exceptionally large rise in staff for subjects allied to medicine is the result of mergers between HEIs and nursing schools which took place over the period.

Table 2 Numbers of permanent academic staff by subject area: 1995 and 2000

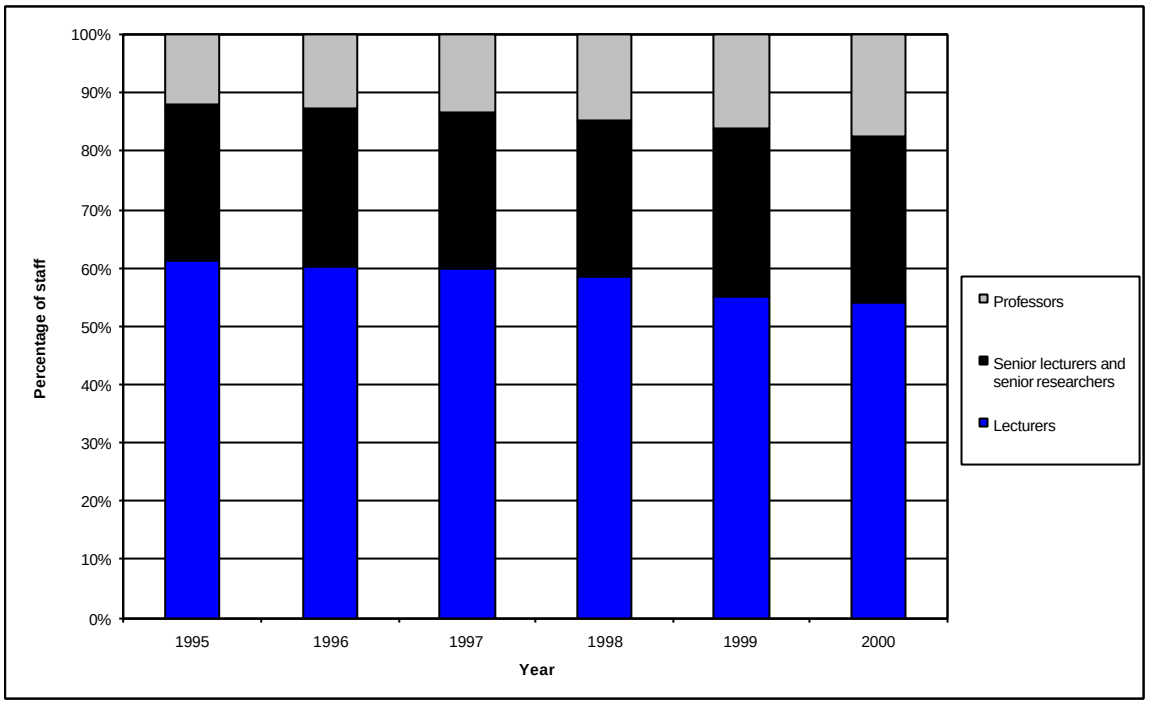
Subject	1995	2000	% change
Subjects allied to medicine	3,730	5,678	52.2%
Biological sciences	5,030	5,805	15.4%
Veterinary sciences, agriculture, etc	691	707	2.3%
Chemistry	2,058	1,960	-4.8%
Physics	2,225	2,167	-2.6%
Other physical sciences	1,603	1,846	15.2%
Mathematical sciences	2,768	2,637	-4.7%
Computer science, librarianship, information science	2,355	3,054	29.7%
Engineering, technology, building & architecture	7,215	6,524	-9.6%
Social political and economic studies	8,383	9,298	10.9%
Law	1,866	2,092	12.1%
Business and administrative studies	3,756	4,246	13.0%
Languages	4,815	4,921	2.2%
Humanities	3,841	4,183	8.9%
Creative arts and design	3,005	3,678	22.4%
Education	3,368	3,816	13.3%
Unknown and combined subjects	6,187	4,373	-29.3%
All subjects	**62,896**	**66,985**	**6.5%**

48. The proportion of research-associated staff depends on the subject (varying, in 2000, from 24 per cent in business to 79 per cent in physics), though this pattern has been stable over the time period. See Annex B for more details.

Grade

49. Figure 5 shows the movement towards higher grades. The proportion of professors increased from 12 per cent to 17 per cent, and of senior lecturers from 27 per cent to 29 per cent. The number of lecturers declined, both as a proportion, and in terms of absolute numbers (from 39,000 to 36,000).

Figure 5 Grade distribution of permanent academic staff: 1995 to 2000



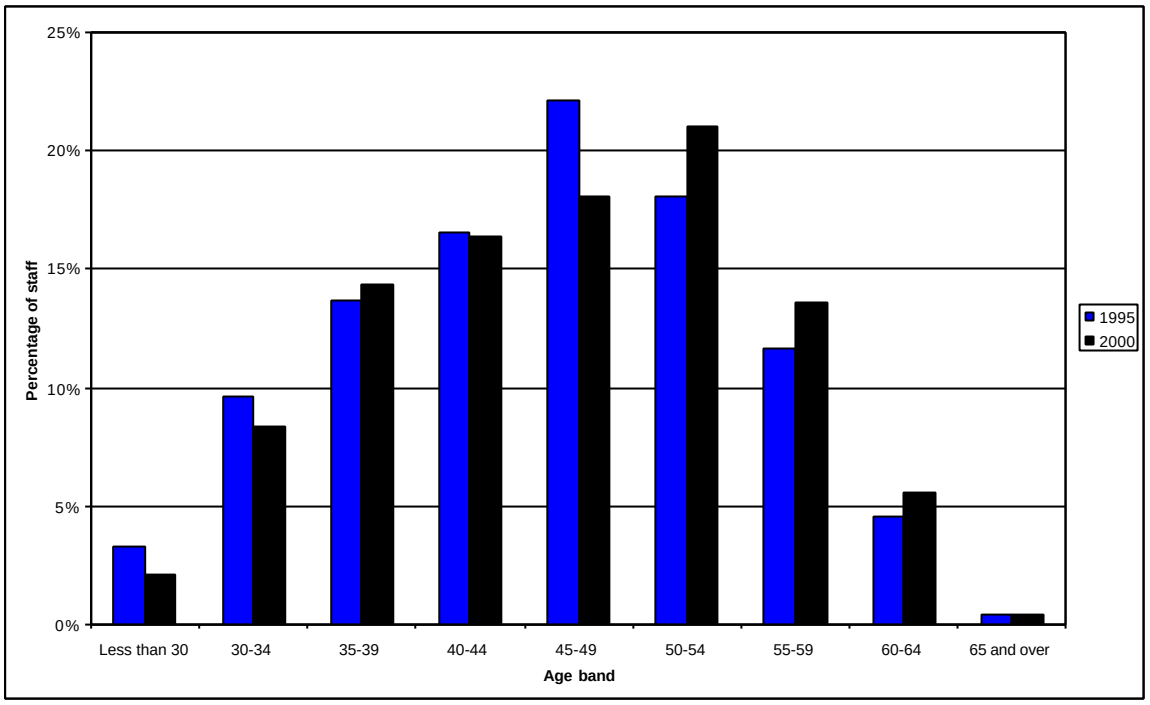
50. The grade distribution is associated with research status. In 1995 around 4 per cent of the non-research associated staff were professors, compared with 19 per cent of research-associated staff. By 2000, the proportion of professors in non-research associated staff had more than doubled to 9 per cent, while the proportion of research-associated staff had risen to 25 per cent.

51. There are also large difference in grade structures across subjects. In 2000, the percentage of professors in art and design was 7 per cent, whereas for physics it was 29 per cent. Over the time period, all subjects saw a growth in the proportion of professors, and the relative position of the subjects was largely unchanged, except for subjects allied to medicine. For this subject group, the proportion of professors fell over the first two years, and by the end of the period was only slightly higher than at the beginning. This can be explained by the fact that this subject grew through mergers with nursing schools, which had their own distinctive grade structure. Full details are at Annex B.

Age

52. Figure 6 shows the age profile of academic staff. The change over the period is complicated. The proportion of staff over 50 has increased, but so too has the proportion of those between 35 and 39. It is, of course, the number of over 50s that will largely determine leaving rates, due to retirements over the next 10 years, so the observed trend is consistent with the view that overall leaving rates will increase.

Figure 6 Age profile of permanent academic staff: 1995 and 2000



53. The overall age profile in Figure 6 is an aggregation of quite different age profiles for different subjects. For example, in 1995 chemistry staff had a particularly old profile, with many due to retire. By 2000 this had happened, and these older staff were replaced by recruits, increasing the proportion of staff in their 30s. Figure 7 shows the change in the age profile for chemistry. (Note that the age profiles for all years and all subjects are included at Annex B.)

Figure 7 Age profile of permanent academic chemistry staff: 1995 and 2000

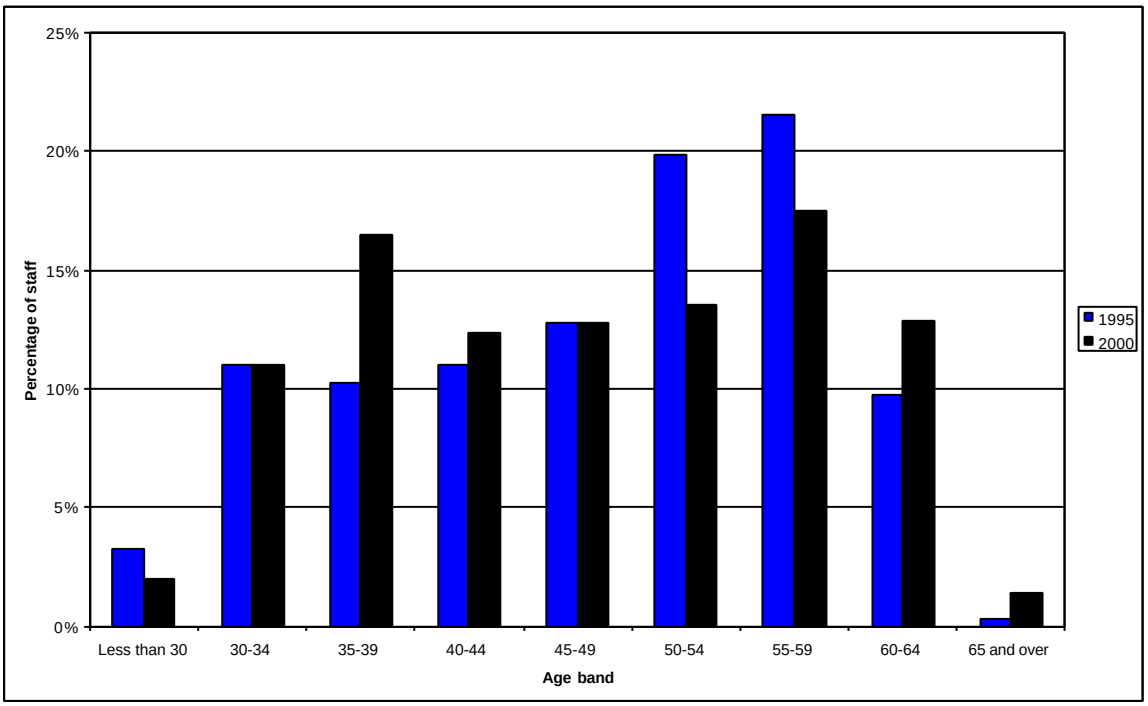
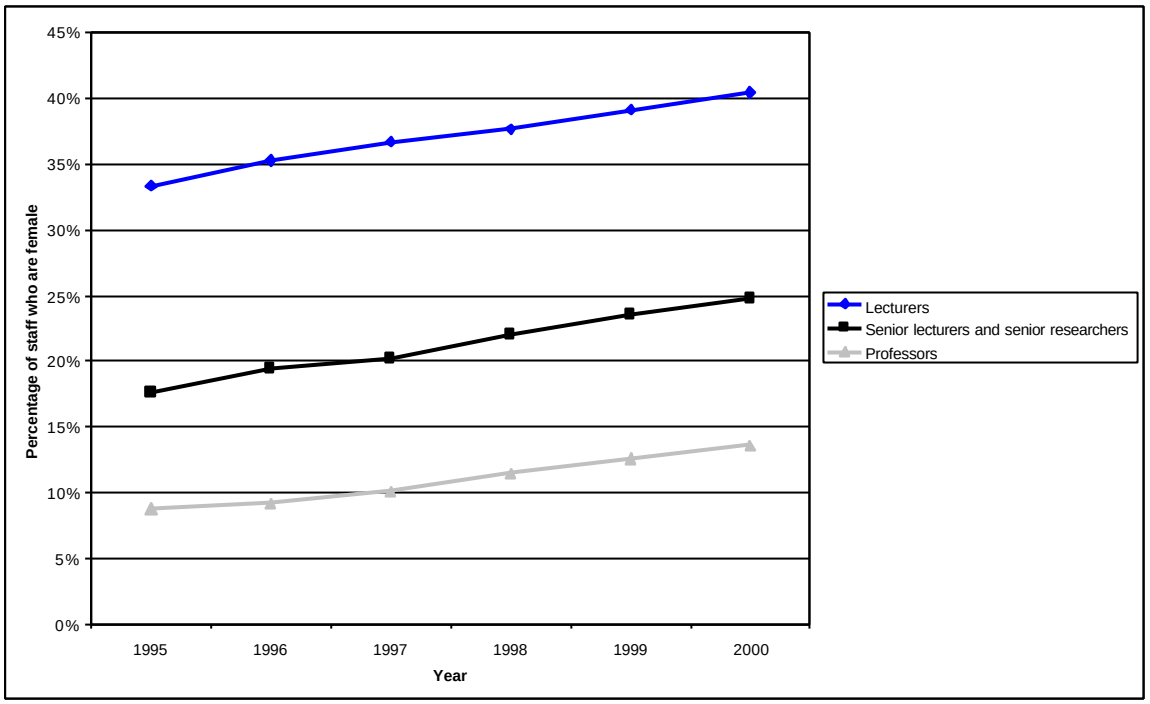


Figure 8 Percentage of permanent academic staff who are female, by grade: 1995 to 2000



Sex

54. Figure 8 shows the percentage of permanent academic staff who are female, by grade. For all grades the percentage of female staff has been increasing. This is due to the greater overall growth in numbers of female staff over the period. The growth has been particularly marked for the higher grades. For example, the numbers of female professors grew by over 140 per cent between 1995 and 2000, though this was from a low base of 653 in 1995. Table 3 shows the growth figures across the grades, for male and female staff.

Table 3 Growth in numbers of male and female permanent academic staff between 1995 and 2000

Grade	Growth 1995 to 2000	
	Males	**Females**
Lecturers	-15.8%	14.1%
Senior lecturers	2.9%	58.6%
Professors	48.0%	141.5%

55. The distribution across subjects is different for men and women. The percentage of female staff in 2000 varied from 7.5 per cent for physics to 58.5 per cent for subjects allied to medicine. However, all subjects saw substantial growth in the proportion of women. Full details are at Annex B.

UK permanent academic staff: 2000-01 to 2010-11

56. The trends in numbers of permanent academic staff between 1995-96 and 2000-01 show an increasing proportion of staff over 50. Given that this trend cannot continue indefinitely, the next question is what will be the recruitment levels and staff numbers in the future.

57. To answer this question, we took a population with the same attributes as used in the historical analysis, that is staff with an FTE of 40 per cent or more, on lecturer and equivalent grades or higher, and with permanent contracts. We again excluded medical staff. We then projected into the future, annually ageing staff by one year, and having staff leave, be promoted or recruited according to the propensities that we have found recently.

58. In order to estimate such movements, it was necessary to link HESA staff records for the same person across institutions and between years. The method used is described at Annex C. Having done this, we could then select one record per person per year explicitly, rather than approximating to it by taking a census count as we did for the historical trends. This means that the numbers in the projections, while corresponding broadly to the same populations as for the trend analysis, will not be exactly the same.

59. It is important to appreciate the limitations of these projections. First, they do not give us a way of estimating what the total required number of staff will be; they simply show the relationship between any given level of recruitment and size of population. Second, we are assuming that the specific rates we observe now will apply in the future. So, for example, we have estimated that there is a 6.7 per cent chance of a 40 year-old male engineering lecturer, in a department that has not had research funding, leaving the sector in the following year. And we assume that this specific rate will apply through to 2010-11. We make similar assumptions about specific promotion rates. Further, we assume that the profile of the recruits will be the same as, or at least will be based on, the profile of recent recruits.

60. Some of the key findings from this work have already been reported by the Roberts' Review ,[6] but more details are provided here. Paragraphs 62-73 below give an overview of the model. Readers who want to see the results can turn straight to paragraph 74, while those who would like a fuller description of the model should go to Annex D.

61. The report of the results is in three parts. First (paragraphs 74-81) we look at the consequences of continuing with current recruitment, and the recruitment requirements to maintain current staff numbers, both for the sector as a whole, and for specific subjects. We find that, overall, current recruitment levels are sufficient to maintain current staff numbers, though this does not apply for certain subject areas, in particular mathematics, physics and engineering. Second, we explore the projected changing profile of the staff population, with respect to grade, age and sex. We find that the trends continue to a population with more women and more staff on higher grades. The population also ages slightly for a few years before levelling off. Finally, we consider the recruitment, and cost implications, of increasing the size of the population of academic staff. More detailed tabulations of all these results are reported at Annex E.

Model overview

The core population

62. The model treats permanent academic staff as a single group, which we will refer to as the 'core population'. Year on year we are concerned with:

a. Leavers. These include staff who retire, take up employment outside the UK HEI sector, go abroad, move to a grade below lecturer, move to a non-permanent contract, or to a position with less than 40 per cent FTE. They do not include staff who leave one institution and take up another permanent academic position at a different UK HEI.

b. Continuers. These are staff who remain in the core population. About 1.3 per cent will change institution.

c. Recruits. These are staff who were not in the core population in the previous year. They include staff who were previously on temporary contracts, had a low FTE, or were in grades below lecturer, and staff returning after a break of a year or more, as well as those completely new to the UK HEI sector.

63. Table 4 shows destinations and origins of leavers and recruits respectively.

Table 4 Movement into and out of the core population

	Percentage of leavers to	Percentage of recruits from
Low FTE	12.2%	3.1%
Low grade	3.0%	7.7%
Not permanent	12.5%	28.4%
Outside sector	72.5%	60.8%

Notes
Reference years 1997-98 and 1998-99.
Low grade excludes those that also have low FTE.
Not permanent excludes those with low FTE or low grade.

Flows out of, within and into the core population

64. The trend analysis described five attributes, which are also used as factors in the modelling. These factors, with the number of different values used, are:

a. Research association – whether a majority of staff in the associated department attracted research funding after the 1996 RAE (two values).

b. Subject groupings (17 values).

c. Grade – professor, senior lecturer or lecturer (three values).

d. Age – each age from 25 to 65 and a single group for the over 65s (41 values).

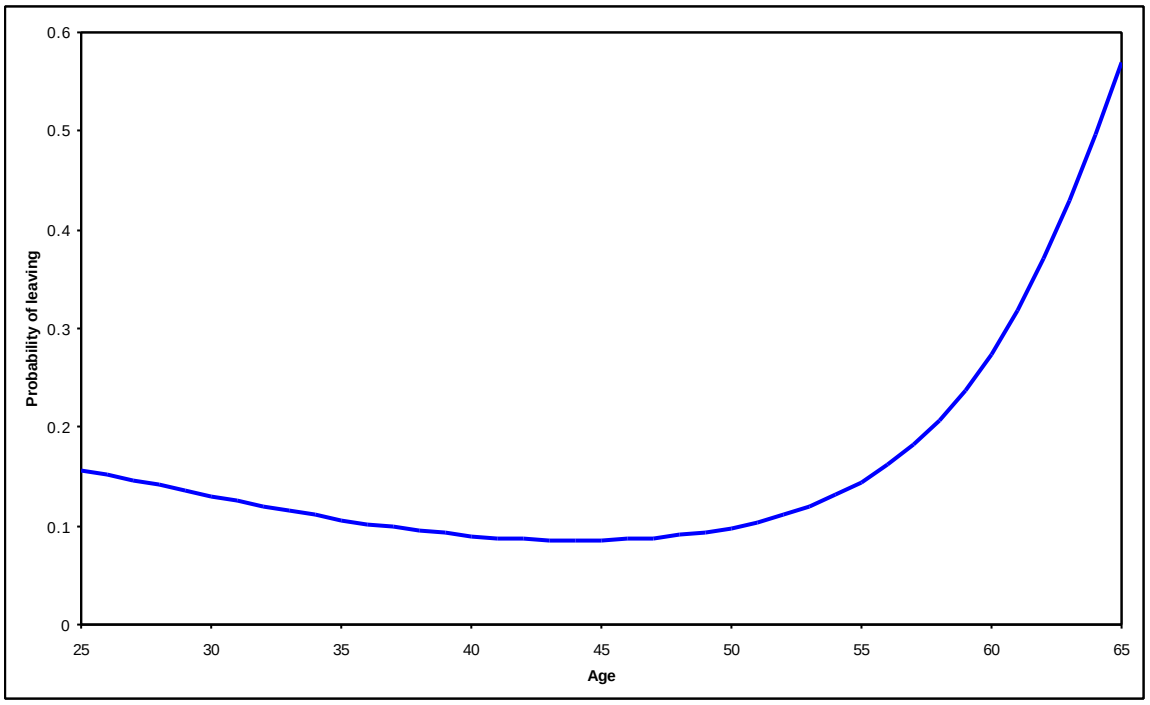
f. Sex (two values).

There are 8,364 possible combinations of these factors (8,364 = 2x17x3x41x2).

65. In the model, two individuals with the same characteristics as described by these attributes are treated as though they are identical. There are other factors that affect, say, the chance of an individual being promoted, but the model can only make use of the data that are available and of reasonable quality. Even with these simplifications, the model still has a large number of possible combinations of factors, which makes it more complex than can be handled through conventional manpower planning methods, so a statistical modelling approach has to be adopted. Full details are given in Annex D.

66. The chance that an individual will leave depends, in a complex way, on all five factors. Figure 9 shows how the chance of leaving depends on age for a particular combination of attributes. For this particular group, the chance of leaving is at the minimum at 44 years old. The exact shape of the probability curve by age varies with the other characteristics, but the overall pattern of higher chances of leaving at the young and old ends of the scale is quite general.

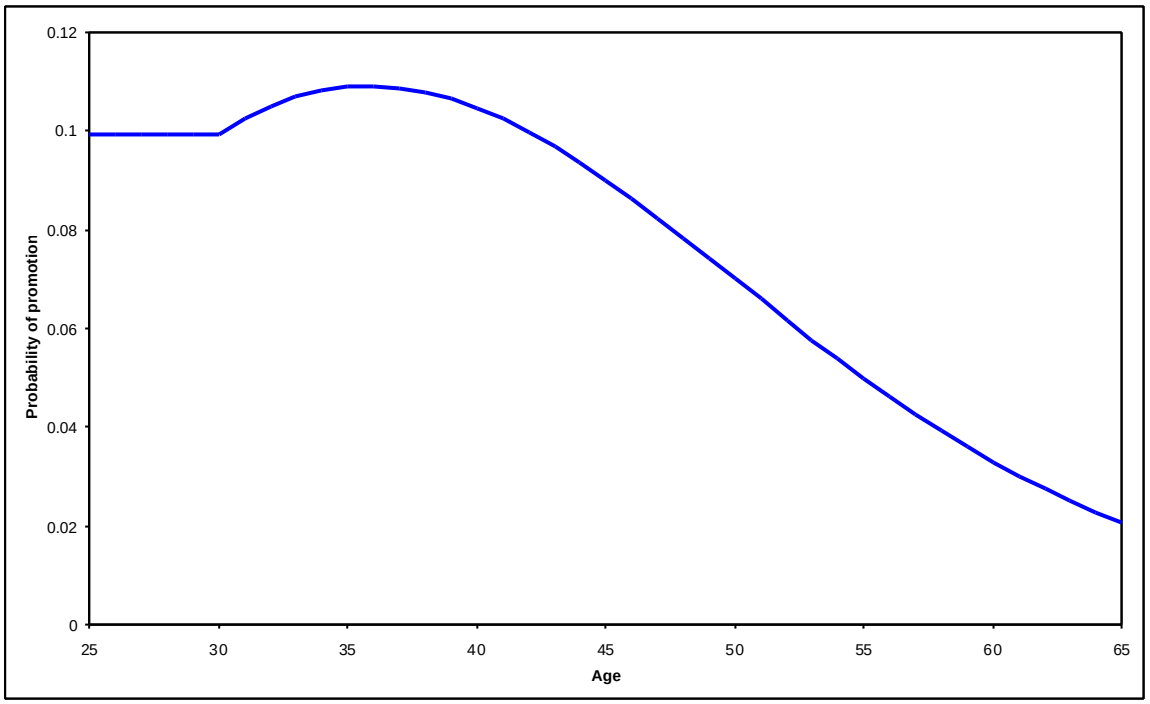
Figure 9 Probability of a male engineering non-research lecturer leaving



67. Each year, every individual that continues within the core population ages by one year. In the projection, both the sex and subject of each individual are set to remain the same. In the actual data we do find some individuals changing subject, but the numbers are small. There are no significant net changes: movements in different directions tend to cancel each other out.

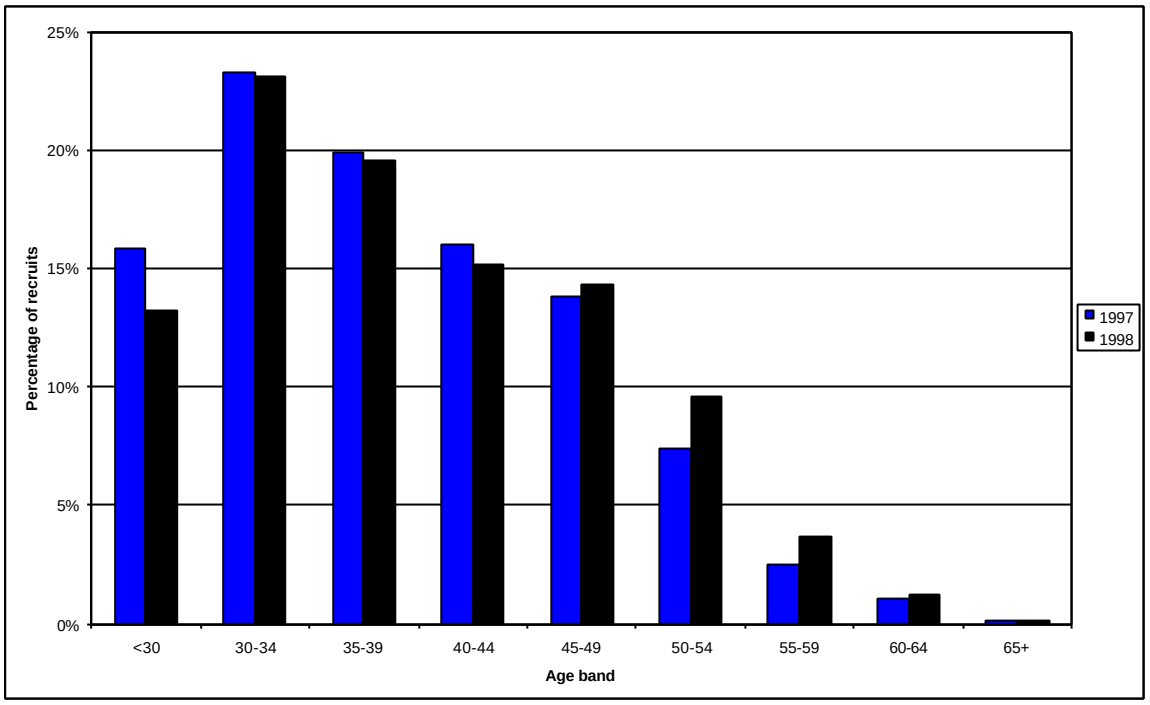
68. The projections do allow for changes in grade, and under some scenarios we also allow a change in the research-associated status of staff. Figure 10 shows how the chance of being promoted from senior lecturer to professor varies with age for research-associated male mathematicians. The chance of promotion increases to a maximum of just under 11 per cent at the age of 36, and then gradually declines with age.

Figure 10 Probability of promotion to research-associated professor for male research-associated mathematics senior lecturers



69. Recruits are sampled from a population with the characteristics of the recruits for the years 1997-98 and 1998-99. The age distribution of these recruits is shown in Figure 11. The age profile of recruits is, as we would expect, much younger than the population as a whole, with for example only 11-15 per cent over 50 compared with about 35-40 per cent in the population as a whole. (See Figure 6, paragraph 52 above.)

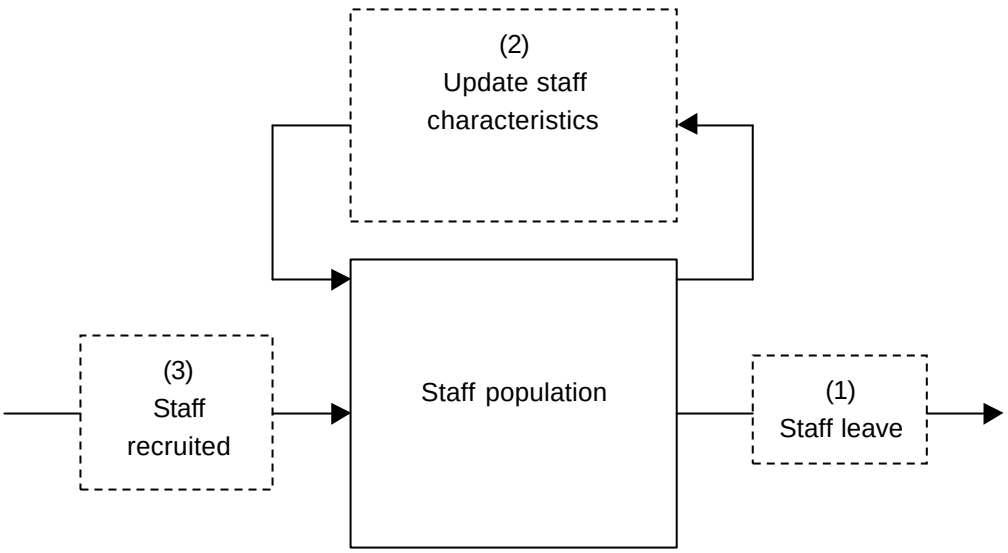
Figure 11 Distribution of age of recruits to the core population



The annual projection cycle

70. The annual projection cycle involves three steps, shown in Figure 12.

Figure 12 The annual projection cycle



71. Each year we first select staff to leave. Using the five characteristics we can calculate the probability that each staff member will leave, and we randomly assign each individual as

a leaver or continuer using these probabilities. (For a full description of this process, with an assessment of the variability of these random assignments, see Annex C.)

72. For the next steps of updating and recruiting we use three different projection cycle protocols. These are the 'box-flow', 'current-recruitment' and 'recruit-to-maintain' protocols. Full details are given at Annex D, and they are described in outline below.

a. The box-flow protocol. The numbers in each grade are kept constant. Only upward movements between grades are allowed, and there can be no changes in research status. We start by replacing the leavers from the highest grades (professors) by recruiting and 'pulling' individuals from lower grades. We then recruit and pull into the senior lecturer grades in a similar way, and finally we recruit lecturers. Though this follows the standard approach for manpower projections, it does not fit well with the structure of academic positions. As we have seen from the historic trends, the proportions of grades are not fixed, and grades do not simply reflect a set reporting structure.

b. The current-recruitment protocol. This is a simple projection of current movement. The grade and research status of staff are changed at random according to the probabilities determined by the five factors. Staff are then recruited, at random, from indefinitely large subject pools of potential recruits with the same characteristics as current recruits. The number of recruits is set to continue at current levels, whatever happens to staff numbers. This protocol realistically reflects the movement between grades and research status that we observe, but the assumption of constant recruitment numbers is clearly not realistic. Institutions will recruit, or attempt to recruit, on the basis of their needs.

c. The recruit-to-maintain and recruit-to-expand protocols. Staff change their grade and research-associated status at random, as for the current-recruitment protocol. As a result of staff leaving, some grades and research status groups within a subject area will have fewer staff, though some may well have the same or higher numbers. With the recruit-to-maintain protocol, recruits are taken only for the groups with lower numbers, and the total number of recruits is set to equal the number of leavers. The recruit-to-expand protocol modifies this procedure by requiring the numbers in each group to increase. This protocol is the most realistic. It allows the free movement between grades and research status that we observe, while setting recruitment levels to be determined by a defined total number of staff. There remains the question of what that total number of staff should be, a question that is not addressed by the projection model itself.

73. Though we think the recruit-to-maintain and recruit-to-expand protocols are the most realistic, it is useful to run projections under all three protocols. A comparison of the results gives us a better understanding of what is likely to happen.

Results: current numbers and current recruitment levels

74. Figure 13 shows the number of staff, and Figure 14 shows the number of recruits using the three projection cycle protocols.

Figure 13 Projected number of staff: 2000-01 to 2010-11

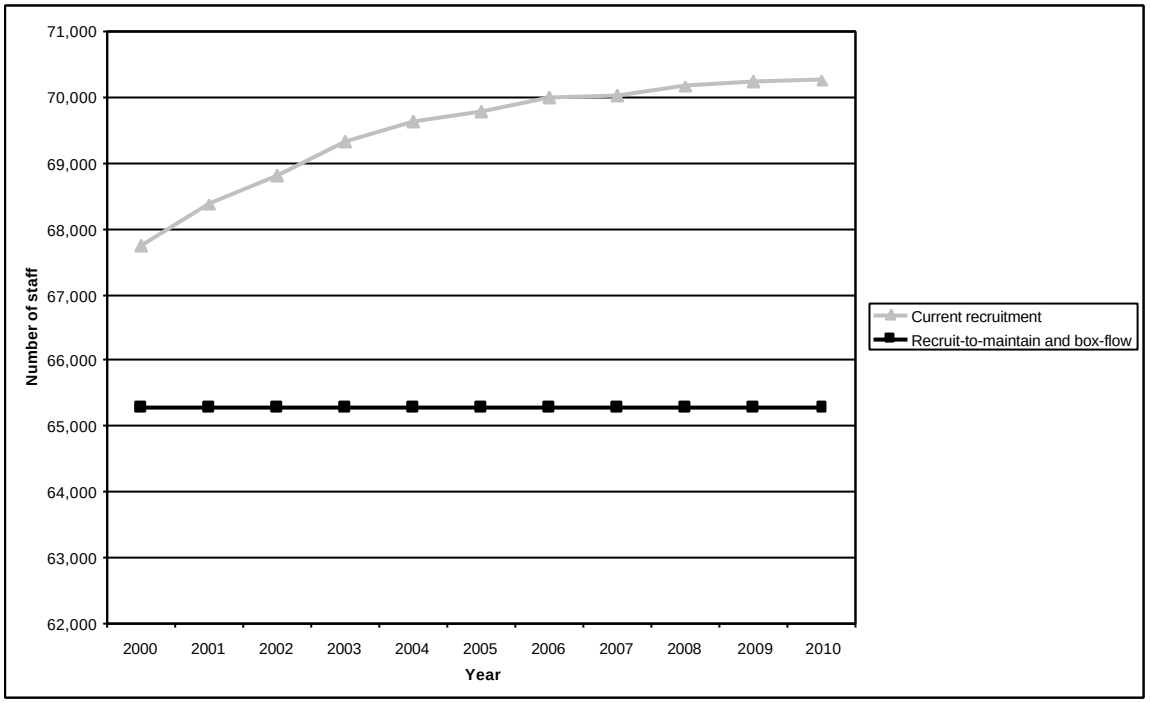
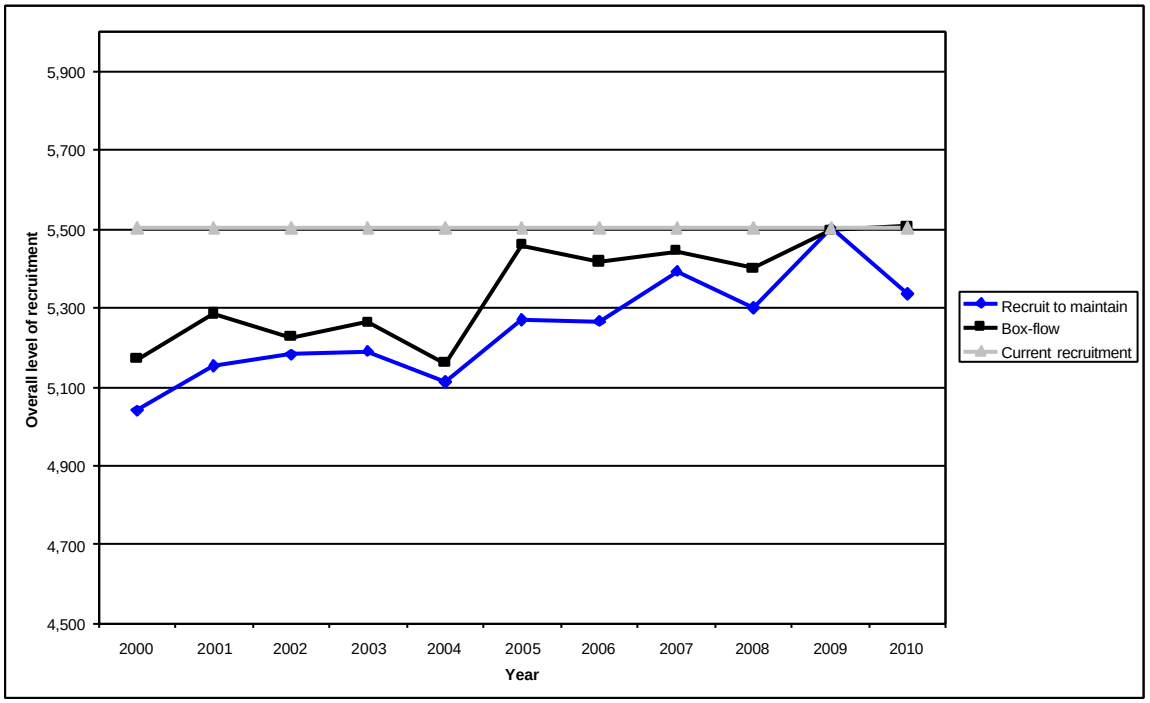


Figure 14 Projected number of recruits: 2000-01 to 2010-11



75. The current-recruitment protocol leads to an increasing number of staff, with the total gradually reaching more than 70,000. The box-flow and recruit-to-maintain protocols have been set to keep the numbers at their current level. Below we explore what happens under different scenarios (see paragraphs 89-99.)

76. The box-flow and recruit-to-maintain protocols both show that maintaining current staff numbers does not entail an increase in recruitment. Taken together with the increased staff numbers projected, assuming current staff levels, we can see that the current age structure will not generate an overall increase in future recruitment needs. However, this conclusion does not hold for all subject areas.

Staff and recruits in mathematics, physics and engineering

77. Table 5 summarises the output of the three annual projection protocols for mathematics, physics and engineering. The population and recruitment levels in 2010-11 are shown as a percentage of those in 1998-99.

Table 5 Student numbers and recruits projected for mathematics, physics and engineering

Protocol	Statistic	Mathematics	Physics	Engineering	All subjects
Current recruitment	Staff number (2010-11 as % of 1998-99)	89%	89%	86%	108%
Box-flow	Recruitment (2010-11 as % of 1998-99)	141%	109%	136%	100%
Recruit to maintain	Recruitment (2010-11 as % of 1998-99)	133%	113%	122%	97%

78. The figures in Table 5 show that current recruitment levels in mathematics, physics and engineering would lead to a decline in numbers of more than 10 per cent, and that to maintain current numbers would entail increases in recruitment of between 10 and 40 per cent. This is consistent with the recent decrease in staff numbers (see Table 2) at those levels of recruitment. If staff numbers are not to decline further in these subjects, these

results are of particular concern, as surveys and case studies have shown that institutions are already having difficulty recruiting staff in these subjects.[7]

Staff and recruits in law and social policy

79. Table 6 summarises outputs of the three annual projection protocols for law and social policy.

Table 6 Staff numbers and recruits projected for law and social policy

Protocol	Statistic	Law	Social policy	All subjects
Current recruitment	Staff number (2010-11 as % of 1998-99)	105%	104%	108%
Box-flow	Recruitment (2010-11 as % of 1998-99)	119%	113%	100%
Recruit to maintain	Recruitment (2010-11 as % of 1998-99)	117%	111%	97%

80. The figures in Table 6 show a rather confusing picture for law and social policy. It seems that current recruitment levels will more than maintain current staff numbers, yet both the box-flow and recruit-to-maintain protocols show an increased need for recruitment to maintain staff numbers. When we look in detail at the outputs of the model, it seems that with the current recruitment levels the subjects are, in effect, 'building up reserves' in the first years of the projection. The box-flow and recruit-to-maintain protocols reduce the initial recruitment, which has an impact on the overall grade and age structure, which in turn leads to an increased requirement for recruits by 2010-11. For these subjects, the situation is uncertain, but there may be an increased need for recruitment in the longer term if current recruitment levels are not maintained in the short term.

81. For all other subjects, the results of the projections are unambiguous: they show that current recruitment levels are more than enough to maintain current staff numbers.

Results: staff profiles

Projected age profiles

82. Figure 15 shows the age profile of the projected population in 2010-11 compared with that in 2000-01, using the output from the recruit-to-maintain protocol. The other protocols show a similar trend.

Figure 15 Age profiles for 2000-01 and 2010-11

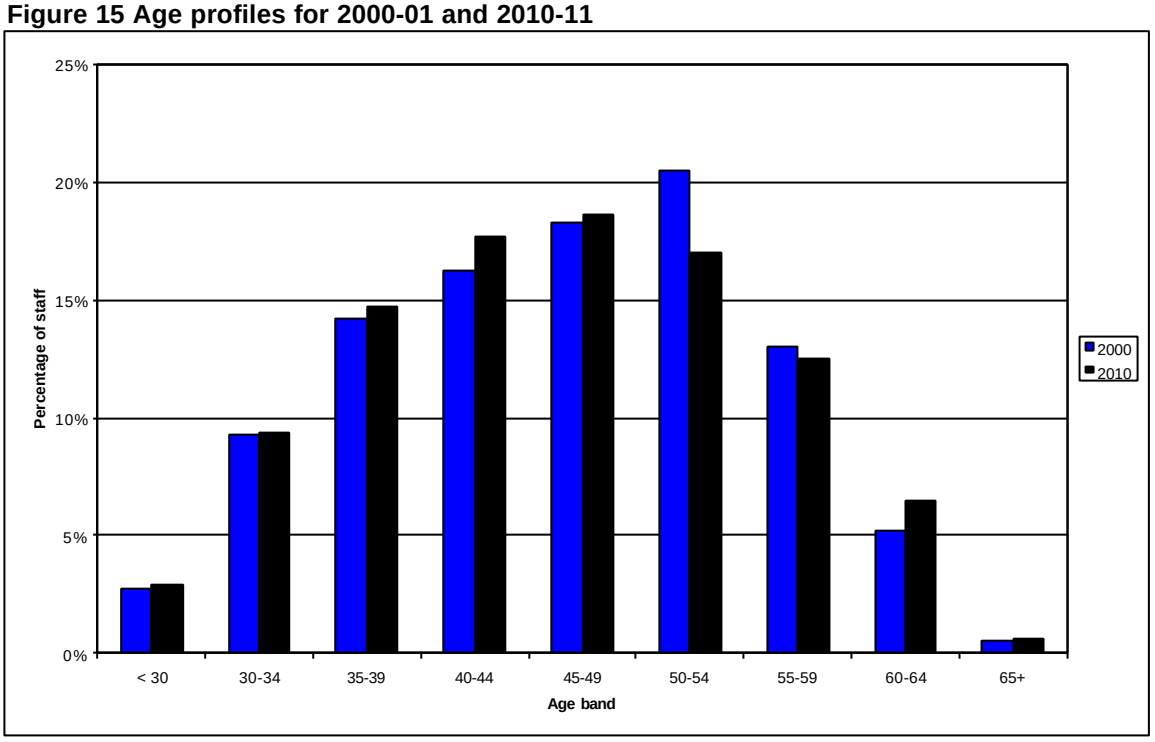


Figure 15 was amended on 27 January 2003. This graph is incorrect in the printed version of the document.

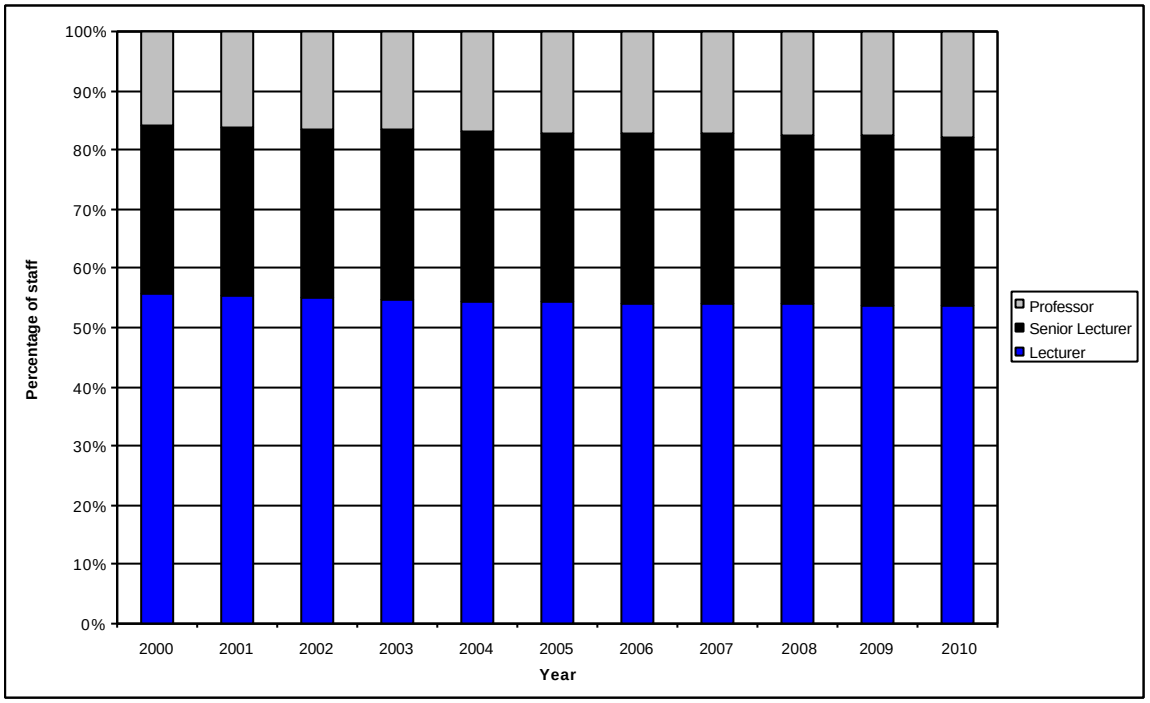
83. The change in the projected age profile is complex, as is the actual change observed in the time series. The proportions of staff aged 55-64 and 35-44 increase, and the proportions of other age groups decrease. Over the period the proportion of all those over 50 continues to increase for the first two years of the projection, and then slowly decreases. The lack of abrupt changes in the age distribution is consistent with the conclusion that we do not face a sudden overall increase in recruitment needs.

84. This overall picture differs for different subjects. The 'problem' subjects referred to above – mathematics, physics and engineering – all have projected age profiles which are younger overall, analogous to the results for chemistry through the time series (see Figure 7). For these subjects, maintaining numbers requires more recruits, which makes the age profile younger. The detailed results are presented at Annex E.

Projected grade profile

85. The historical trend showed an increasing proportion of staff in higher grades (see Figure 5). The grade pattern from the recruit-to-maintain protocol is shown in Figure 16 below.

Figure 16 Projected grades for recruit-to-maintain protocol



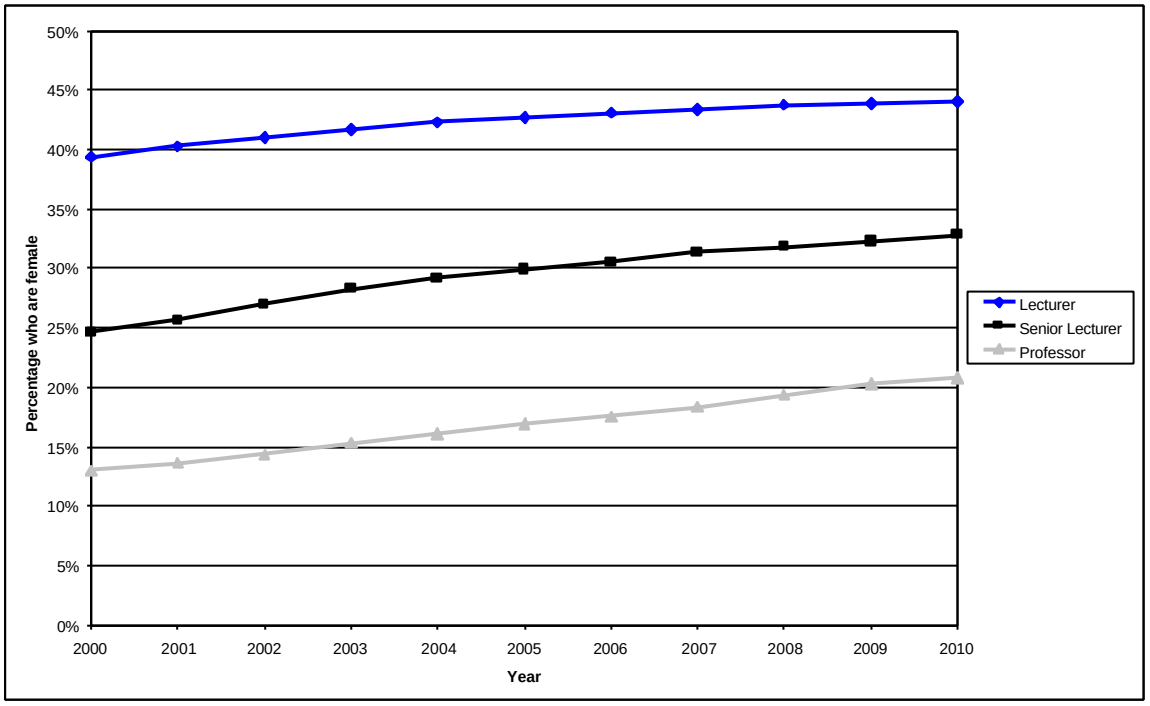
86. The current-recruitment protocol shows a very similar grade projection as Figure 16. The box-flow protocol is designed to hold the numbers in each grade constant, so the outcome of the grade profile is decided in the model specification. To decide whether the trend towards an increased proportion of higher grades will or should continue, we need to consider why this is occurring. There is evidence that promotion and reward strategies, such as the creation of personal chairs, are being used to retain staff with much sought-after skills.[8] If this is the case, we should accept that the trend is likely to continue, since a reversal would probably increase the leaving rates of key staff, which in turn could increase the cost of maintaining the number and quality of staff.

Projected numbers of female staff

87. Figure 17 shows the percentage of female lecturers, senior lecturers and professors using the recruit-to-maintain protocol. The other protocols give similar results. The trend observed for the historic data continues, with increasing proportions of female staff. Particularly notable is the increase in the proportion of professors who are female, from 13 to 21 per cent. This is due, in part, to female staff recruited before the projection period 'working through the ranks', and in part to the high proportion of female recruits compared with the proportion in the general population.

88. With respect to this second factor, the projection models are likely to under-estimate the proportion of women. The participation rate for women in higher education, as measured by the Age Participation Index (API), had caught and exceeded that for men by 1992.[9] Since then, the gap has been growing. There is a similar trend of rising participation by women in postgraduate study.[10] We should therefore expect the proportion of female recruits to the core population to increase, while the model takes a fixed profile based on recruits from 1997-98 and 1998-99.

Figure 17 Projected percentage of women in each grade



Results: recruitment requirements for an expanding sector

89. The modelling described above assumed that either current recruitment levels or current staff numbers were to be maintained. This was the most straightforward way of exploring whether the current age structure would generate a need for increased recruitment.

90. The number of recruits needed will, of course, depend on the future numbers of academic staff. We know that the number of students taught in higher education institutions (HEIs) is likely to increase. Through the decade up to 2010-11, the population sizes of young adults will grow, and participation rates are also planned to increase. To estimate the resulting rate of growth of student numbers in HEIs we need to consider:

- the rate of increase in participation
- course lengths
- incidence of repeat years
- extent and timing of non-completion
- rates of re-admission to undergraduate courses

- levels of provision for EU and other overseas students
- levels of postgraduate provision
- amount of provision in further education colleges (FECs).

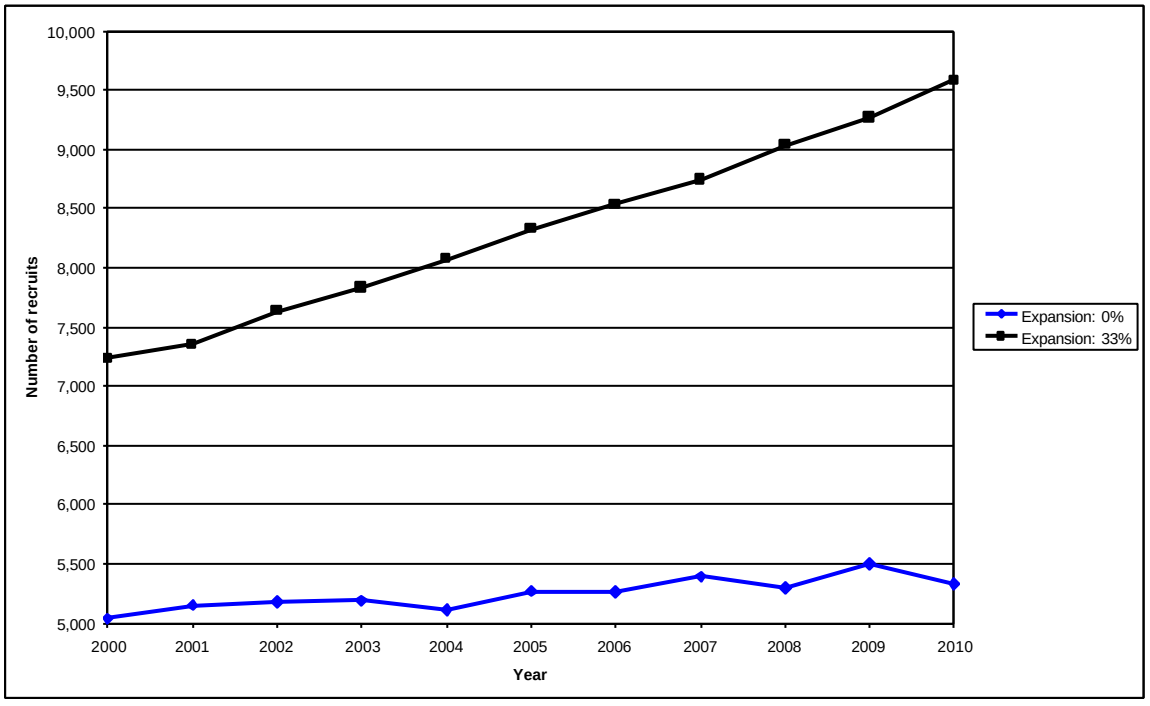
91. Given all these factors, an estimate of the growth in total student numbers is uncertain. It is likely to be at least a third of the current total. In order to estimate the numbers of academic staff required, we also need to know:

- staff:student ratios (related to staff teaching time)
- levels of research and other non-teaching activity (relative to teaching activity)
- growth by subject areas.

92. We do not have authoritative answers to these questions either, so there is no settled view as to what the future staffing requirements will be. In the scenarios described here, we assume that any future expansion is uniform, that is, that the proportions associated with different subjects remain the same, and that the balance between research-associated staff and non-research associated staff will be determined by the propensities to leave, move and recruit. For these scenarios the recruit-to-maintain protocol has been adapted to produce a range of recruit-to-expand versions. Each scenario assumes that the rate of expansion is constant between 2000-01 and 2010-11.

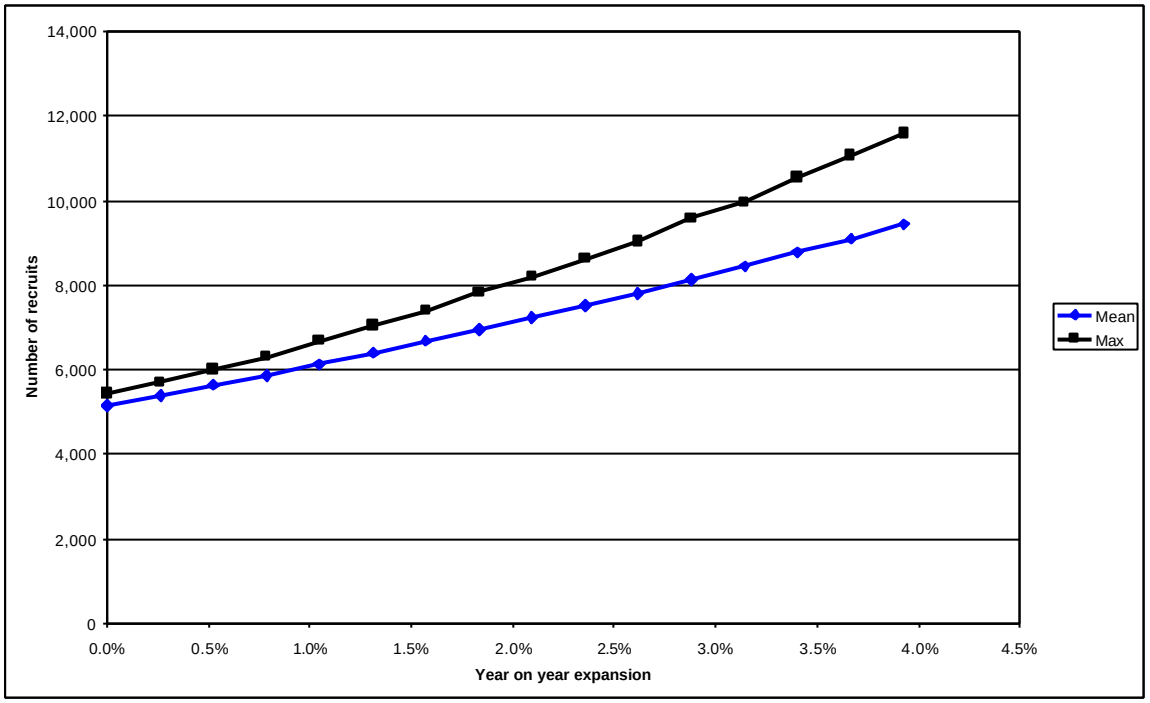
93. Figure 18 shows the number of recruits generated by the recruit-to-maintain protocol (also shown in Figure 14), along with the recruits needed to generate a 33 per cent expansion in staff numbers by 2010-11. This is the kind of expansion that would be required if staff numbers were to increase in line with student numbers.

Figure 18 Recruit to maintain, and recruit to expand by a third



94. To maintain staff numbers, between 2000-01 and 2010-11 the average and maximum numbers of recruits are 5,160 and 5,445 respectively. To increase staff numbers by a third the average is 8,448 and the maximum is 9,957. Figure 19 shows the average and maximum recruitment numbers for different expansion rates.

Figure 19 Average annual recruitment between 2000-01 and 2010-11 required to achieve given annual growth rates



95. Figure 19 shows, as we would expect, that the average number of recruits required increases with the required annual increase in the number of staff. To increase staff numbers by 1 per cent a year, the average number of recruits per year has to increase by about 17 per cent above the rate needed simply to maintain numbers. To increase staff numbers by 3 per cent a year the average number of recruits per year needs to increase by 60 per cent.

96. This recruitment to increase population 'elasticity' depends on overall retention rates. Where retention rates are high, the recruitment rate to maintain numbers is low, and the proportional increase in recruitment to achieve a growth in population is high. This is reflected in the differences between subjects. For example, the biological sciences were found to have an average leaving rate of less than 6 per cent. Therefore to increase biological staffing numbers by 3 per cent a year on average would require an expansion of between 65 and 75 per cent in the average number of recruits compared with the recruitment rate to maintain numbers. By contrast, education, with a leaving rate of over 8 per cent per annum, requires just over a 50 per cent increase in average recruitment.

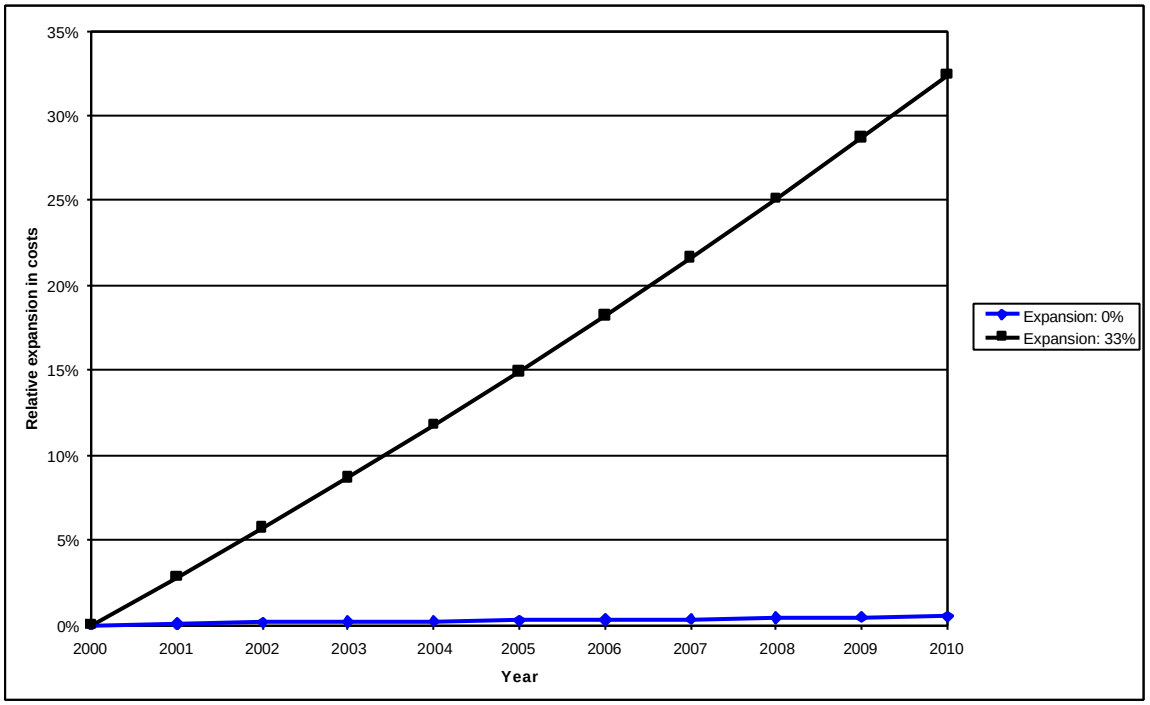
97. Thus, though the current age structure of staff will not, in general, lead to a need to increase recruitment, any significant growth in staff numbers in any subject area will call for significant growth in staff recruitment. These projections assume that the current specific leaving rates remain constant; any increase in these rates would, of course, increase the

numbers of recruits needed. Given the widespread difficulties institutions are already having recruiting staff, [11] achieving the growth in numbers may well require special measures.

Staff costs

98. Future staff costs involve a number of factors outside the scope of this study. For example, pay levels have been identified as an important and growing issue for both recruitment and retention,[11] so it would be unsafe to assume that current pay levels will be a good guide to what is required in the future. Nevertheless, these projections can contribute to our assessment of future costs. Using the five factors in the model – that is subject, association with research, sex, age and grade – a nominal salary can be assigned to each individual in the projection, using salary data from 1998-99. This can then be used to estimate the costs associated with expansion and the changing staff profile. Figure 20 shows the relative staff costs relating to different levels of expansion according to the recruit-to-maintain and recruit-to-expand scenarios.

Figure 20 Relative staff salary costs associated with expansion and a changing staff profile



99. With no expansion, the changing staff profile can be expected to lead to a small increase in staff salary costs of about 0.5 per cent by 2010-11. This is largely due to the increasing proportion of staff in higher grades.

Conclusions

100. Though the trends from 1995 to 2000 show an increasing proportion of permanent academic staff over 50, all the projections we have carried out imply that current recruitment rates would maintain overall staff numbers in the future. For three subject areas – mathematics, physics and engineering – current recruitment levels are insufficient to maintain staff numbers. The recent decline in the numbers of staff in these subject areas will continue unless recruitment is increased.

101. Any marked increase in leaving rates specific to age, sex, subject, grade and research status would mean that current recruitment would not maintain overall staff numbers. Apart from specific difficulties in computing and business-related areas, institutions find that the main problem is recruitment rather than retention of academic staff. Further, about half the retention problems that have been identified relate to retaining staff at a particular institution, rather than within the sector as a whole.[11] However, it would be unwise to be complacent, and we will continue to monitor leaving rates.

102. If the numbers of academic staff are to increase through this decade, then there will need to be a marked increase in recruitment rates. The number of young people is going to increase. And there are plans to increase participation rates in higher education. So there certainly will be a need for more academic staff, though it is not clear how many, or in which areas. However, given that quite modest increases in overall staff numbers require a large increase in recruitment rates, and given the current difficulties experienced by HEIs in recruiting, there are likely to be severe difficulties in increasing staff numbers unless specific measures are taken.

Further work

103. We plan to monitor recruitment, promotion and leaving rates and update our projections. This should give an early warning of any departure from the trends we have identified.

104. Initial presentations of this work have generated interest and questions beyond the scope of the original inquiry, which was focused on predicting what future recruitment levels would be required. For example, there is widespread interest, and concern, about the proportion of women and ethnic minorities in senior grades. These projections show that the proportion of professors who are female is likely to increase, simply through a continuation of current trends.

105. We have been asked whether similar changes might be expected in the number of professors from ethnic minorities. The propensity modelling for promotion, though fit for the purpose it was intended, is not sufficiently detailed to assess whether, for example, there is an unexplained and unjustified disadvantage for women. However, it would be possible to extend these models in order to explore such questions. The same approach could be used to assess whether there is any association with ethnicity and the propensity to be promoted. We plan to address these questions in further analysis.

References

1. UCEA, 2002, 'Recruitment and retention of staff in UK higher education – a survey and case studies', IRS Research Report. www.ucea.ac.uk under 'Reports'.

2. The numbers of PhD home domiciled qualifiers increased by 25 per cent between 1995 and 2000. The only subject which saw a significant decrease in numbers over this period was physics, which declined by 16 per cent. The proportion of PhD starts with firsts remained constant at 42 per cent of those with a known class of degree. (Unpublished HEFCE analysis of HESA student record data.)

3. The numbers of non-UK nationals within the core population of permanent academic staff at grades of lecturer and above have been increasing. Before 1997 the numbers of records with unknown nationality obscure the picture, but between 1997 and 2000 the numbers of non-UK nationals increased by 36 per cent to over 8,000, which represents over 10 per cent of the population. (Unpublished HEFCE analysis of HESA staff record data.)

4. Brian Ramsden, 2001, 'The age of academic staff in higher education institutions - a comparative study'. Universities UK unpublished report.

5. Leanne Elliott, 2000, 'Revitalizing universities through faculty renewal', Research File, Volume 4, No 1. www.aucc.ca/en/research/faculty.pdf

6. HM Treasury, 2002, 'Set for success: the supply of people with science, technology, engineering and mathematics skills', paragraphs 5.38 to 5.45. www.hm-treasury.gov.uk/Documents/

7. UCEA, 2002, ibid. In the survey many institutions reported recruitment difficulties in engineering, physics and mathematics. Only computing and business-related subjects presented greater recruitment and retention difficulties than engineering (pages 22 and 23). In addition, four engineering departments and three mathematics departments were visited as part of the case studies, and all seven were found to be experiencing difficulties in recruiting (pages 67 and 70).

8. For example, see UCEA, 2002, ibid, page 70. The researchers found that at all three mathematics departments visited, 'increased pay, including "promotion", was being used as a measure to retain staff'.

9. HEFCE, 2001, 'Supply and demand in higher education', HEFCE 01/62, Figure 3, page 7.

10. In 1995-96 33 per cent of PhD qualifiers were women, by 2000-01 the proportion had increased to 41 per cent. (Unpublished HEFCE analysis of HESA student record data.)

11. UCEA, 2002, ibid. Retention problems tend to be more prevalent among support staff, for whom, like academic staff in computing, accountancy, law and economics, there is direct competition from other employers outside higher education (page 57).

Annexes available on the web

The following annexes are available with the report on the HEFCE web-site, www.hefce.ac.uk under ‘Publications’.

Annex A Definitions used in constructing the time series

Annex B Detailed results for time series 1994-95 to 2000-01

Annex C Creating an individual longitudinal record of academic staff

Annex D Academic staff projection models: methods and rationale

Annex E Academic staff projection models: details of outputs