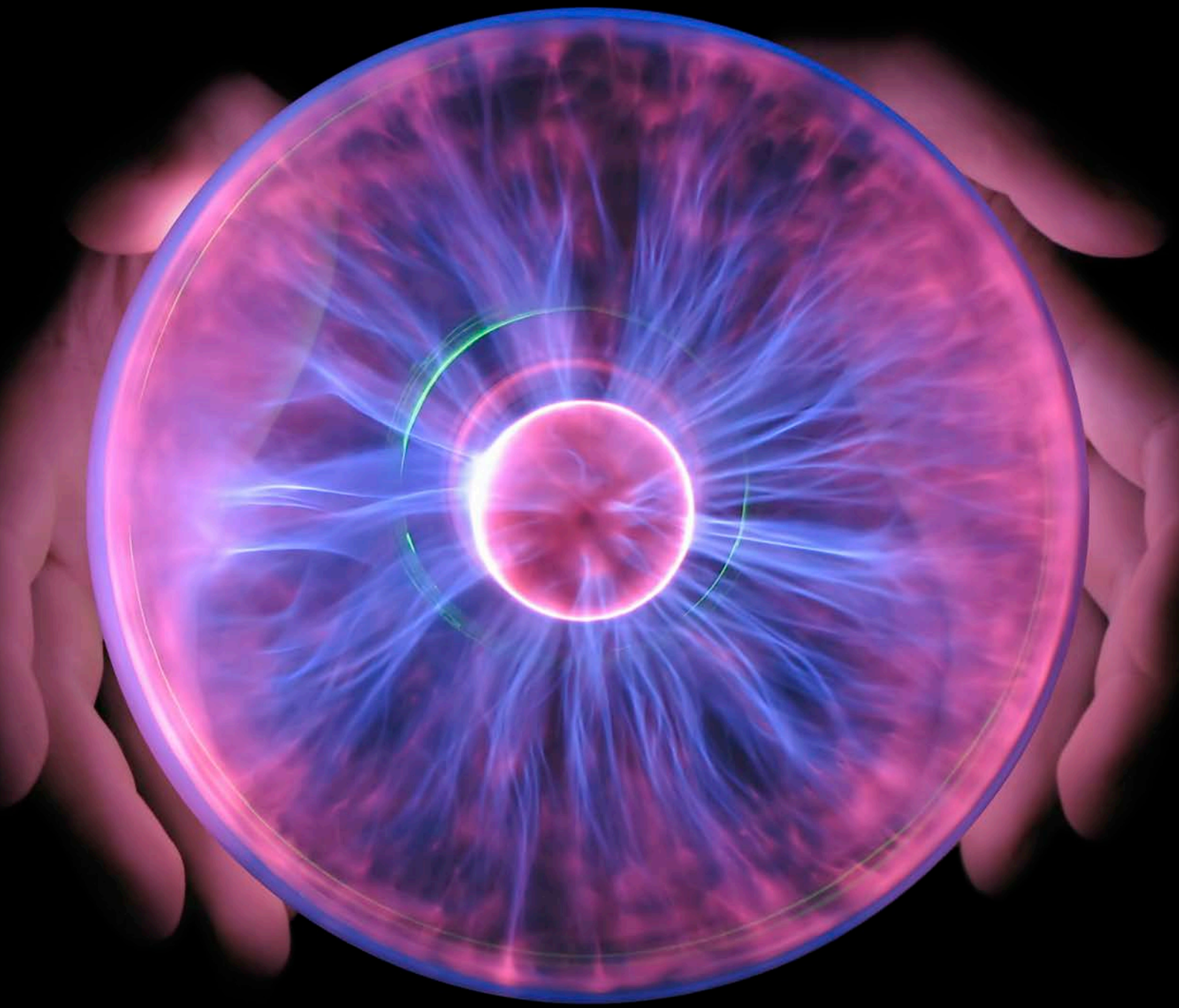
A report prepared for the Institute of Physics by Laura Thomas | **November 2014**

Physics in Scotland

the brightest minds go further

Do physics • Go far • Earn more



IOP Institute of Physics in Scotland

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About this survey

More than 1107 responses were collected via an online survey in order to study the careers of physics graduates from Scottish universities. The survey consisted of 14 questions on the qualifications and career of respondents. The age of respondents was spread evenly across all age brackets. Around 55% held a Bachelors or MSci degree, more than 6% held an MSc and 35% held a PhD qualification. Respondents were split across all eight universities offering physics qualifications in Scotland, with the majority being from Edinburgh, Glasgow, St Andrews and Strathclyde.

Where possible comparisons are made with the 2009 report, *Physics in Scotland: the brightest minds go further*[1].

[1] Institute of Physics, *Physics in Scotland: the brightest minds go further*, 2009

Executive summary

The responses to the 2014 survey reinforce the conclusions from the 2009 report, *Physics in Scotland: the brightest minds go further*, that physicists have a broad range of career options, the flexibility to move between sectors and the opportunity of an excellent salary.

Key findings from the 2014 survey cover employment sectors, pay and gender differences:

- Physics graduates' knowledge and skills make them flexible employees and highly desirable to employers. There is no one job that is associated with a physicist, they are found across a diverse range of sectors. Since 2009, there have been no significant changes in the spread across employment sectors. This shows that even in difficult financial and economic circumstances, physics graduates are still in demand.

  However, there are still not enough qualified physicists to meet demand. Employers are reporting difficulty in recruiting to physics-related posts. Even though there has been an increase in the numbers graduating with a physics degree in Scotland, further growth is needed.
- In the period since the last survey, we have seen an increased percentage of our respondents earning more than £40,000 (57.8% in 2014 increased from 52.2% in 2009) and £50,000 (43.7% in 2014 from 37.5% in 2009). We see very little difference in earnings between those who hold a BSc and those who have a PhD.

  When earnings are examined by sector we find that those teaching in schools still receive the lowest wages. The number of specialist physics teachers in schools in Scotland is declining. The exact reasons for this are unclear and action is required to halt this decline – particularly as we see the numbers taking the physics Higher qualification increase and the demand for physics graduates grow.
- Male respondents are more likely to earn a higher salary than female respondents: 49% of male respondents reported earnings more than £50,000 compared with just 22% of female respondents.
- We saw that female respondents were more likely to be working in the services sector, education – school and health and care. 30% or more of the respondents who said that they worked in these sectors were female. The sectors with the lowest female representation were telecoms, aerospace and electronics, electrical and IT, that had 10% or less female respondents making up their number.

  There are still broad gaps to be overcome in earnings and employment of male and female physics graduates. The gaps start to open shortly after graduation and more work with employers is needed to understand and address the issues causing these differences.

1

Graduate employment and recruitment

[2] AGCAS, *What Do Graduates Do?* 2013

[3] The Careers Group, *What Do Graduates Do? Scotland*, 2013

Increasing numbers of people are choosing qualifications in physics, both in secondary and higher education. Physicists are excellent problem solvers and critical thinkers. They have first-rate mathematical and practical skills and are known for their ability to adapt their skills and knowledge to a wide range of areas. Physics graduates have broad options for a career, making them competitive in the job market and allowing them to move easily between sectors.

1.1. Graduate employment

The most recent Destination of Leavers from Higher Education (DLHE) survey[2] shows that the route to employment for physics graduates is distinct when compared to an average across all subjects in Scotland (figure 1).

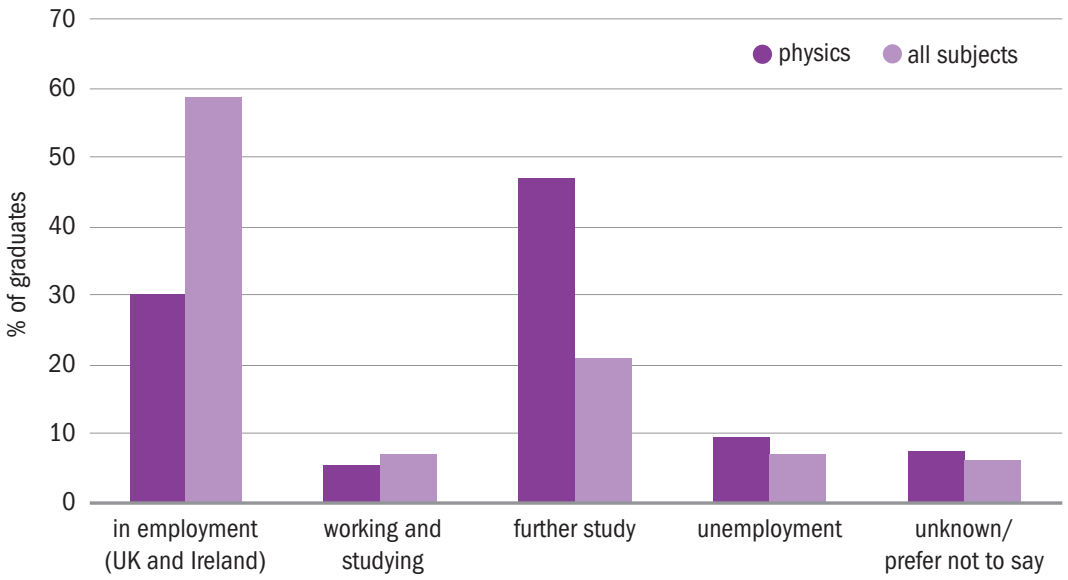
The figure that stands out most is that more than 40% of physics graduates have gone on to further study, compared with 25% for biology and 34% for chemistry. Across all subjects in Scotland, only around 16% go on to further study. Compared with respondents to the survey, more than 40% have a postgraduate qualification (8% hold an MSc and 35% hold a PhD). This level of further study is the same as we saw in our previous survey in 2009, *Physics in Scotland: the brightest minds go further,* and is therefore a feature of the subject that physicists are more likely to go onto take further qualifications.

We can review graduate employment over time by examining the first job of all respondents and then grouping them by age. By looking at each sector we can identify any changes in recruitment across the different age groups, which can reflect the emergence or decline of different sectors. There is no readily identifiable, typical job for physicists.

We can see this from the range of sectors in which our respondents found their first job (figure 13, p17). There has been a decline in the number of physics graduates going into areas such as:

- Armed forces
- Education – school (e.g. teaching)
- Electronics, electrical and IT
- Government – other (e.g. civil service)
- Telecom

Figure 1: Employment/study status for graduates six months after graduation[2, 3]



This decrease in the numbers going into areas such as electronics, electrical and IT, and telecoms is surprising given the growth in these sectors.

We have seen numbers increase or remain stable in:

- Education – university (see details in figure 2)
- Financial services
- Health care

The Institute of Physics in Scotland undertakes a survey of first-year physics undergraduates to find out about their reasons for choosing the subject and their learning experience. It is interesting to note the sectors that they expect to work in (table 1).

The most popular sectors highlighted by the first-year undergraduates follows a similar pattern to those identified by as "acceptors" of a physics degree offer in the report *Impact of Tuition Fees on Prospective Physics Students*[4]. A large proportion among those based in a Scottish Higher Education Institution (HEI) are undecided and there is much less interest in a non-physics related area compared with the "acceptors" group (based in England) where 2% were interested in finance/banking and 23% in business management. This large difference in interest could be explained by the "acceptors" group facing a higher financial cost of going to university compared with Scottish undergraduates. The "acceptors" will potentially pay up to £9000 per year in fees, therefore, before taking on that debt they may have investigated their career options at an earlier stage than their Scottish counterparts

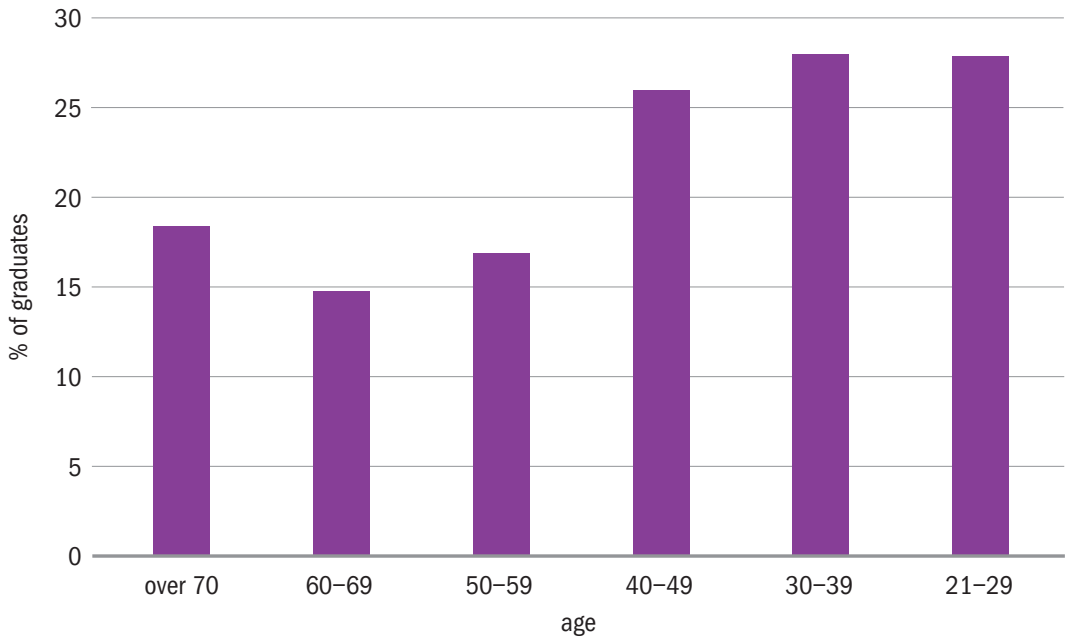
Table 1: Expected area of employment on graduation[5]

Area of employment	%
Research in a university	17
Energy industry	16
Research, non-university based	12
Engineering	10
Education – school or university	10
Meteorology/earth sciences	1
Medical physics	1
Not related to physics	4
Unsure	29

[4] YouthSight for the Institute of Physics, *The Impact of Tuition Fees on Prospective Physics Students*, 2013

[5] IOP Scotland, *Undergraduate Physics Survey*, 2014

Figure 2: First job response grouped by age: education – university (other sectors can be viewed in the Appendix, p17)



and be encouraged by the high starting salaries on offer to physics graduates in areas such as finance.

In the future, the CBI expects there to be strong demand for those who are highly skilled, particularly in sectors that have been identified as providing the best opportunity for growth in the economy[6]. The sectors identified are construction, manufacturing and engineering, high-tech and science – all employers of physics graduates. It is therefore important to increase the numbers of people studying physics at university.

Employers are finding it difficult to recruit to some physics-related positions. In Spring 2014, 17% of employers said that the most difficult vacancies to recruit to were engineering related[7]. This compares with 5% for academic vacancies and 4% for teachers. A large proportion (16%) of first-year undergraduates based in Scottish HEIs in 2014, have identified the energy industry as a potential future employer for them[8]. This has been highlighted as a key sector by the Scottish government and the supply of highly-skilled physics graduates will be essential in supporting any future growth in Scotland. In the recent survey of the energy sector, 54% of companies (294 organisations) said that they expected to be recruiting more employees in the next year[9]. The sector already employs around 12,000 individuals in Scotland. However, 21% identified a problem in recruiting to graduate engineering positions and a further 6% reported difficulty in recruiting PhD-level employees in the research and development area.

Table 2: The most popular course destinations for accepted applicants with physics Higher in 2011[11]

Course destinations	%
Mechanical engineering	7.9
Preclinical medicine	5.3
Physics	4.7
Civil engineering	4.4
Computer science	4.2
Chemical, process and energy engineering	3.8
Law by area	3.2
Electronic and electrical engineering	3.0
Accounting	2.7
Pharmacology, toxicology and pharmacy	2.5

1.2. Recruitment to physics qualifications

In the past five years there has been a large increase in the number of applications to physics and astronomy courses in the UK. Between 2009 and 2014 there was a 56% increase in applications to physics and astronomy courses[10]. In Scotland, the increase in acceptances in this period was 20%, while in the UK as a whole, there was an increase of 33%[10]. So, the increase in acceptances does not match the growth in applications. Possible explanations for this disparity include the following:

- Physics departments have physical restrictions that limit their undergraduate intake. The maximum number is usually limited by the size of the laboratories used for teaching practical modules. Universities might want to take on more into the first year, but may not have the space available or funding to expand.
- In many cases, physics is a back-up option for those considering a career in medicine. While physics is becoming increasingly attractive as an option to prospective undergraduates, there is perhaps more that could be done to convert from application to acceptance. Conversion actually dropped from 19% in 2009 to 17% in 2013[10]. In table 2 we can see a snapshot of course destinations from 2011 for those holding a physics Higher. A physics degree course was the third most popular destination for those holding a physics Higher.

The increase in application numbers to physics undergraduate degrees is encouraging, particularly during a time when

[6] CBI, *Tomorrow's growth: New routes to higher skills*, 2013

[7] CIPD, *Labour Market Outlook*, Spring 2014

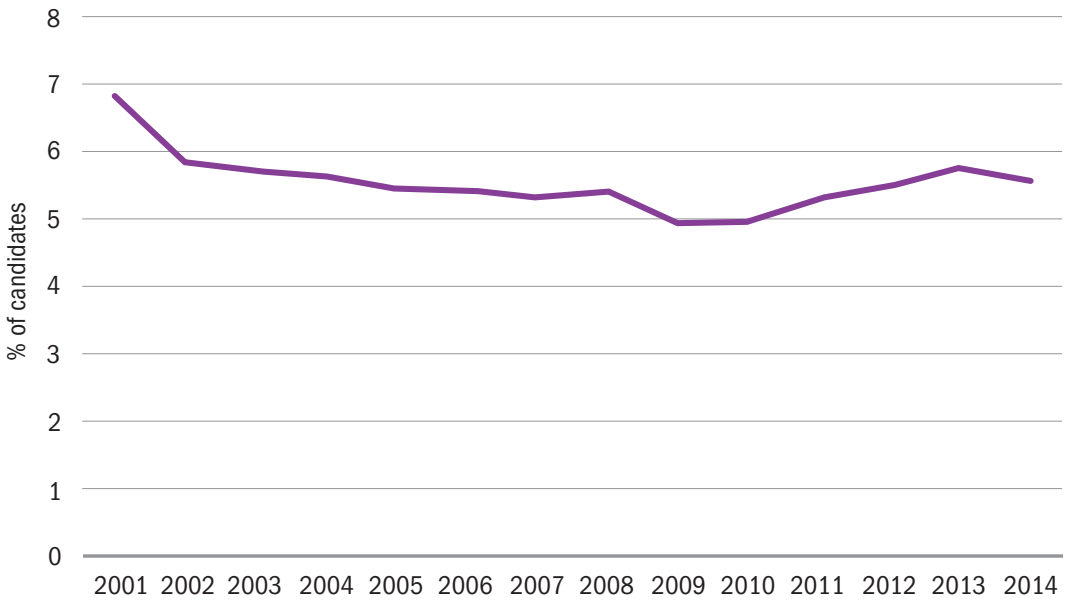
[8] IOP Scotland, *Undergraduate Physics Survey*, 2014

[9] Scottish Renewables, *Employment in Renewable Energy in Scotland*, 2013

[10] UCAS, *Applications, acceptances and ratios by subject group*, 2009 and 2013

[11] Institute of Physics, *Statistical Report: Degree course destinations of accepted applicants with physics and maths A-levels or Scottish Highers 2006–2011*

Figure 3: Higher candidates taking physics 2001–2013 as a percentage of total entries to Higher[12]



[12] SQA, *National Qualifications results 2001–2014*

[13] Scottish Government, *Teachers in Scotland Census*, 2014

the increase in those taking Higher or A-level has been smaller in comparison. Since 2009 there has been a 13% increase in the numbers taking physics Higher, bringing the number to more than 10,000 and back to the 2001 figures[12].

In 2014, the first cohort sat examinations and completed assessment for the new National qualifications. From 2015, schools will be able to offer the Curriculum for Excellence Higher. Physics teachers have worked extremely hard to implement the changes to the curriculum, develop new material and carry out the new assessments. This work has been supported by IOP Scotland through the Physics Teacher Network. It is difficult to predict how these changes may affect the numbers choosing physics qualifications in the future.

In addition to the curriculum change, there is concern that in Scotland we are going to face a shortage of specialist physics teachers. Since 2007, the number of physics teachers in post has decreased by 7%[13]. Responses to our survey show that those working in education still receive the lowest income compared to other sectors (figure 9, p15) and when comparing graduates by age we can see that the number going into teaching has been declining (figure 13, p17). We need specialist physics teachers in secondary schools to inspire and guide the next generation of physicists. This looming shortage is something that IOP Scotland will continue to monitor and investigate.

2

Physics careers

Physics-based businesses make a significant contribution to the Scottish economy. They hold 4% of the workforce and their contribution to the economy increased by £1 bn to £8.5 bn in the period 2005–2010[14]. In this period there was a 9% increase in the total number of physics-based jobs. Despite the economic downturn, the employment prospects for physicists have remained positive and this is reflected in responses to the survey.

2.1. Sectors employing physicists

In 2013 there were more than 12 million graduates working in the UK with more than 40% employed in public administration, education and health care[15]. A similar percentage of our survey respondents (45%) work in these sectors.

Physicists are employed by a wide range of sectors, as can be seen in figure 4. This demonstrates the flexibility of physicists and the demand for the skills and knowledge gained through a physics qualification.

Given that a large proportion (more than 40%) go on to complete some form of further study, it is of interest to identify the sector where those holding a higher degree (e.g. MSc or PhD) go on to work (all sectors shown in figure 14, p17) and an example comparison is shown in figure 5.

- More than 65% of those working in *university education* hold a PhD while in *school education* this drops to just over 6%.
- *Government – research laboratory* employs the highest proportion of PhD holders (with 83%) while no-one in the *armed forces* holds a PhD.
- The top three sectors for those employing a large proportion of MSc holders are: *health and care* (23% hold an MSc – this could be in medical physics or a related discipline), *other service industry* (21% – further qualifications in areas such as law, business and marketing would be relevant) and *school education* (17% – a large number of these are likely to have an education-related qualification).

[14] Institute of Physics, *The Importance of Physics to the Scottish Economy*, October 2012

[15] ONS, *Graduates in the UK Labour Market*, 2013

Figure 4: Current sector of employment of respondents (%)

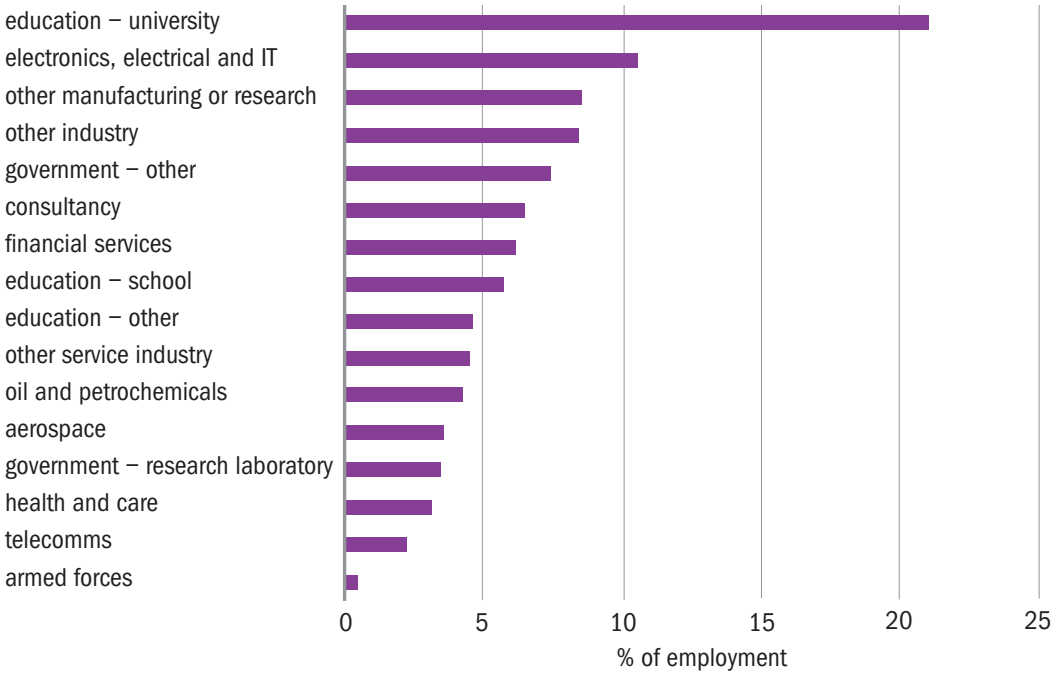


Figure 5: Comparison of qualifications held by current sector: education – university and education – school. All sector data can be viewed in Appendix, figure 14, p17

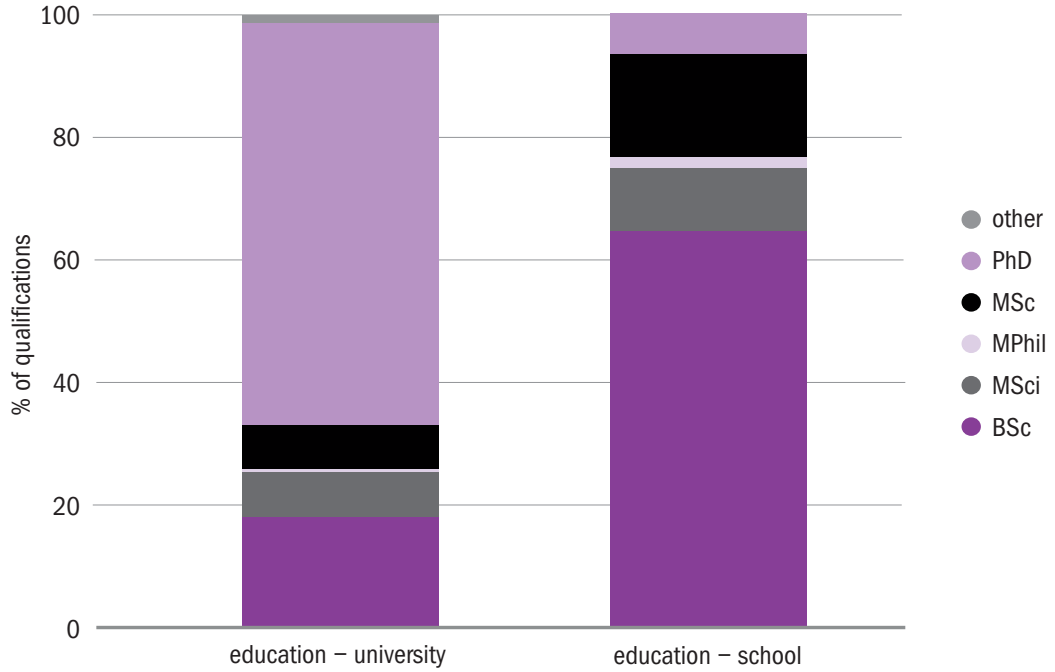


Figure 6: Current sector of employment compared with 2009 survey

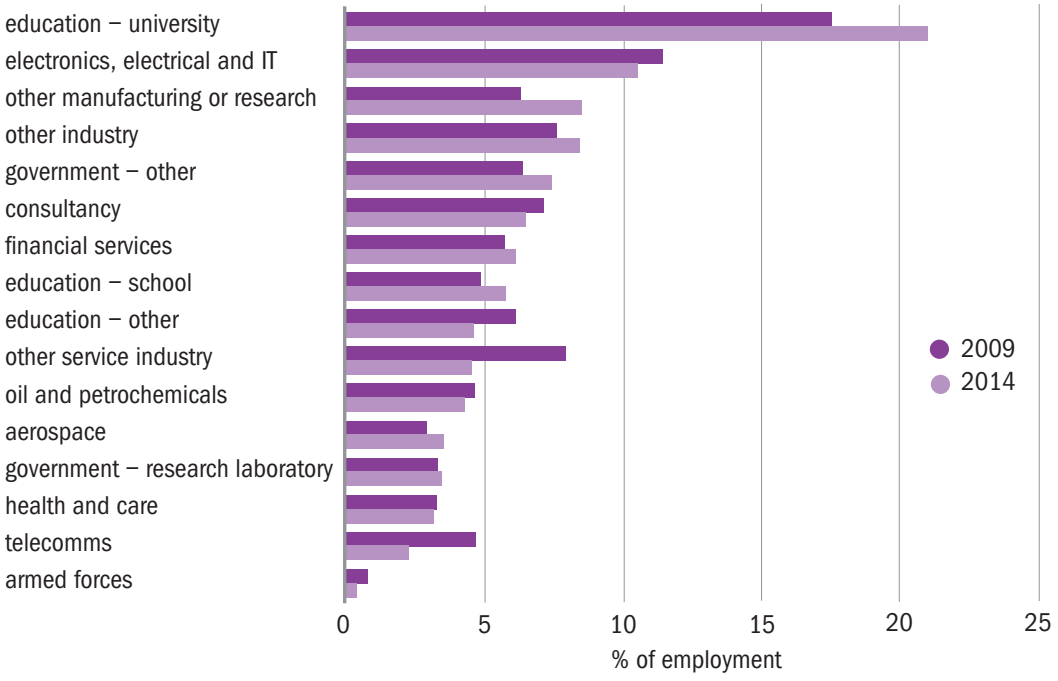


Table 3: Sector of first job compared with sector of current job

First job	Education	Government	Industry	Services	Total
Education	66.2	9.2	16.2	8.5	**100**
Government	15.5	44.7	24.3	15.5	**100**
Industry	13.2	5.3	64.4	17.1	**100**
Services	13.2	4.1	22.3	60.3	**100**

Due to the recession, several sectors have experienced large changes in employment. However, when we compare the current employment sector of our survey respondents with those in 2009 (figure 6, p11) there are no significant changes.

There are only a few small shifts in the sectors employing physicists. This is reassuring given the difficult economic situation over the past five years since the last survey.

- There has been an increase of 3.5% in those being employed in *university education*. The Scottish Universities Physics Alliance (SUPA) added two more universities to the collaboration in 2009 (Aberdeen and Dundee joined Edinburgh, Glasgow, Heriot Watt, Strathclyde, St Andrews and the West of Scotland) and additional research themes. SUPA has supported members in terms of strategy, staff and student recruitment and funding applications, so, this is likely to have positively affected recruitment in this area.
- The largest drop (3.4%) was in the *service industry*, which could reflect the changes in the economy.
- The telecoms sector saw a decrease of 2.4% and the *electronics, electrical and IT* sector saw a drop of 0.9%. These drops are surprising given the current growth estimates for these areas in Scotland. This trend was also seen in graduate recruitment (figure 13, p17). Are physicists becoming less interested in this as an option or are employers recruiting from other degree subject areas?
- *Other manufacturing or research* saw an increase of more than 2% and this could reflect the growth in the renewable energy sector in Scotland. The Scottish government is aiming for 100% of the electricity that Scotland consumes to come from a renewable sources by 2020. As a result, there has been a large amount of investment in research and manufacturing in this sector.
- The remaining sectors saw small increases or decreases.

Respondents were grouped into one of four categories. An explanation of these categories can be found in the Appendix. We can see from table 3 that a large proportion of physicists change sectors. This demonstrates the demand for skills and knowledge of physicists and the flexibility of physics qualifications.

- Based on the first sector employed, *education* has retained the highest proportion at more than 66%, but the *industry* and *services* sectors also retained more than 60% while for *government* this falls below 50%.
- The top destination for physicists is *industry*. 16.2% had their first job in *education*, 24.3% in *government* and 22.3% in *services*. The top destination for those who started out in *industry* is *services* (17.1%).
- Interestingly, similar proportions of those in *government, industry* and *services* move into some form of *education* (13–16%).
- There is only a small movement from *education* (less than 10%), *services* and *industry* (4–5%) into *government*.

In the 2009, we saw that a significant

proportion of physicists work outside the UK. However, percentages working in Europe, North America, Asia/Pacific and the rest of the world have all decreased since 2009. This could be explained either through increased international competition for jobs and/or unfavourable economic conditions.

2.2. Earnings

There has been an increase in the percentage earning higher wages compared with 2009. This echoes increases in the wider economy where the median gross annual earnings increased to £27,000 in 2013, up from £25,100 in 2008[16, 17]. We also find physics graduates within the top five subjects for average annual gross pay (table 4).

Since our 2009 survey there have been small shifts in earnings (figure 8, p14).

- In 2014, 57.8% earned more than £40,000 compared with 52.2% in 2009.
- The percentage earning more than £50,000 has increased from 37.5% in 2009 to 43.7% of respondents in 2014.

When the responses are broken down into four main sector areas, we can see the large variation in earnings.

Table 4: Top five undergraduate subjects for average annual gross pay[18]

Subject	Average annual gross pay
Medicine	£46,000
Engineering	£42,000
Physics	£36,000
Architecture	£35,000
Maths and computer science	£34,000

- *Services* has the highest proportion of those earning more than £100,000 out of the four areas (26.2%), closely followed by *industry* (22%).
- *Education* and *government* have a much smaller proportion earning more than £100,000 (5% and 6.6%, respectively).
- We see that *education* has more in the lowest wage bracket than any other sector. The lower remuneration is often cited as one reason for the lower popularity of the sector. With a looming shortage of physics teachers in Scotland, this is an area of concern.

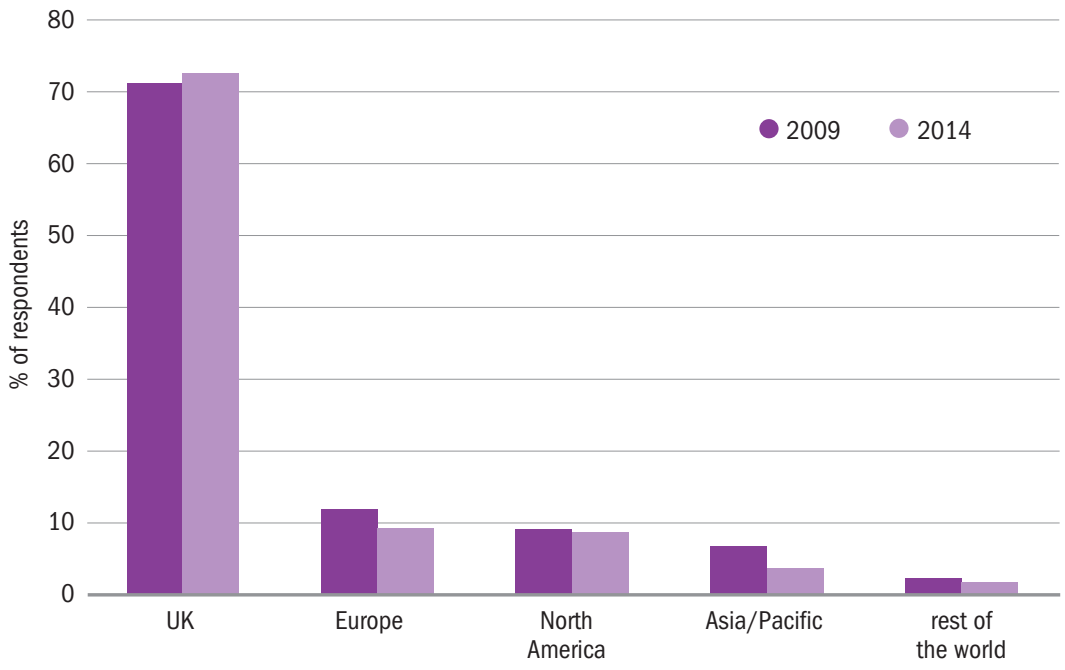
When looking at the highest qualification of the survey respondents we find a slightly

[16] ONS, *Graduates in the UK Labour Market*, 2013

[17] ONS, *Annual Survey of Hours and Earnings*, 2008

[18] ONS, *Graduates in the UK Labour Market*, 2013

Figure 7: Comparison of location of respondents between 2009 and 2014



higher percentage of those with a PhD earning more than £40,000 and £50,000 compared with those holding a BSc, but the difference is small.

2.3. Gender differences

Tapping all our Talents[19], a report by the Royal Society of Edinburgh, concluded that the loss of women from science, technology, engineering and mathematical (STEM) career is a major loss to the Scottish economy and society. This shows the importance of monitoring gender in studies such as this one.

Around 20% of the respondents to the survey were female. This roughly mirrors the average gender split in university physics departments[20]. This section will examine differences between the male and female respondents.

- More than 51% of male respondents' highest qualification is a BSc, this compares with 41% of women.
- For all other types of qualifications, a higher proportion of female respondents than male hold the qualification.

This is in contrast to what has been found elsewhere by the Institute of Physics. Based on national data, females are more likely to take a BSc, less likely to take an MSci and more likely to take an MSc. This difference could be explained by the composition of the sample of this survey or could be related to the time that it takes to complete the qualifications, which is one year longer than in English HEIs.

In section 2.2, we saw that more than 57% earned more than £40,000 and more than 43% earn more than £50,000. The figures for male and female respondents are as follows:

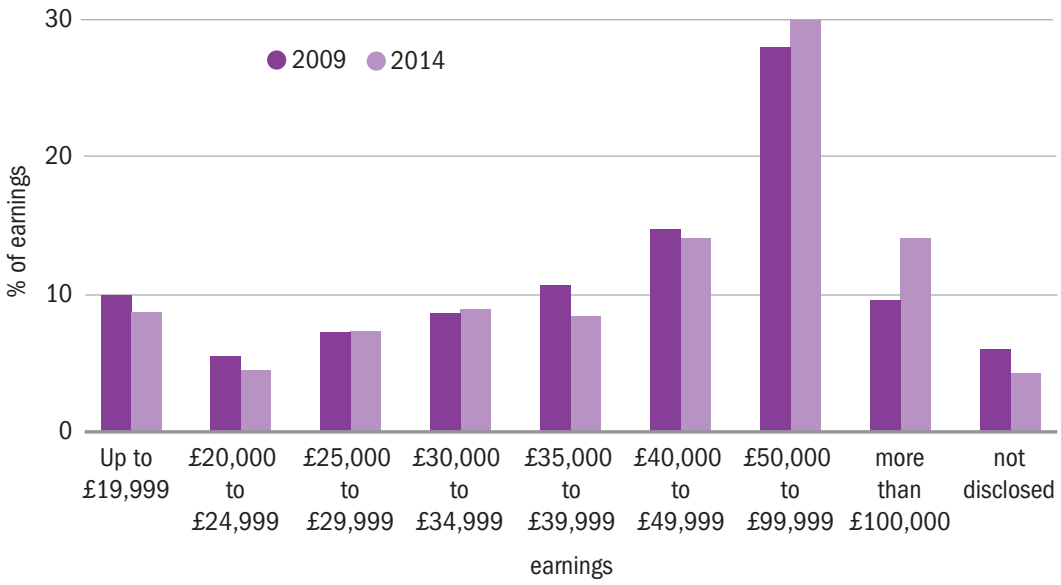
- More than 62% of male respondents earn more than £40,000 compared with less than 40% of females.
- When it comes to earnings of more than £50,000, 49% of male respondents earn above this figure while just 22% of females fall into this category.

The difference in pay between male and female graduates is not restricted to physics but is seen across all subjects. In 2013, the Office for National Statistics found that

Table 5: Comparison of earnings by highest qualification held

Earnings	BSc	PhD	Difference
More than £40,000	59.2%	64%	4.8%
More than £50,000	45.4%	48.8%	3.4%

Figure 8: Comparison of stated earnings between 2009 and 2014



[19] Royal Society of Edinburgh, *Tapping all our Talents: Women in science, technology, engineering and mathematics: a strategy for Scotland*, April 2012

[20] Institute of Physics, *Statistical Report: Physics Students in UK Higher Education Institutions*, 2012

male graduates earned on average £3 per hour more than females[21]. It was suggested that this was being skewed by the larger number of males in the more highly-rewarded subjects, e.g. physics, engineering, but we have seen that within the physics graduate grouping there is still a gap in earnings between genders, so, this difference is yet to be explained fully and merits further investigation. The Institute of Physics carries out an annual salary survey of members and this data shows that the gap between male and female graduates starts to open just one year after graduation.

[21] ONS, *Graduates in the UK Labour Market*, 2013

Figure 9: Earnings by sector (excluding retirees and those on a career break)

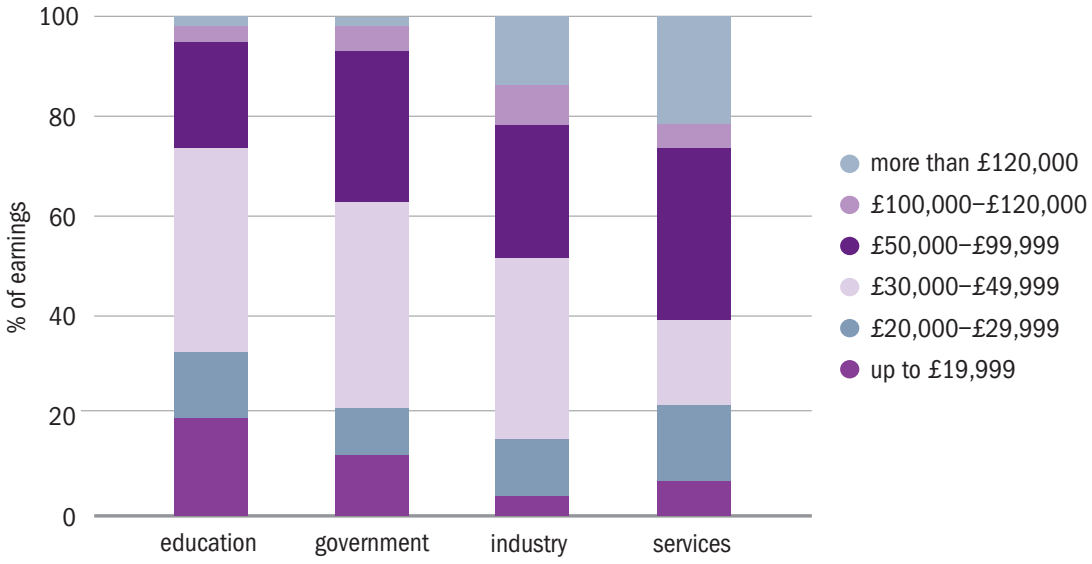
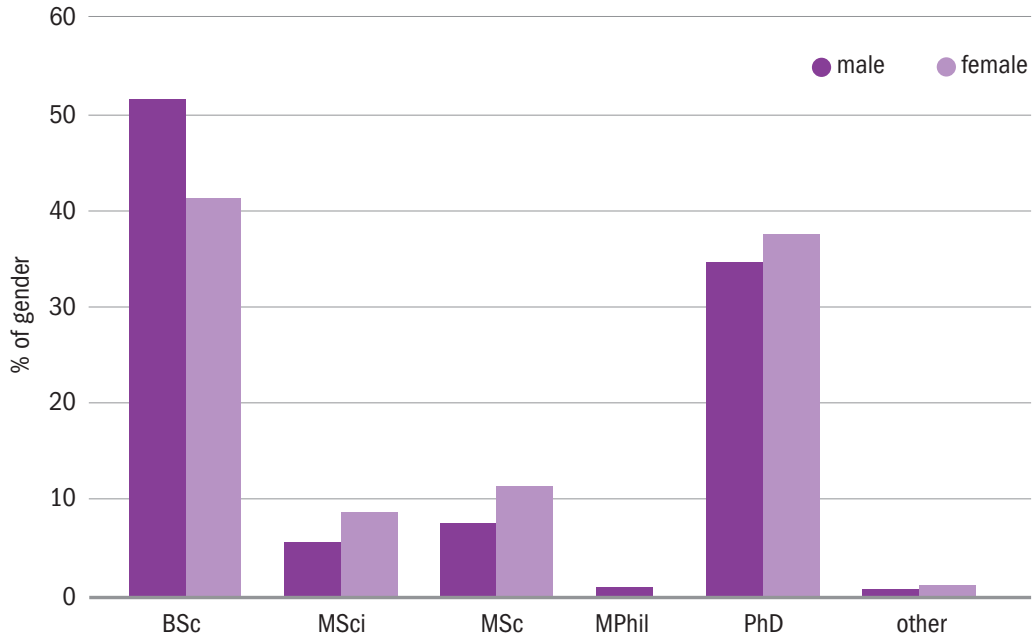


Figure 10: Type of qualification held by gender



There are distinct differences in the gender split across the sectors (figure 12).

A higher proportion of women can be found in the sectors to the right-hand side of figure 12. It is difficult to draw conclusions as to why these sectors employ a higher proportion of female respondents.

The Institute of Physics is active in tracking and trying to address gender imbalances. Information on the work carried out can be found at **www.iop.org.uk/diversity**.

Figure 11: Earnings by gender

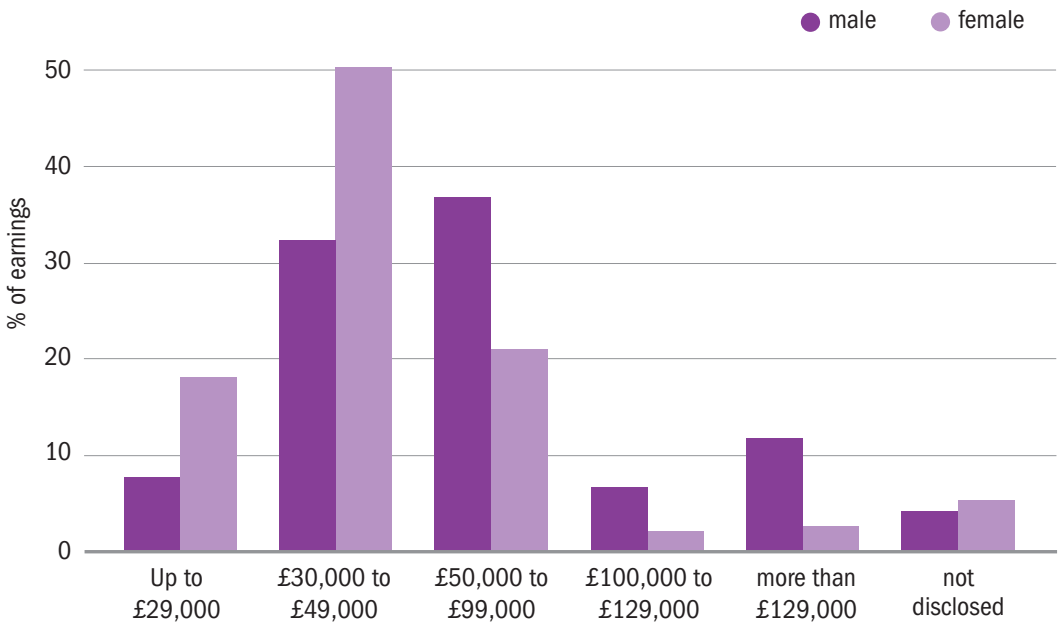
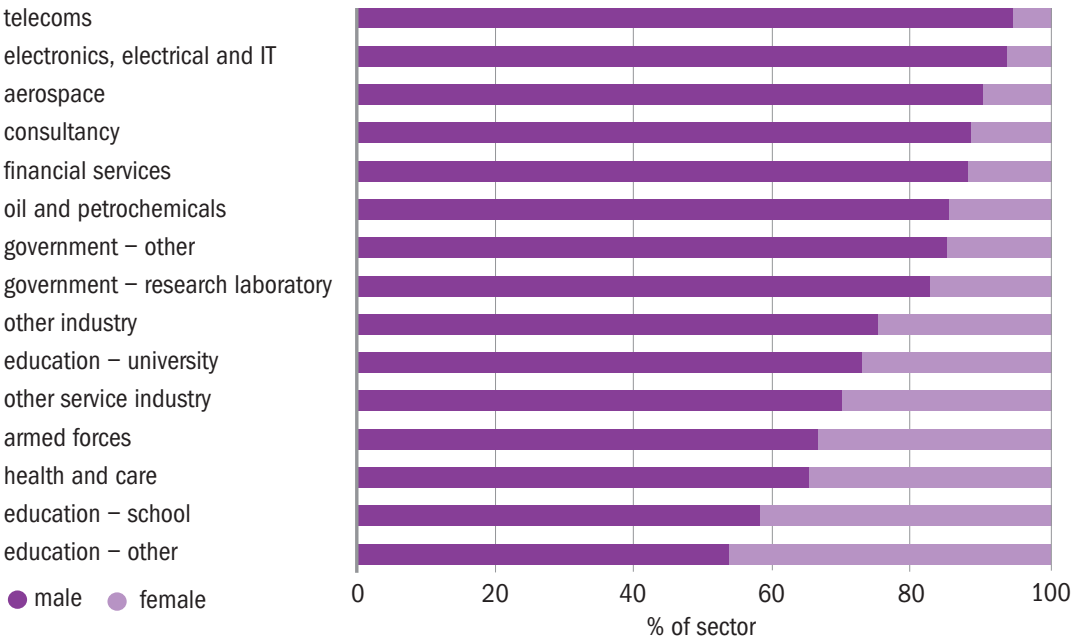


Figure 12: Gender split by sector



Appendix

Figure 13: Sector of respondent's first job grouped by age

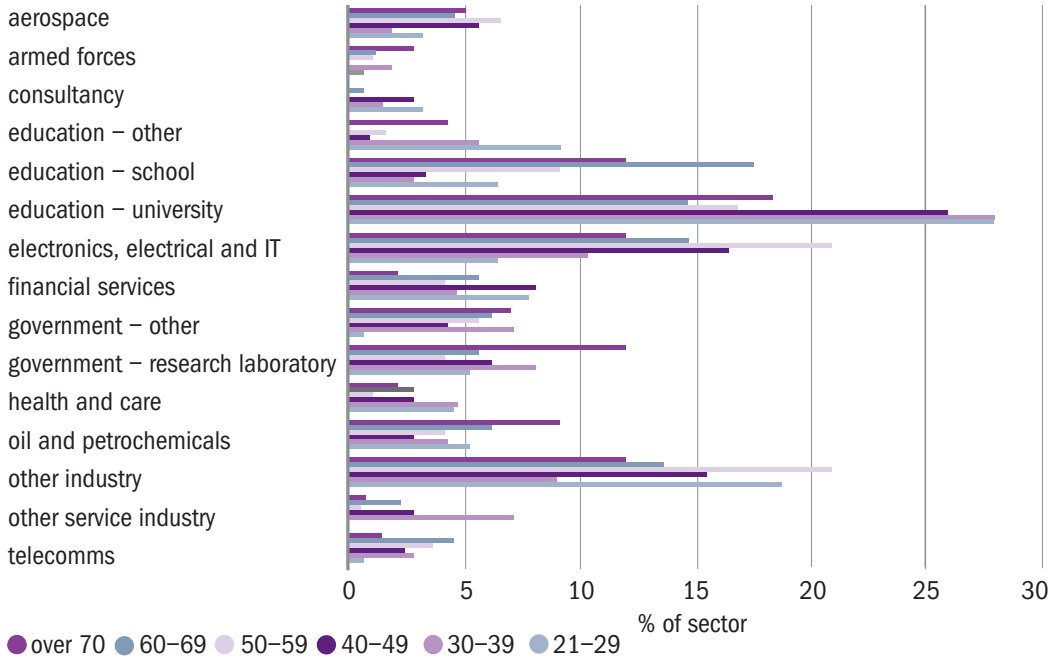
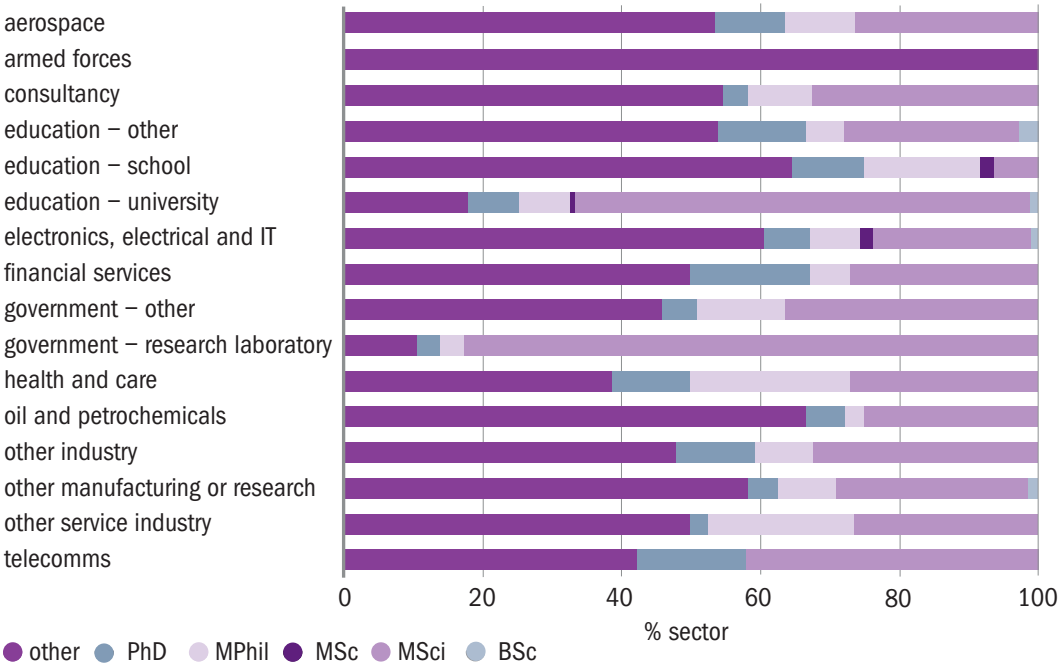


Figure 14: Qualifications held by current sector



4

Categorisation of jobs

In some places we have grouped jobs together in education, services, industry or government. Respondents made their own choice of sector, for example they were asked to indicate their current sector of employment and options were pre-fixed with one of those four choices:

Table 6: Q6 – what is your current sector of employment?

Education	Government	Industry	Services
School	Armed forces	Aerospace	Consultancy (scientific/technical)
Sixth-form college	Central government or civil service in government	Agriculture	Consultancy (management)
Further/higher education	Regulatory body	Forestry or fishing	Contract R&D
University	Research council	Chemical	Financial services
Other	Research laboratory	Petrochemical	Health and care services
Other education, please specify	Other government	Electrical	Interest groups (professional body, learned society, trade union)
	None of the above, please specify	Food, drink and tobacco manufacture	Legal services
		Oil	Other services, please specify
		Information systems engineering	
		Light manufacturing	
		New media, i.e. web design, editing or electronic publishing	
		Nuclear fuel processing	
		Electronics/IT/software	
		Publishing	
		Printing	
		Telecommunications	
		Transport	
		Other industry, please specify	
Career break			
Retired			

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