



The impact of doctoral careers

Policy briefing

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This briefing has been produced for policymakers and those involved in the funding, design and delivery of doctoral study within the UK. It is based on research conducted between Spring 2012 and Spring 2014 with doctoral graduates and their employers. The study provides evidence of the roles doctoral graduates fill in the labour market seven to nine years after graduation, the impact they have and the benefits they bring to organisations, the economy and wider society.

Introduction

This study considers the medium term career pathways and destinations of graduates who completed their doctorate at a UK institution. Economic theory suggests that individuals with higher levels of education may have greater ability to adapt or create new technologies and inventions which are central to economic growth and future job creation. Innovation of this nature can generate other societal benefits, such as reducing carbon emissions or improving the quality of life for people. Additionally, those with higher levels of education may also be able to pass on some of their skills and knowledge in the workplace, boosting the productivity of those around them. Based on this theory, it is possible to hypothesise that doctoral level study could result in both public and private benefits. Until this research was undertaken little was known about these public benefits and previous longitudinal studies tended to be smaller scale and / or focus on doctoral graduates from specific disciplines.

This briefing summarises the findings from the study. It provides evidence that supports the continued public investment in doctoral level study and the potential consequences of sub-optimal investment in doctoral education, including a reduction in the efficiency and competitiveness of our economy.

What do doctoral graduates do?

50 per cent of doctoral graduates responding to our survey work in higher education. However this masks differences by subject discipline; graduates with doctorates in arts and humanities (62 per cent) and social sciences (65 per cent) are most likely to be working in this sector. Manufacturing and engineering (10 per cent) and research and development (10 per cent) are the main employment industries outside of higher education that doctoral graduates responding to our survey are working in. The full report sets out further information on the key sectors and roles that doctoral graduates are working in seven to nine years after graduation. Here we focus on the extent to which graduates are using the research skills developed during doctoral study and are involved in undertaking research.

Research can play a vital role in the competitiveness and growth prospects of an economy. 24 per cent of our survey respondents are working in predominantly research roles in higher education or elsewhere. However this is likely to be an under-estimate of doctoral graduate involvement in research. We know, for example, that those working in higher education teaching roles are also likely to undertake research. 31 per cent of survey respondents employed in the UK stated that they conducted research most of the time

in their current employment, whilst a further 34 per cent conduct research some of the time.

Those undertaking research often have high levels of involvement in the formation of new knowledge and understanding, which can consequently lead to the development of new goods and services. Researchers also facilitate the adaptation and utilisation of new technologies within organisations, thus boosting productivity.

Generally, doctoral graduates responding to our survey are satisfied or very satisfied with their current role, and in particular with the intellectual challenge. However researchers working in higher education are least satisfied with their current role, and express particular concern over job security and career prospects. Only 26 per cent of researchers in higher education are employed on a permanent or open-ended contract seven to nine years after graduation, which is significantly lower than the proportion of any other occupational group surveyed; for example, 83 per cent of researchers working outside higher education are on permanent or open-ended contracts seven to nine years after graduation.

While we have no evidence that less than attractive conditions for researchers in higher education are adversely impacting on the sector, it is also arguable that this is unlikely to be helpful in attracting talented researchers either. There is a possible risk that researchers may avoid entering the sector, despite this being a time when the UK needs to maintain and build upon the strength of its research base.

The value of doctoral graduates to employers

Although many roles outside academia do not formally require candidates to have a doctorate, doctoral graduates bring a range of key skills to an organisation which can benefit the employer. Overall, the employers we spoke to are very positive about the quality of their doctoral graduates' work and the attributes they bring to the organisation. Employers particularly value the following skills and attributes of doctoral graduates.

Specialised knowledge

This is especially the case where there is a business need for in-depth knowledge such as in businesses based on science and technology. However, employers in other sectors also stress the importance and impact of specialist knowledge on their business.

“One of our doctorates was key, through their knowledge of the subject matter, to us winning new business. It was a major win, it was an in-road for a new client as well, which was even better because it opened the door [...] and clearly when other projects followed, they were keen to have this individual work on their projects.”

Small employer, research and development.

Research and analytical skills

In completing a PhD, graduates are required to review and formulate rigorous research methodologies, as well as collect and analyse data. Employers reported how these skills are then applied in the workplace, raising the quality and improving the robustness of the work produced and providing the stimulus for new issues to be explored.

“There are individuals with doctorates that have developed new research ideas that are truly innovative. [...] [It’s] definitely the case that there’s a real value there. I think some of that will come again from the rigour of the thought process in terms of understanding and being able to look at a problem and think very widely around it, and think laterally around it.”

Large employer, finance, business, IT and legal.

Problem solving skills

Doctoral students are often faced with problems that need to be overcome. The ability to define and solve a problem in a dynamic working environment is highly beneficial to employers in a variety of sectors and can lead to new ideas and innovation.

“Some of our business units come to us and say we’ve got a problem with this aircraft material and we employ doctoral graduates to think through those problems, understand the theories, be able to apply that practically to problems and come up with solutions which may be totally new solutions that nobody has thought of before.”

Large employer, manufacturing and engineering.

Commercial awareness and the inter-personal skills required to work successfully in a team are two attributes that some employers whom we spoke to feel are sometimes lacking in doctoral graduates. Work experience outside

academia is crucial for many employers, particularly as it provides evidence of doctoral graduates’ ability to work in a commercial environment.

Some doctoral graduates report that they have sometimes experienced negative stereotypes of their skills and attributes; however, these were not typically shared by employers who have direct experience of employing doctoral graduates. There may also be a need for more effective communication of the value of employing doctoral graduates in certain roles and sectors in order to maximise both the opportunities available to doctoral graduates themselves and the benefits of their skills to employers and the UK economy.

Contribution to innovation

Innovation and technological progress are vital for an economy to experience long-term economic growth and improvements in its productive potential. Pre-requisite skills for innovative people are detailed subject knowledge, a creative mindset and strong problem solving skills. As indicated above, these are all attributes doctoral training appears to develop. This research illuminates the ways in which doctoral graduates innovate and thus contribute to the performance of business and the economy overall.

Almost all employers interviewed felt the doctoral graduates they employ contribute to innovation. Graduate and employer interviewees gave a diverse and impressive range of examples of how they had innovated, from improved telecommunications products to the detection of cybercrime; from creating new flavours for the food industry to reducing multiple births resulting from fertility treatment; and from re-opening airspace following the Icelandic volcanic eruption to speeding up the assessment of financial claims.

Figure 1 shows the involvement of doctoral graduates responding to our survey in different types of innovative activity. For each type of innovative activity in the graph, at least 50 per cent of respondents stated that their doctorate was either essential or important in enabling them to innovate in this way, confirming the value of the doctorate to innovation.

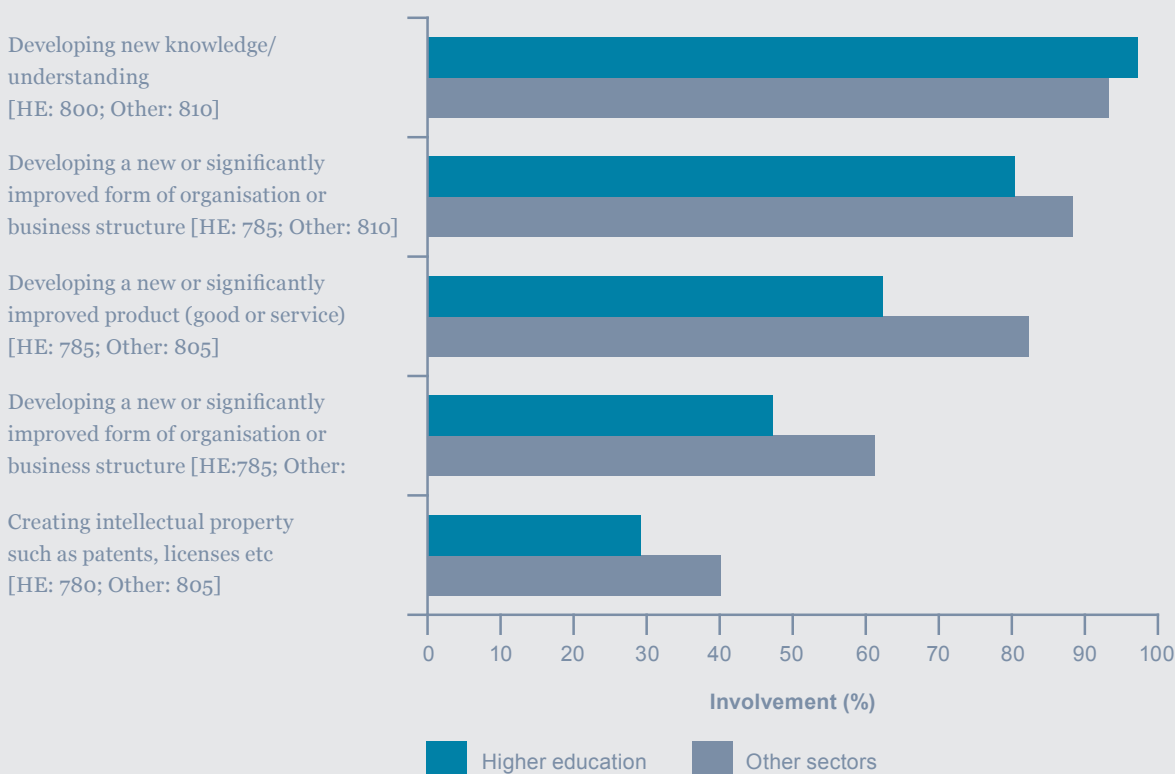
Doctoral graduates also support innovation by contributing to their employer’s absorptive capacity – that is the organisation’s ability to identify, adapt and integrate new technologies and ideas. Absorptive capacity is important for innovation, with recent evidence finding positive impacts of absorptive capacity on growth and productivity outcomes.¹ Our

research shows how doctoral graduates can be instrumental in connecting linking knowledge generation and application. They bring the latest knowledge and ideas to their employers and provide the necessary insider understanding, contacts and credibility to forge effective connections with academia.

“The doctoral graduates are a good bridge between us and the universities we collaborate with - they understand how universities work and academic language better than someone with a first degree.”

Medium sized employer,

Figure 1:
Doctoral graduate involvement in different types of innovative activity.



¹ Allas, T. (2014) Insights from international benchmarking of the UK science and innovation system BIS https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/277090/bis-14-544-insights-from-internationalbenchmarking-of-the-UK-science-and-innovation-system-bis-analysis-paper-03.pdf

research and development.

Figure 2 shows that high proportions of survey respondents, both in and outside higher education, have been involved in enabling acquisition or adaptation of knowledge, ideas or technologies.

Impact

Previous research has often focused on the private returns to doctoral study. However, the work of doctoral graduates could have an impact on employers, the economy and wider society, which needs to be understood if we are to ensure that we do not under-invest in this form of education. Impact for employers can be generated through doctoral graduates' contribution to innovation, and/or as a result

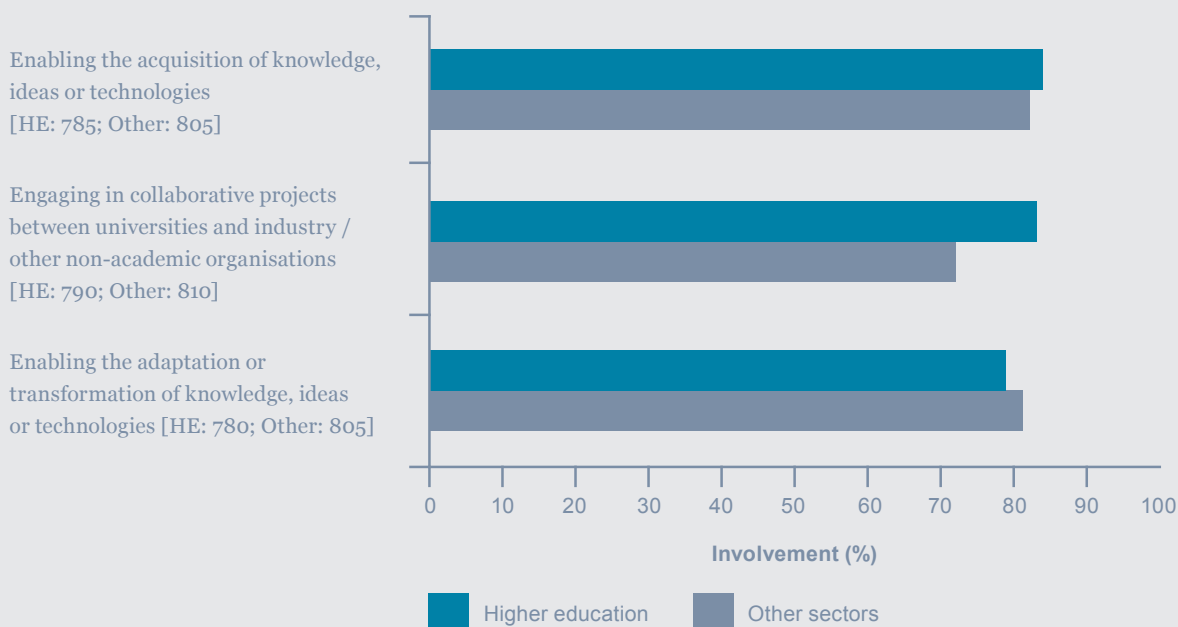
of the essential or value-added contribution that they make to the organisation that employs them. The research found that doctoral graduates create impact for their employers by contributing the following:

- *Generating income or directly enhancing profitability*
- *Enhancing competitiveness*
- *Enhancing profile or credibility*

Generating income or enhancing profitability

Doctoral graduates taking part in our research are often involved in the development of new products or services. Our interviews with employers highlighted how new or improved products contribute to increased revenue. Examples were also given of doctoral

Figure 2:
Doctoral graduate involvement in activities that contribute to absorptive capacity.



graduates contributing to winning new clients, business or income streams.

Increased productivity, efficiency gains and savings

Interviews with graduates and employers highlighted how the creative thinking and problem-solving skills of these employees had helped to generate new ideas and opportunities on how to increase efficiency or solve long-standing problems. The confidence and resilience to bring forward and progress ideas are essential for these positive changes to be made, with the doctorate being influential in developing these attributes.

Enhanced profile or reputation

In our interviews with graduates about the benefits of doctoral study, individuals did discuss how their qualification led to them being treated with greater respect by family members and the wider community. Yet, employing doctoral graduates can also raise the profile and reputation of their employer, as their contribution to a particular project or produce can often be seen as indicating that the final output is of high quality. Furthermore, in some instances, the rigour and strength of the work conducted by these graduates lead to the company winning

awards, raising their status and profile, as this small company notes.

“From a company point of view we have won awards for research we couldn’t have done without our doctors.”

Small employer, research and development.

Spillover effects

The research also provides evidence of the ‘spillover’ of doctoral training benefits to others who work alongside doctoral graduates. 90 per cent of doctoral graduates working outside of higher education who completed our survey have contributed to improving the problem solving skills of others and 88 per cent have helped others to think more creatively. Approximately half of the employers we consulted clearly stated that they felt their doctoral graduates influenced others that they worked alongside in some regard. This influence is achieved by:

- *Inspiring and motivating others*
- *Insistence on rigour in research, raising the quality of others’ work as a result*
- *Acting as mentors or coaches*
- *Providing peer support*
- *Generating ideas and encouraging others to be creative*
- *Working as educators and/ or acting as role models for students at all levels.*

Example: Health and safety in the Olympic park.

This large government agency developed a new software tool to support safety culture in organisations. The tool was compulsory on the Olympic Park as part of the legacy programme to ensure that construction companies were building to the highest possible health and safety standards. A doctoral graduate developed this with other colleagues but was described by the employer as the “intellectual engine” behind the

innovation. The tool is now available as a commercial product and is sold all around the world.

“It’s generating substantial revenue for us and it’s clearly having a big impact on those organisations that buy it because those of them that report back to us, 90 per cent of the time report a significant improvement in their safety performance.”

Example: Improving efficiency within the business.

Owing to a change in European Union law, a finance, business, IT and legal sector employer needed to improve the efficiency and accuracy of how subsidy claims were calculated to avoid being fined for incorrect payments. The existing system was regarded as inefficient, requiring claim agents to manually search across several databases to calculate a payment. Doctoral graduates were

tasked with designing a system that could automate and therefore speed up the data mining process.

“As part of [the graduate’s] work they built a suite of scripts and processes that helped the team validate these payments, in probably about a tenth of the time that they would have done through the manual process.”

Conclusions

This research shines a light on the careers of doctoral graduates seven to nine years since they graduated. It also contributes to filling a research gap in terms of understanding some of the benefits of doctoral study for employers, the economy and society.

Our research found that while working as a researcher in higher education is a common destination on graduation, doctoral graduates can become disillusioned or find work outside higher education more attractive. **There is a need to address this as otherwise there is a risk that the sector is not maximising the benefits of talented researchers.**

Our research provides evidence from graduates and employers that doctoral graduates can play an important role in bridging the divide between industry and universities. **It may be worth exploring further how collaboration between small and medium enterprises (SMEs) in particular and universities can be developed, as this is likely to prove mutually beneficial.**

The innovations graduates contribute to benefit their employers through increased sales and improved profitability, but our research has also illustrated the wider benefits to society of the work of doctoral graduates, for instance through improved health and wellbeing, reduced environmental harm and cultural enrichment.

Employers clearly value doctoral graduates and their contribution to innovation and generating impact. Employer concerns over the skills that doctoral graduates may lack generally relate to their ability to adapt to working in a commercial environment. Work experience outside academia (alongside the PhD) is important for many of the employers we spoke to. **Therefore it is important for early doctoral graduates to consider how they can build their experience whilst completing their doctorate, which would consequently increase their employability and may enable them to access their desired career paths more quickly.**

Case study 1: Environmental and economic benefits.

PassivSystems provides homeowners and businesses with the information and tools to control and optimise energy usage, delivering significant energy and cost savings. This SME has only a handful of doctoral graduates working in research and development and business development roles, yet they make an important contribution to the innovative outputs of the company.

For certain roles they look for staff with the academic rigour in research, where a PhD is a bonus, but also with commercial experience and ability in product development. They find doctoral graduates have more in-depth specialist knowledge and problem solving skills.

“They’re more disciplined in research and problem solving and often they bring with them a deeper domain knowledge of areas that they’ve worked on, than someone who’s just done a first degree or an MSc.”

Doctoral graduates excel in innovation and recent innovations in particular have been developed by doctoral graduates. PassivSystems develops advanced heating control systems and their latest product has almost exclusively, in terms of the control algorithms, been developed from research innovation prototyping done by a doctoral level employee. The employee interviewee takes up the story from here:

“Heat pumps are difficult to control and tend to be controlled in a crude way, but I came up with a very mathematical way of controlling them which should make them a lot more efficient.”

This innovation brings benefits for the company in terms of increased competitiveness, as the employer explained.

“I think we will have a very differentiated product. Secondly, it enables us to talk with some amount of confidence and swagger about the product, saying that it is innovative and has been designed on good quality evidence-based research.”

There are benefits for wider society and the environment too from these innovations. More efficient heating control systems can help the country decarbonise and contribute to the government’s vision for a cleaner society. Yet, what many people care about far more than carbon is money. This innovation could save 20 to 40 per cent off people’s bills. A lot of the heat pumps are used in social housing, saving money for councils and people in social housing, which is a big positive too.

Case study 2: Improving health and wellbeing.

Collaborative work undertaken by the Human Fertilization and Embryology Authority has helped to reduce multiple births resulting from fertility treatment and the associated risks to the children.

About a tenth of the organisation's 60 employees have science doctorates and work as inspectors with responsibility for inspecting laboratories that conduct IVF.

While not a requirement for the role, doctoral graduates bring robust ability in analysis and critical thinking. They have a strong attention to detail and can understand complex scientific literature. They also have a high level of credibility as inspectors. As the organisation has moved towards greater use of statistical analysis, doctoral graduates have increasingly provided an important skill set to the team, complemented the strengths of others without doctorates and helped to influence the skills of other staff with, for example, a clinical rather than research background.

“Those skills, they do rub off on other people, I have to say. That confidence with number, data, analysis, that confidence I think that brings a real genuine benefit to the team without which we probably would struggle.”

The ability of doctoral graduates to communicate analysis more widely was also highlighted as an area where they add value.

“When [a doctoral graduate] goes out on inspection, he will take some quite complicated stats and he's able to explain those to the sector and explain how they can use these analyses to improve their success rates and improve the quality of service they provide.”

Twin pregnancies can carry a higher risk of premature birth, low birth weight, cerebral palsy and other lifelong problems. The Authority are trying to encourage clinics, where possible, to reduce their multiple birth rate by making good choices and not putting two embryos back if it's not needed. Through their analysis, they can tell clinics when their multiple birth rates are higher than the norm.

As a team, they have developed a new system which involves analysing success rate data in real time. This can be fed back out to clinics and then used that as a risk management tool. Almost a quarter of all IVF births previously resulted in a multiple birth; the work of this organisation has reduced this to about 15 per cent. While this major achievement was a team effort, doctoral graduates made an important contribution.

“That's quite a few babies not born prematurely, not born with life-long problems. [...] I think the skills that those doctoral scientists bring have been, yes, have contributed. It's not all of course but [...] if you didn't have those individuals in the team who are confident with data and analysis, it would be harder to achieve those things.”