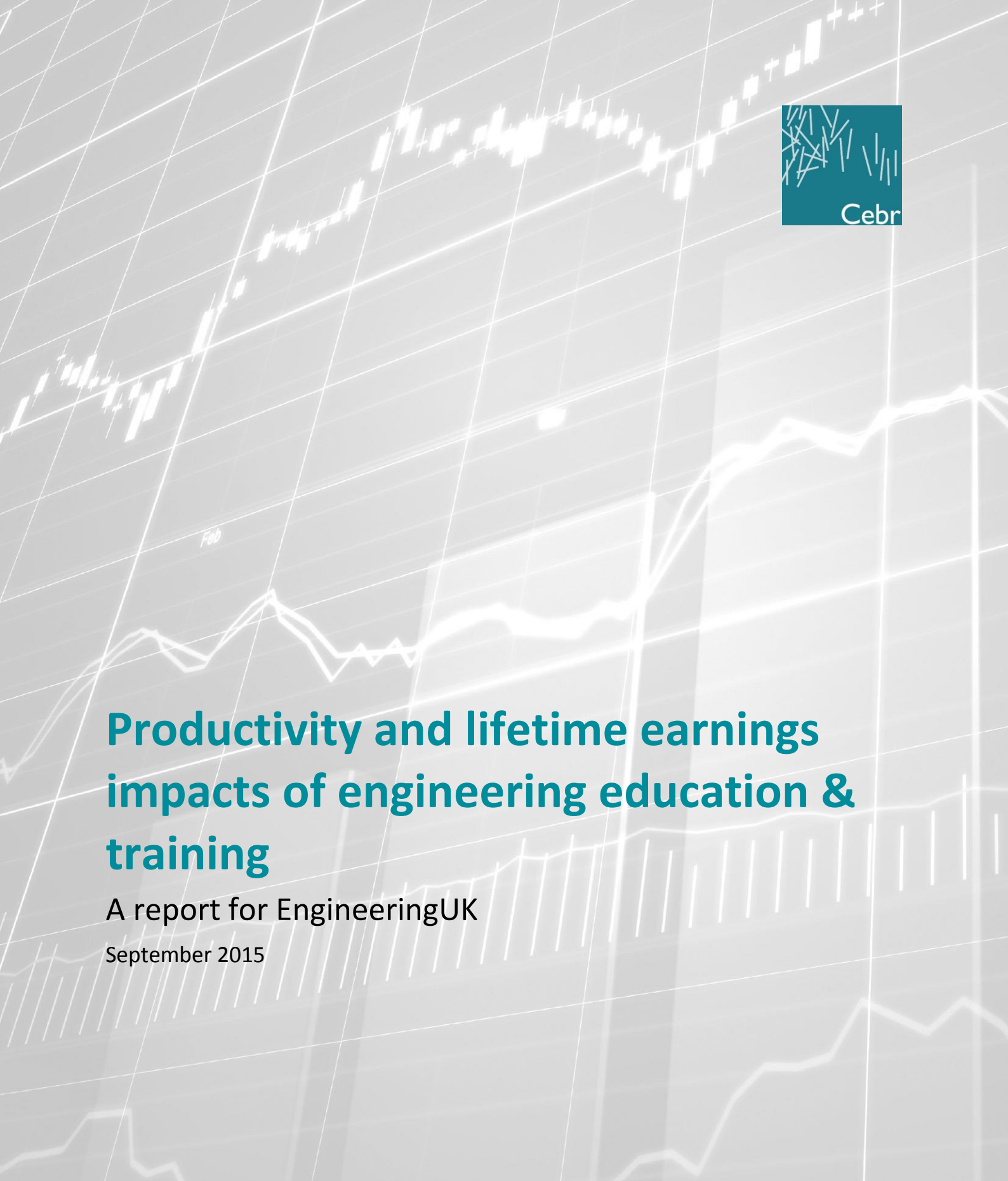


# Productivity and lifetime earnings impacts of engineering education & training

A report for EngineeringUK

September 2015

Cebr

**Authorship and acknowledgements**

This report has been produced by Cebr, an independent economics and business research consultancy established in 1992. The views expressed herein are those of the authors only and are based upon independent research by them.

The report does not necessarily reflect the views of EngineeringUK.

London, September 2015

# Contents

# Executive Summary

This report presents a series of new analyses carried out by Cebr for Engineering UK that explore the economic impact of engineering in the UK. The report is divided into three parts; the first chapter quantifies the productivity impact of the engineering sectors' apprenticeship schemes, the second chapter compares the relative economic outcomes of engineering apprentices and graduates in terms of employment, pay and the relative 'lifetime earnings premium' of achieving these qualifications relative to having a standard GCSE or A level education. The final chapter extends the previous research on the economic impact of engineering by providing estimates of impact on GVA and employment at the sub-sector (SIC 3-4-digit) level.

### Productivity impact of the engineering sectors' apprenticeship schemes

- Cebr carried out a new analysis to estimate the net productive benefits to the UK economy of EMT[1] apprenticeship programmes of the 2013/14 cohort of completed apprenticeships over a ten year period commencing at the beginning of training.
- On average, it was found that an EMT apprentice needs to remain as an employee for a **minimum of 7 years including the period of training** in order for the employer to reach a break-even point in respect of their investment in this type of training. Apprentices who start at a younger age produce a larger net productivity benefit and have a shorter investment payback period. **After 7 years, the cost of training has been covered by the increased productivity of employees, and they begin to generate a net productivity benefit.**
- The analysis found that the average EMT apprentice generates a **net productivity benefit of £32,200 after ten years** from the start of training. This represents an **average internal rate of return (IRR) for the employer of 11.8%.** This is higher than the cost of capital faced by most companies, indicating that training apprentices represents a sound investment for employers.
- The analysis found that after ten years from the start of training, the **aggregate productive contribution to the UK economy** from the UK's **49,500 EMT apprentices that completed in 2013/14** is estimated at **£1.6 billion** in 2014 prices.
- **Approximately 371,000 level 3 and 4 EMT apprentices completed their programme between 2005 and 2014**. These individuals are now positively contributing towards the UK's productive capacity as part of the UK's skilled labour force.
- If we assume that the estimated net productivity benefit per EMT apprentice after ten years from the beginning of training was the same for each year cohort, **the productive contribution of the 371,000 EMT apprentices that completed each year during 2005 and 2014 (10 cohorts) amounts to £12 billion (2014 prices).** This contribution is substantial, equivalent to **8% of GVA growth during the period 2005 and 2014**.This indicates that EMT apprenticeship programmes have a sizable impact in boosting the overall productive capacity of the UK economy and that increasing the number of apprenticeships will provide additional benefits.

### Assessing the relative fortunes of engineering graduates and apprentices

- Cebr carried out another new analysis to calculate the net earnings premium associated with Level 2 and 3 apprenticeships in different subject areas. These findings were compared to findings from a 2011 study by London Economics that calculated the net earnings premium associated with attaining a degree in equivalent subject areas.

[1] Engineering and Manufacturing Technologies.

- It was found that the **net lifetime earnings premium associated with an EMT level 3 apprenticeship is approximately £111,900** (2014 prices) – one of the highest amongst apprenticeship subject areas and ranking second after construction, planning and built environment only. This is 26% lower than the net lifetime earnings premium associated with an engineering degree (£151,300). However, the difference between the lifetime earnings premium of an engineering degree compared to an engineering apprenticeship is smaller than the average across all subject areas (26% as opposed to the 29% average across all subject areas).

- The analysis found that, in general, the net lifetime earnings premium associated with gaining a Level 3 apprenticeship is substantial, averaging £80,900 across all subject areas.

- Taking into account the increase in university first degree fees that were imposed in 2012, which were not accounted for in the London Economics paper (published in 2011), evidence from recently published research [2] suggests that the **average percentage differential between a Level 3 apprenticeship and a degree across all subjects has since fallen from 29% to between 18% and 25%**. This means that the economic decision around whether or not to attend university has become less clear than it was in the past with the gap between the payoff from a degree and an apprenticeship inevitably having narrowed. This is accentuated for EMT apprenticeships where the percentage differential with an EMT degree was already smaller at 26%.

- The analysis examined the difference **between the earnings premium of a Level 2 and Level 3 EMT apprenticeship (£64,900 and £111,900 respectively) and found it to be considerably larger than the average** (72% compared to an average of 22% across all subject areas). This likely reflects the range of frameworks – from vehicle maintenance repair to rail transport engineering that fall within the engineering and manufacturing technologies subject area – which encompasses pay levels across the earnings spectrum.

### Breakdown of the 2014 economic impact of engineering in the UK at the sub-sector level

- In the final chapter, Cebr has updated previous research for Engineering UK on the economic impact of engineering to give estimates for 2014. We also extended the analysis by providing estimates of the impact on GVA and employment at the engineering sub-sector (SIC 3-4-digit) level.

- The analysis shows that engineering represents one of the largest sectors in the UK economy, contributing an estimated **£412.2 billion or 27.2% of UK GVA** (gross value added – a measure of economic output) – larger than the retail and financial services sectors combined.

- Total employment in engineering sectors is estimated at **5.6 million in 2014, representing 17.2% of total employment in the UK**.

- Within the engineering sector, **electronic and electrical engineering represents by far the largest sub-sector**, contributing £131 billion in GVA and employing an estimated 1.5 million people in 2014.

[2] Cambridge Econometrics/ Warwick Institute for Employment Research, 2013, 'Review of the Economic Benefits of Training and Qualifications, as shown by Research based on Cross-Sectional and Administrative Data', BIS Research Paper No. 105.

# 1 Productivity impact of engineering apprenticeships

This chapter of the report presents Cebr's new analysis of the productivity boost to the UK economy provided by engineering & manufacturing technologies (EMT) apprenticeship programmes.

The objective of the analysis was to:

- Estimate the costs incurred by companies from employing an EMT apprentice over a ten year period[3] covering the period of training and subsequent years;
- Calculate the productive output benefits associated with employing an EMT apprentice;
- Estimate the net productive benefits to the UK economy of EMT apprenticeship programmes for the 2013/14 cohort of completed apprenticeships for a ten year period covering the period of training.

## 1.1 Key findings

The analysis produced the following key findings:

- the average EMT apprentice generates a **net productivity benefit of £32,200 over a 10 year period** from the start of training;
- On average, an EMT apprentice needs to remain as an employee for a **minimum of 7 years including the period of training** in order for the employer to reach break-even point on their investment in training;
- Apprentices that start at a younger age produce a larger net productivity benefit and have a shorter investment payback period;
- The analysis found that after ten years from the start of training, the **aggregate productive contribution to the UK economy** from the UK's **49,500 EMT apprentices that completed in 2013/14** is estimated at **£1.6 billion** in 2014 prices.
- **Approximately 371,000 level 3 and 4 EMT apprentices completed their programme between 2005 and 2014**. These individuals are now positively contributing towards the UK's productive capacity as part of the UK's skilled labour force.
- If we assume that the estimated net productivity benefit per EMT apprentice after ten years from the beginning of training was the same for each year cohort, **the productive contribution of the 371,000 EMT apprentices (10 cohorts) that completed each year during 2005 and 2014 amounts to £12 billion (2014 prices).** This contribution is substantial, equivalent to **8% of GVA growth during the period 2005 and 2014**.This indicates that EMT apprenticeship programmes have a sizable impact in boosting the overall productive capacity of the UK economy and that increasing the number of apprenticeships will provide additional benefits.

[3] A ten year period is used to frame the analysis for several reasons; 1) as more time passes following the apprenticeship, the apprentice accumulates more experience and on the job training, which makes it more difficult to isolate and attribute productivity benefits to the apprenticeship programme, 2) as time passes, employees are more likely to have moved to other firms and into other sectors, which would likely diminish the net productive benefit that accrues to employers from investing in training, 3) as apprentices become more experienced, they can command higher salaries in the labour market, which diminishes the margin between their wage and their productive output - reducing the net productive benefit associated with investing in their training.

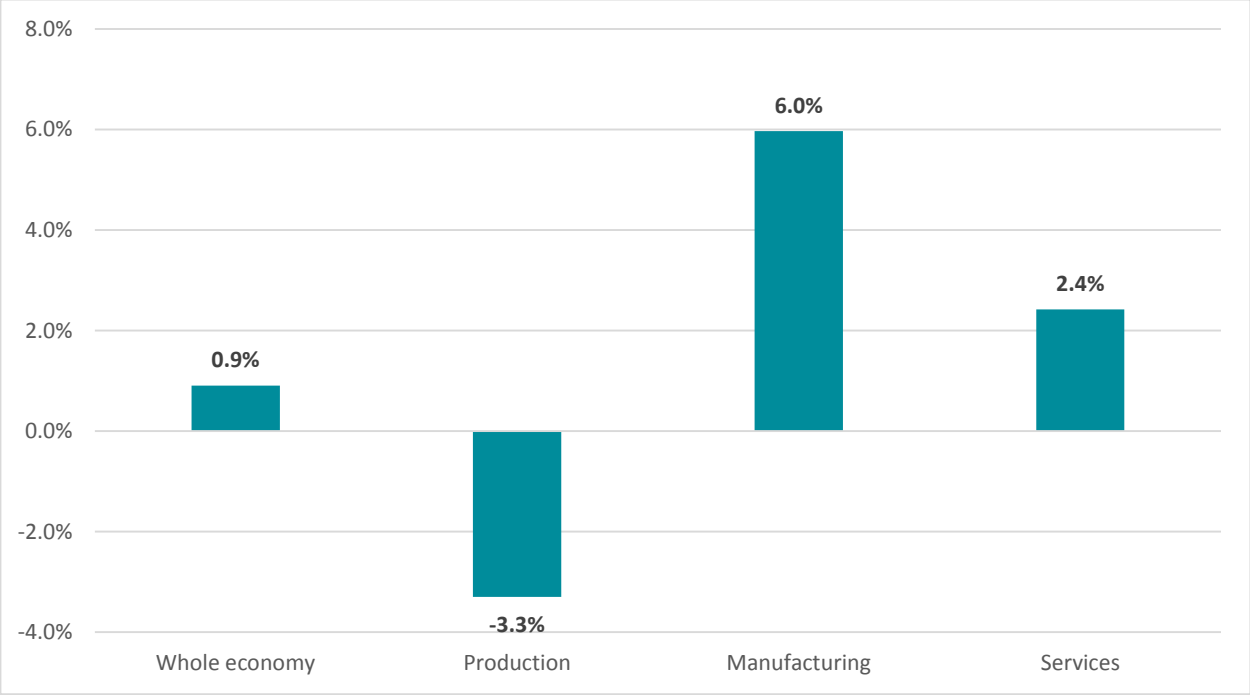
The findings described above are explored in further detail in this chapter. In the first section, an introduction is provided on the theory as to how EMT apprenticeships generate productivity benefits. The second section presents the main findings of the analysis.

## 1.2 Implications of engineering apprenticeships for the UK productivity challenge

A core challenge for the UK economy is to maintain higher productivity growth – which is essential to long term economic growth. In recent times, the economic growth we have experienced has been generated by increasing labour inputs (number of hours worked) rather than increasing the efficiency with which those inputs are used. That efficiency can come from more productive machinery and equipment and also better trained and skilled workers.

Since 2008, UK productivity has seen muted growth (see Figure 1) yet employment has increased dramatically since the downturn as more workers have been hired to produce proportionately the same output rather than producing more with the existing number of staff. This has meant strong wage growth in the short term but will ultimately translate into higher inflation (once the impact of lower oil prices has passed through), as companies transfer the cost of larger wage bills to their customers. Over the long-term, this higher wage-induced inflation would be damaging for the competitiveness of the UK economy and for economic growth.

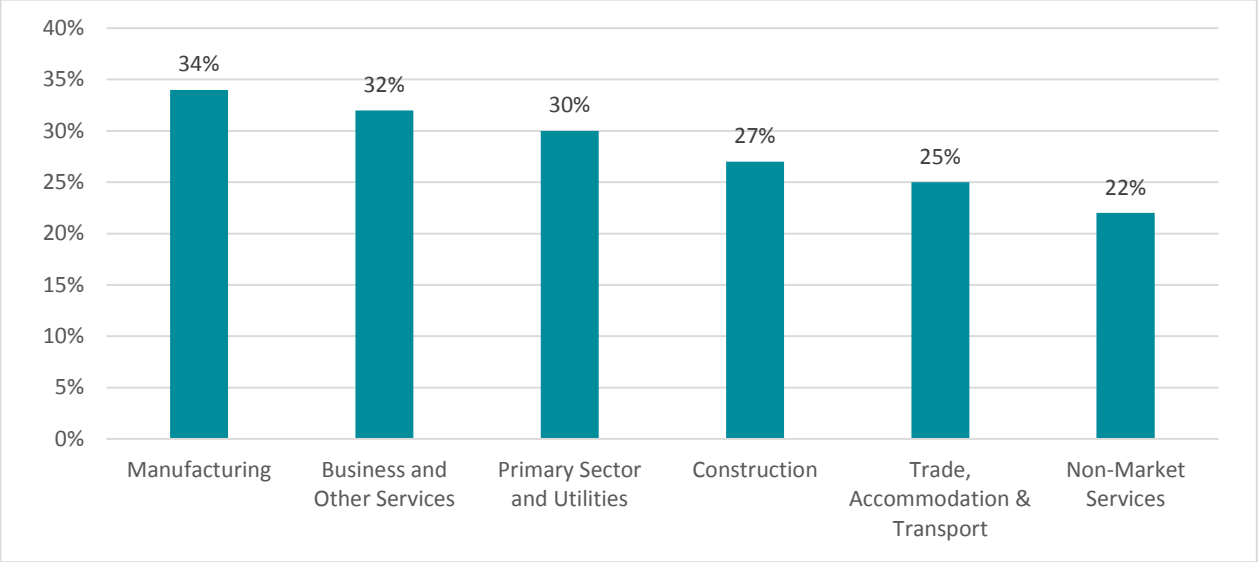
**Figure 1: Growth in output per hour worked, 2008 - 2014**




*Source: Labour Productivity, Q2 2015*

Certain sectors of the economy are now running into the constraint of a lack of skilled workers (see Figure 2). Without an increase in the productivity and size of the workforce, economic growth will be restrained in the long term. Some sectors have succeeded at achieving productivity growth – most notably manufacturing (see Figure 1) – however the potential of these sectors to increase productivity could be limited when firms cannot find employees with the suitable skills required to maintain and expand business operations.

**Figure 2: Skills shortage vacancies as a percentage of all vacancies, by industry**




*Source: UK Commission's Employer Skills Survey (UKCESS) 2013*

One way to alleviate this constraint is for employers to train individuals in the skills that they need via apprenticeship programmes and on-the-job training. Trainees benefit from permanently higher skills level which allows them to be more productive over their lifetime. At the national level, more apprentices therefore translates into a greater productive capacity in the economy and fewer skills shortages. This contributes towards a more efficient and competitive economy, and a greater overall output potential.

## 1.3 How do engineering apprenticeships generate productivity benefits?

Engineering apprenticeship programmes provide mutual benefits to both employer and employee which, in turn, feed into the wider economy. Companies gain from a supply of skilled staff trained to the company's requirements and the apprentices benefit from a permanent increase in their skills and productivity and thus their earning power and employability. Furthermore, these skills remain with the employee even if they leave the company and therefore benefit the entire economy by improving the average level of workforce productivity.

Engineering apprenticeships differ from engineering university degrees in that the costs of education and training are generally covered by the employer - apprentices work alongside experienced staff learning as they contribute, and are paid during their training period. Engineering apprentices are generally paid less than the average worker at their firm. This is in recognition that training of apprentices imposes costs upon the employer which must be covered over a period of time. These costs include the apprentice's salary (including employer's national insurance), the time of managers and experienced staff spent supervising apprentices, the cost of class-based training, materials and exams, and the cost of administration.

A further cost that must be accounted for by the employer is the risk that apprentices might 'drop-out' of the programme. In 2013/14, there was a **72% success rate across EMT frameworks**[4] – this means that approximately 28% of apprentices that started with the group that completed in 2013/14 failed to complete their training. The cost of training drop-outs represents an investment that often cannot be

[4] The Skills Funding Agency, 2015, 'Apprenticeship success rates dataset'.

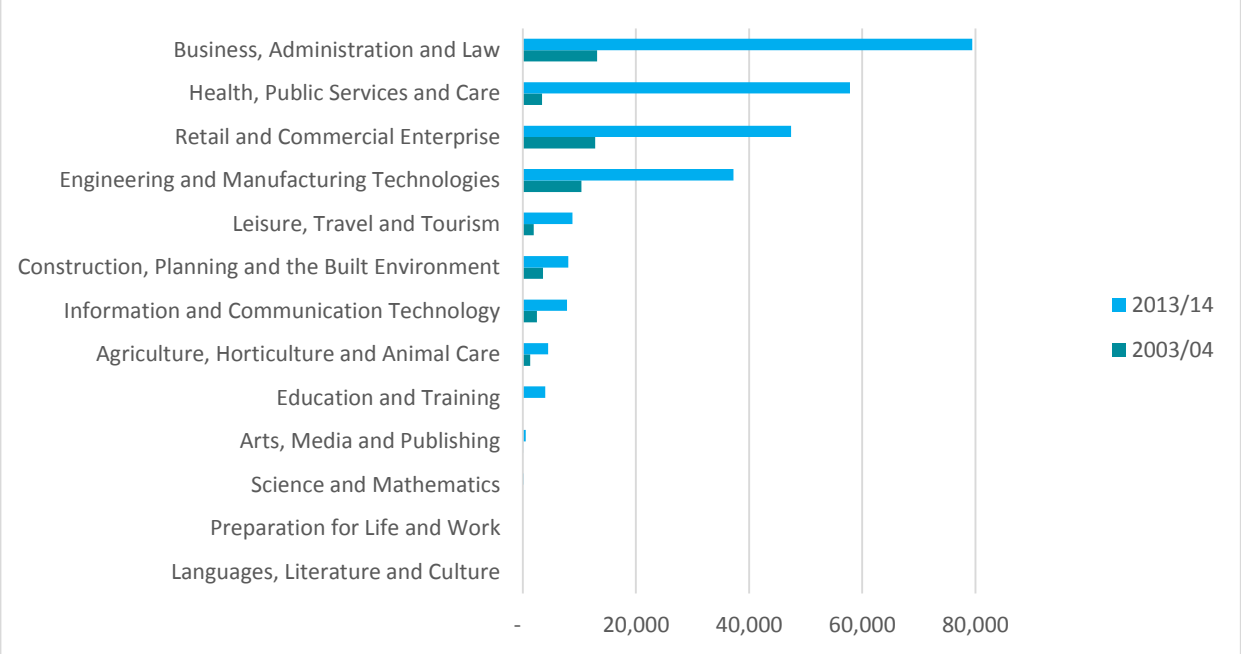
recouped (unless the trainee remains as an employee) and must be borne by employers. This pushes up the overall cost to the employer of running an apprenticeship programme.

In terms of the benefits that apprentices provide to companies, each apprenticeship scheme can be expected to produce different levels of productive output that is dependent on the intensity and duration of training, and the type of knowledge acquired. An EMT apprentice's productive output is anticipated to rise in each year of employment such that after a number of years, they are expected to produce the same output as an experienced worker. It can be expected that an apprenticeship scheme of longer duration and higher cost would normally produce correspondingly higher productive output to offset the additional cost of the scheme, although this is not always the case.

The productivity benefits that EMT apprentices generate for employers and for the UK represent the difference between the cumulative cost of paying for the apprentice's salary, training and supervision, and the productive output of the apprentice, which increases over the period of employment.

It appears that the benefits from employing apprentices have been recognised by companies and apprentices alike, with the number of apprentice starts increasing dramatically in recent years. In England[5], the number of individuals completing an engineering and manufacturing technologies apprenticeship increased 261% between 2003/04 and 2013/14, from 10,360 to 37,400 individuals. **EMT trainees now represent 15% of all apprentices in England.**

**Figure 3: Apprenticeship completions, Level 2, 3 and 4, 2003/4 and 2013/14, England**




*Source: Department for Business Innovation, and Skills, National Apprenticeship Service*

## 1.4 Productivity benefits of engineering & manufacturing technologies apprenticeships

To explore the specific productivity benefits of EMT apprenticeships, Cebr has carried out **a new analysis** which establishes the costs and productive contribution of the typical EMT apprentice over a ten year period for apprentices completing their training in 2013/14[6].

[5] Data for England only. Statistics on EMT completions in NI, Wales and Scotland for 2003/04 are not currently available.

[6] The analysis covers the 3.5 years of apprenticeship training and the subsequent 6.5 years following completion of training. For the group completing in 2013/14, this would represent approximately the period 2011 to 2020.

Cebr estimates that the average EMT apprentice generates a **productive contribution of £307,900 over a ten year period** beginning at the start of the apprenticeship programme. Taking into account costs of employment and training of £275,700, the average EMT apprentice generates a **net productivity benefit of £32,200 over the period** (see Table 1). This represents an average internal rate of return (IRR) for the employer of 11.8%. This is higher than the cost of capital faced by most companies, indicating that training apprentices represents a sound investment for employers. Excluding the training costs of drop-outs and considering the return at the individual apprentice level, the IRR rises to 17.1%.

The productive benefit of an apprentice varies depending on age - apprentices who start their programme at an older age are normally paid higher wages during their training than younger age groups[7]. This means they generate a lower net productivity benefit over the period relative to younger apprentices (see Table 1).

**Table 1: EMT net productivity benefit summary: by age group, including drop-out costs, apprentices completing in 2013/14**

| | Total cost of apprentice incl. salaries and training over 10 year period | Apprentice productive contribution over 10 year period | Net productivity benefit over 10 year period |
|---|---|---|---|
| 16-18 | £257,300 | £307,900 | £50,600 |
| 19-24 | £278,100 | £307,900 | £29,800 |
| 25+ | £293,400 | £307,900 | £14,500 |
| **Weighted average** | **£275,700** | **£307,900** | **£32,200** |

*Source: Cebr analysis*

From the employer's perspective, it would be ideal if apprentices stayed on as employees of the company long after they have completed their training so that the training costs can be recouped fully and they can maximise their investment in training. However, this does not always materialise in practice, as apprentices are free to move to other companies with their newly acquired skills and experience. This means that the findings presented in Table 1 represent the net productivity benefit to the UK economy from EMT apprenticeships rather than the benefits that accrue to individual companies.

To gain an understanding around the amount of time that an engineering apprentice would need to remain as an employee in order for the costs of training to be covered, Cebr has estimated the employer break-even point (in years) associated with each age group.

On average, an EMT apprentice needs to remain as an employee for a **minimum of 7 years** (including the period of training) to reach the point at which the employers costs equal the productive benefit that the apprentice has generated for the company. When the additional costs of drop-outs are added to the cost of training an individual apprentice, this 'break-even' point rises to 8 years.

**Table 2: Employer break-even point per apprentice**

| | Break-even point: completed apprentice | Break-even point: including drop-out costs |
|---|---|---|
| 16-18 | 5 Years 4 months | 6 Years 1 months |
| 19-24 | 7 Years 2 months | 8 Years 1 months |
| 25+ | 8 Years 9 months | 9 Years 11 months |
| **Weighted average** | **7 years 0 months** | **8 years 0 months** |

*Source: Cebr analysis*

In 2013/14, a total of 49,500 individuals completed a level 2, 3 or 4 apprenticeships in the UK. To give an understanding of the national-level productive contribution of EMT apprenticeship programmes, Cebr has generated estimates for the ten year cumulative productivity benefit that these apprentices provide to the

[7] This is of course based around the assumption that once apprentices complete their programme, they produce the same productive output regardless of age. However, it is reasonable to suggest that older apprentices may be able to be more productive by utilising other skills they may have acquired during their lifetime – although it is not possible to determine whether this is a factor based on the existing data.

UK economy[8]. The analysis found that the aggregate productive contribution to the UK economy amounted to **£1.6 billion** in 2014 prices (presented in Table 3).

**Table 3: Estimated cumulative net productivity benefit over ten year period - 2013/14 completions, UK, 2014 prices, by age and level**

| | 16-18 | 19-24 | Age 25+ | Total |
|---|---|---|---|---|
| Level 2/3 | £891m | £469m | £233m | £1,593m |
| Level 4 | £5m | £2m | £0m | £7m |
| **Total** | **£896m** | **£470m** | **£233m** | **£1,600m** |

*Source: Cebr analysis*

Breaking these estimates down by country, the results show that the cumulative productivity benefit of EMT apprentices is the largest in England with the 2013/14 cohort expected to contribute £1.2 billion over a ten year period from the beginning of their training. Wales has a proportionately larger concentration of apprentices relative to Northern Ireland and Scotland and this feeds through to an estimated cumulative productivity benefit of £186 million over a ten year period (see Table 4).

**Table 4: Estimated cumulative net productivity benefit over ten year period - 2013/14 completions, UK, 2014 prices, by country and level**

| | UK | England | Wales | Scotland | Northern Ireland |
|---|---|---|---|---|---|
| Level 2/3 | £1,591m | £1,204m | £181m | £111m | £94m |
| Level 4 | £7m | £2m | £5m | £0m | £0m |
| **Total** | **£1,598m** | **£1,206m** | **£186m** | **£111m** | **£94m** |

*Source: Cebr analysis*

Over the period 2005 and 2014, approximately 371,000 level 3 and 4 EMT apprentices completed their training programme. These individuals are now positively contributing towards the UK's productive capacity as part of the UK's skilled labour force.

Looking at the productive contribution of EMT apprentices over this longer period, if we assume that the estimated net productivity benefit per EMT apprentice after ten years from the beginning of training was the same for each year cohort, the productive contribution of the 371,000 EMT apprentices that completed each year during 2005 and 2014 (10 cohorts) amounts to approximately £12 billion (2014 prices).

This contribution is substantial, equivalent to 8% of GVA growth during the period 2005 and 2014.This indicates that EMT apprenticeship programmes have a sizable impact in boosting the overall productive capacity of the UK economy and that increasing the number of apprenticeships will provide additional benefits.

## 1.5 Conclusions – productivity impact of engineering apprenticeships

Apprenticeships provide mutual benefits to both apprentices and employers. Apprentices achieve a permanent increase in their skills and productivity and thus their earning power and employability. Employers gain from a supply of skilled staff trained to the company's requirements which ultimately helps companies to increase their productivity.

An important finding of the research relates to the break-even point at which the investment of employers exceeds the cumulative benefit they receive. Cebr's analysis finds that the average EMT apprentice needs to be retained for seven years from the time they commence their training for an employer to recoup their investment, rising to eight years if the costs of drop-outs are taken into account. This represents a longer

[8] These findings should be interpreted as a net productivity contribution to the UK economy in general as opposed to the benefits accruing to the original employers specifically.

period than is observed in many other industries that Cebr has assessed. The findings therefore emphasise the importance for EMT employers of creating an attractive work environment that offers career progression through training in order to retain staff for longer periods of time, as well as the need for policies that minimise the risk of drop-outs of apprentices during their training.

Robust labour productivity growth is key to the UK's long term economic prosperity. Yet the UK lags behind many of the world's major economies on this measure - British productivity is 28% lower than in France, 29% lower than in Germany and 30% behind the US. With productivity growth in the UK remaining at stubbornly low levels – and some sectors subject to skills shortages – the Government has made it a top priority to address this issue.

From the research that Cebr has undertaken, it is clear that engineering and manufacturing technologies apprenticeships provide a substantial boost to the UK's productive capacity and are extremely important for sustaining the UK's EMT skills base.

# 2 Assessing the relative fortunes of engineering graduates and apprentices

In this section, Cebr presents the findings of a new analysis that quantifies the lifetime earnings premium associated with achieving an apprenticeship qualification in different subject groups (relative to no qualification) and compares this to the earnings premium associated with a degree in an equivalent subject.

The objective of the analysis was to:

- Estimate the lifetime earnings premium associated with an apprenticeship qualification in different subject areas, taking account of the direct and indirect costs of completing an apprenticeship[9];
- Present the results from BIS/London Economics research that estimate the equivalent lifetime earnings premium from a third-level degree;
- Compare the estimated apprenticeship lifetime earnings premium from Cebr's analysis to the earnings premium associated with degrees to gain insights into how the relative payoffs of getting a degree differ from that of an apprenticeship, and how that might have changed since university fees were increased in 2012.

## 2.1 Key findings

The analysis provides the following insights on the relative payoffs of attaining a degree relative to an apprenticeship qualification:

- The analysis found that the net lifetime earnings premium associated with gaining a level 3 apprenticeship is substantial, averaging £80,900 across all subject areas;
- It was found that the net lifetime earnings premium associated with an EMT level 3 apprenticeship is approximately £111,900 (2014 prices). This is 26% lower than the net lifetime earnings premium associated with an engineering degree (£151,300), However, this difference between the lifetime earnings premium of an engineering degree compared to an engineering apprenticeship is smaller than the average difference (29%) across all subject areas;
- Taking into account the increase in university first degree fees that were imposed in 2012, which were not accounted for in the London Economics paper, evidence from recently published research[10] suggests that the average percentage differential between a level 3 apprenticeship and a degree has since fallen from 29% to between 18% and 25%. This means that the economic decision around whether or not to attend university has become less clear-cut than it was in the past and the gap between the payoff from a degree and an apprenticeship has inevitably narrowed;
- The analysis examined the difference between the earnings premium of a level 2 and level 3 EMT apprenticeship (72%) and found it to be considerably larger than the average across all subject areas (22%). This likely reflects the range of frameworks – from vehicle maintenance repair to rail transport engineering that fall within the engineering and manufacturing technologies subject area – which encompass a broad range of pay scales and levels;

These findings are explored in greater detail in this chapter. The first section presents evidence around the relative success of graduates and apprentices in terms of earnings, likelihood of being employed, and

[9] This analysis used findings on the boost to earnings and change in the probability of employment associated with apprenticeships by subject area from the London Economics 2011 paper 'Returns to Intermediate and Low Level Vocational Qualifications', BIS Research Paper No. 53 to estimate the net lifetime earnings premium and net present value of attaining an apprenticeship qualification.

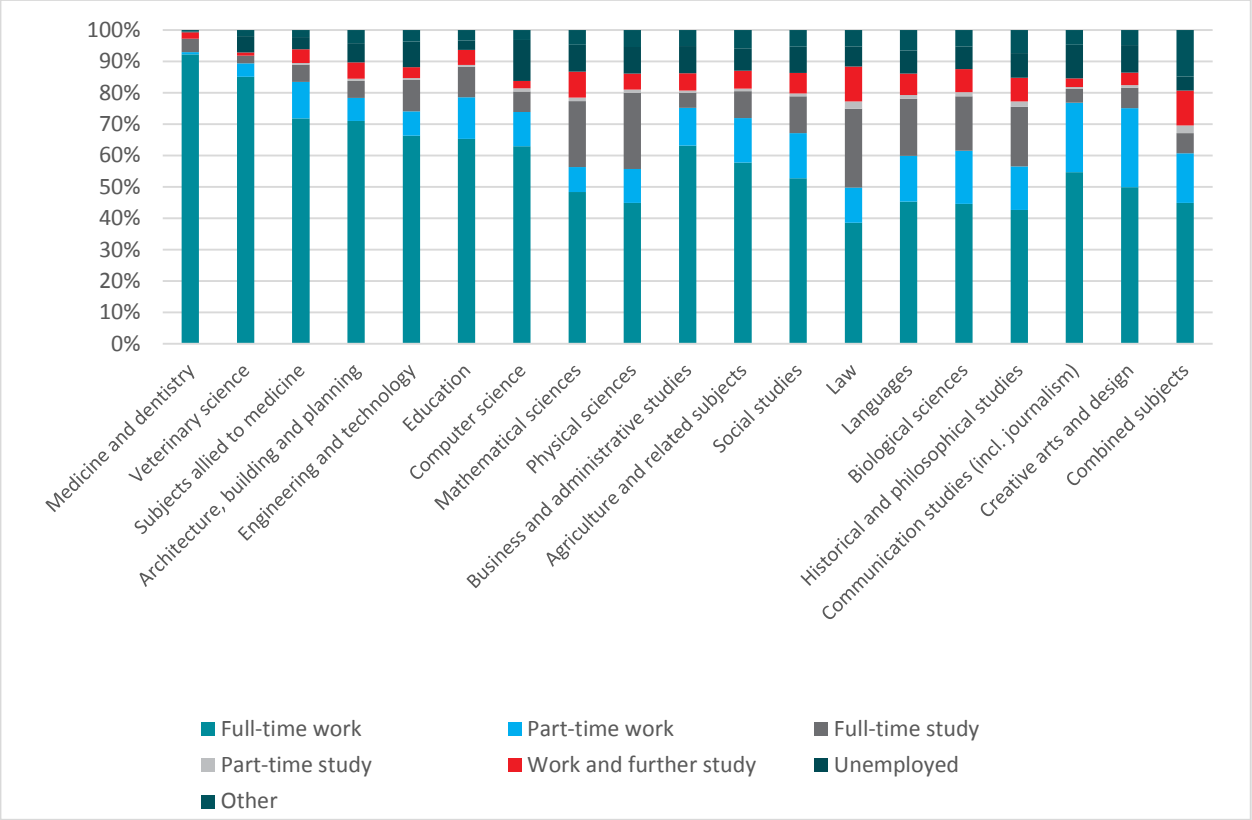
[10] Cambridge Econometrics/ Warwick Institute for Employment Research, 2013, 'Review of the Economic Benefits of Training and Qualifications, as shown by Research based on Cross-Sectional and Administrative Data', BIS Research Paper No. 105.

underemployment rates. The second section presents the results of the analysis. The final section provides conclusions on the relative costs and benefits of obtaining an engineering degree relative to an engineering apprenticeship.

## 2.2 Evidence on the benefits of an engineering qualification

It is generally recognised that being in possession of an engineering qualification leads to better labour market outcomes. The evidence shows that engineering graduates are more likely to have a job, less likely to be underemployed and have higher wages relative to graduates of many non-STEM subjects. Evidence from the Higher Education Statistical Agency shows that engineering graduates (and STEM graduates more generally) are more likely to be in employment relative to those that graduate in non-STEM subjects (see Figure 4).

**Figure 4: Destinations of all full-time first degree graduates (2012/13) - UK domiciled**

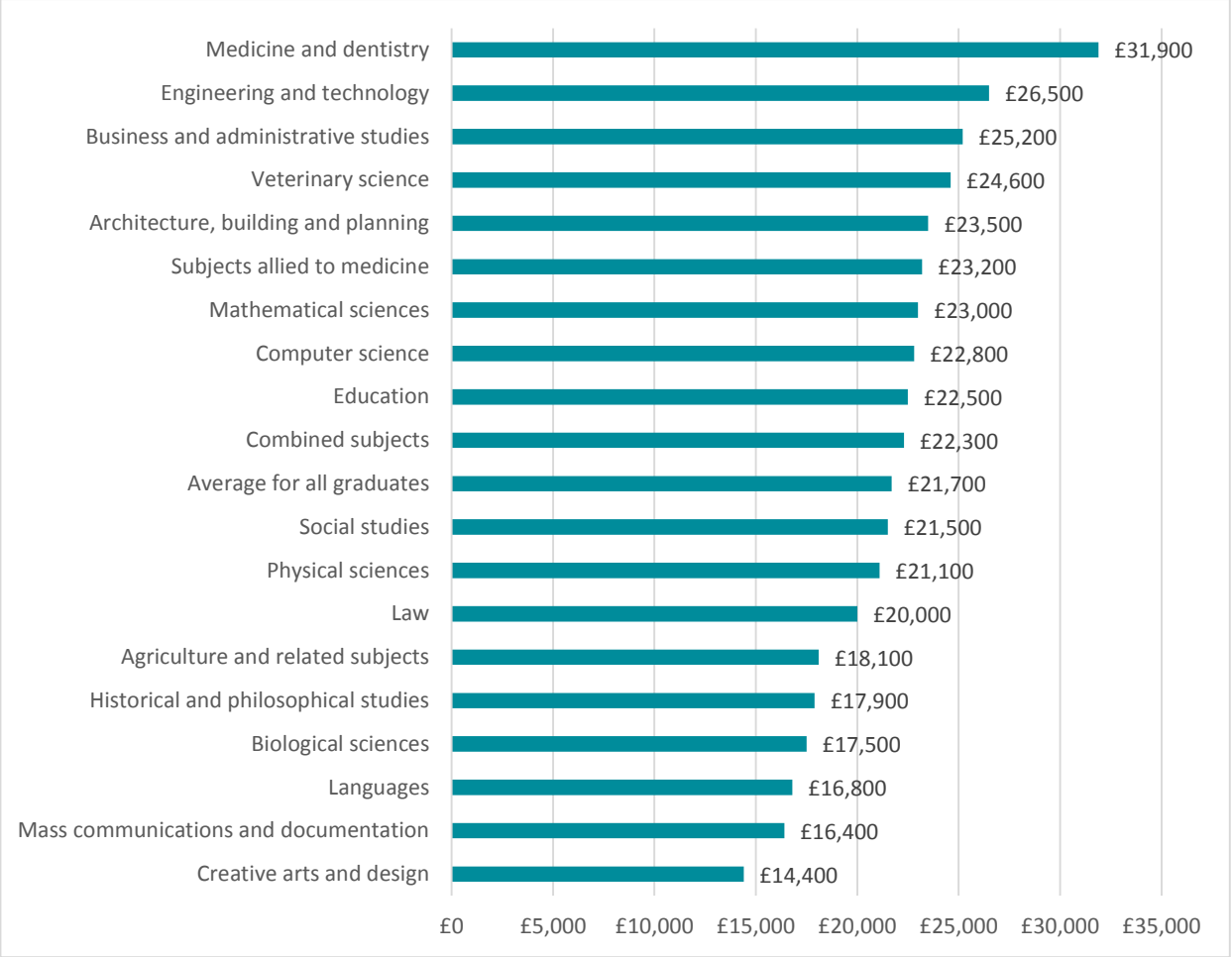



*Source: HESA*

In terms of the success of graduates at finding employment when they complete their degree, 66.3% of engineering graduates in 2012/13 were in full-time employment compared to an average of 57.7% for all graduates.

Starting salaries for engineering graduates are particularly high, averaging £26,500 in 2013 and ranking second only after medicine (see Figure 5). STEM subjects such as mathematical sciences, architecture and computer science also rank highly, with average graduate salaries close to or above £23,000. This far exceeds the average graduate salaries of many of the most popular arts subjects such as languages, where starting salaries average just £16,800. This indicates that STEM graduates – and engineering graduates in particular – normally see the benefits of their qualifications almost immediately once they enter the labour market.

**Figure 5: Average annual starting salaries of graduates by subject area (2013)**




*Source: HESA, Engineering UK*

The evidence suggests, therefore, that, for some people considering going to university, it could make more financial sense to obtain an apprenticeship qualification instead. Across all subject areas, for those at the early stages of their career, there is a surprisingly small difference in the annual pay between those in possession of a degree and a level 3 apprenticeship. A full-time employed person with either a degree or a level 3 apprenticeship in the 30 to 34 age group both have an average salary of approximately £32,500[11] (see Figure 6).

[11] From Cebr's analysis of ONS Labour Force Survey micro dataset Q1 2015

**Figure 6: Average full-time annual pay by highest qualification obtained, by age group**


*Source: ONS Labour Force Survey micro dataset Q1 2015, Cebr calculations*

## 2.3 Comparison of the net lifetime earnings premium of degree and apprenticeship qualifications

With undergraduate tuition fees having increased in 2011/12 from £3,290 to either £6,000 or £9,000 depending on the university, students are now paying up to £27,000 for a three year degree and thousands more on living expenses. This has meant that the economic decision about whether or not to attend university has become less clear-cut than it was in the past. Higher tuition fees mean that the gap between the expected return on investment in a degree relative to an apprenticeship has inevitably narrowed.

Despite this, it is important to recognise that apprenticeships and degree courses do not represent direct substitutes and fulfil different but important positions in a firm's skills base:

- The roles that apprentices and graduates fulfil in the company are quite different, yet are equally important for the operation of the firm. EMT apprentices tend to fill operational and technical roles while graduates tend to have roles in product design, research and production supervision;
- The earnings progression tend to be more rapid for an engineering degree relative to an apprenticeship. Graduates and apprentices may earn similar salaries at the early stages of their career but this gap often widens over the career;
- There is normally a higher minimum education requirement for a degree course relative to an apprenticeship which limits the possibility of substitution.

As highlighted in section 2, gaining a qualification or degree should be considered an investment of time and money from which an individual receives a return in the form of higher earnings and an increased probability of being employed. Once a trainee or student has been accepted on the course, they need to weigh up the potential future earnings that can be achieved with their investment of time and money in obtaining either a qualification or a degree.

The net benefit of obtaining a degree/apprenticeship can be presented as the lifetime net earnings premium – the net present value of the sum of the future stream of earnings associated with the degree/apprenticeship less the sum of direct and indirect costs. The lifetime net earnings premium is composed of the following factors:

- The earnings differential between what the individual earns after achieving the qualification and what they would have earned otherwise, given their highest level of education (normally A-levels or GCSE).

This differential will be higher depending on the salary they can command in the labour market with their qualification;

- The increased likelihood that the individual will be in employment as a result of having a higher level of education;
- The direct cost of the qualification such as tuition fees. The benefit of apprenticeships is that direct costs tend to be covered by the employer, whereas the direct costs of a degree are normally covered by the student via a long-term loan provided by the Government;
- The indirect cost/ opportunity cost of foregone earnings that the individual could have earned if they were not in education or receiving a lower rate of pay while completing an apprenticeship;

Cebr has carried out a new analysis to calculate the net earnings premium associated with level 3 apprenticeships relative to level 2 apprenticeships in different subject areas.[12] These are presented in Table 5 next to net earnings premia in the equivalent degree subject relative to a level 2. These data were sourced from a paper by London Economics (2011a). The comparison is made to gain insights into how the relative payoffs of getting a degree differ from that of an apprenticeship.

The analysis shows that the net lifetime earnings premium associated with gaining a level 3 apprenticeship is substantial, averaging £80,900 across all subject areas. The net lifetime earnings premium of a level 3 apprenticeship was found to be on average 29% lower relative to the average degree. However for some apprenticeship subject areas such as arts, media and publishing and agriculture, the lifetime premia can be higher than for their degree equivalent.

The net lifetime earnings premium associated with an engineering and manufacturing technologies level 3 apprenticeship was estimated to amount to approximately £111,900 - ranking second amongst apprenticeship subject areas only after construction, planning and built environment. This is 26% lower than the net lifetime earnings premium associated with an engineering degree (£151,300), slightly lower than the weighted average percentage differential across all subjects (29%).

**Table 5: Estimated net lifetime earnings premium: level 3 apprenticeship and degree (prior to 2012 fee increase), presented in 2014 prices**

| Apprenticeship subject area | Level 3 apprenticeship | Closest equivalent degree subject area | Degree | Degree / Apprenticeship premium % (£) differential[13] |
|---|---|---|---|---|
| Arts, Media and Publishing | £51,100 | Mass communication & documentation | £34,700 | -47% (-£16,400) |
| Science & Mathematics | £104,100 | Physical/environmental sciences | £98,800 | -5% (-£5,300) |
| Agriculture, Horticulture & Animal Care | £78,400 | Agriculture | £76,800 | -2% (-£1,600) |
| Retail & Commercial Enterprise | £95,500 | Business & administrative studies | £123,900 | 23% (£28,400) |
| Construction, Planning & Built Environment | £117,500 | Architecture, building & planning | £156,500 | 25% (£39,000) |
| **Engineering & Manufacturing Technologies** | **£111,900** | **Engineering** | **£151,300** | **26% (£39,400)** |
| Languages, Literature & Culture | £43,000 | Linguistics, classics & rel. subjects | £70,700 | 39% (£27,700) |

[12] See Appendix for detailed methodology

[13] Green shaded cells represent apprenticeship subject areas where the net lifetime premium exceeds that of the equivalent degree subject area. Yellow and red shaded cells represent apprenticeship subject areas where the net lifetime premium is less than that of the equivalent degree subject area.

| Apprenticeship subject area | Level 3 apprenticeship | Closest equivalent degree subject area | Degree | Degree / Apprenticeship premium % (£) differential[13] |
|---|---|---|---|---|
| Business, Administration & Law | £69,500 | Business & administrative studies | £123,900 | 44% (£54,400) |
| Health, Public Services & Care | £77,700 | Subject allied to medicine | £195,900 | 60% (£118,200) |
| Social Sciences | £41,800 | Social studies | £108,700 | 62% (£66,900) |
| Information & Communication Technology | £27,700 | Mathematical & computer sciences | £143,300 | 81% (£115,600) |
| **Weighted average** | **£80,900** | **Weighted average** | **£113,600** | 29% (£32,700) |

*Source: London Economics 2011a (degree NPV), Cebr analysis (apprenticeship NPV)*

The lifetime earnings premia associated with degrees are derived from a paper that was published in 2011. Since 2012, the Government has allowed universities to charge dramatically increased tuition fees of up to £9,000 per year. A 2013 study by Ian Walker and Yu Zhu on behalf of the Department for Business, Innovation and Skills[14] specifically examined the sensitivity of degree lifetime earnings premia to tuition fee changes. The study estimated that degree NPVs would be between £6,000 and £15,000 lower as a result of the fee increases. Applying these findings to average NPVs for a degree and an apprenticeship in Table 5 would result in the percentage difference falling to between 18% and 25% across all subject areas.

An intermediate apprenticeship (level 2) is usually of shorter duration, with less demanding coursework and entry requirements relative to an advanced apprenticeship (level 3). As a result, the lifetime earnings premium associated with a level 2 qualification would be expected to be lower. This was found to be the case, with a level 2 apprenticeship providing an average lifetime earnings premium of £66,400, 22% lower than that of a level 3 apprenticeship (see Table 6).

The percentage difference between the earnings premium of a level 2 and level 3 engineering and manufacturing technologies apprenticeship was found to be considerably larger than the average (72% relative to an average of 22% across all subject areas). This likely reflects the range of frameworks – from vehicle maintenance repair to rail transport engineering that fall within the engineering and manufacturing technologies subject area – which encompasses a broad range of pay scales and levels.

**Table 6: Estimated net lifetime earnings premium: level 2 and level 3 apprenticeship, presented in 2014 prices**

| Apprenticeship subject area | NPV level 2 | NPV level 3 | £ difference |
|---|---|---|---|
| Construction, Planning And Built Environment | £88,600 | £117,500 | £28,900 |
| Engineering And Manufacturing Technologies | £64,900 | £111,900 | £47,000 |
| Science And Mathematics | £30,100 | £104,100 | £74,000 |
| Retail And Commercial Enterprise | £62,100 | £95,500 | £33,400 |
| Agriculture, Horticulture And Animal Care | £27,100 | £78,400 | £51,300 |
| Health, Public Services And Care | £87,400 | £77,700 | -£9,700 |
| Business, Administration And Law | £60,000 | £69,500 | £9,500 |
| Arts, Media And Publishing | £1,700 | £51,100 | £49,400 |
| Languages, Literature And Culture | £3,800 | £43,000 | £39,200 |
| Social Sciences | £30,000 | £41,800 | £11,800 |
| Information And Communication Technology | £33,900 | £27,700 | -£6,200 |
| **Weighted average[15]** | **£66,400** | **£80,900** | **£14,500** |

*Source: Cebr analysis*

[14] Walker and Zhu, 2013, 'The Impact of University Degrees on the Lifecycle of Earnings: Some Further Analysis', BIS Research Paper No. 112.

[15] Weighted by level 2 and level 3 achievements by subject area, 2013/14

## 2.4 Conclusions - costs and benefits of an engineering degree versus an apprenticeship

The evidence from the research clearly suggests that having either an engineering degree or an engineering apprenticeship qualification produces substantial lifetime earnings premia for individuals (relative to those who do not have these qualification) and that, therefore, they are generally a good investment.

However, the choice between attending a university and pursuing an apprenticeship qualification has become less clear-cut for many as a result of recent increases in first degree tuition fees. Individuals who may previously have decided to go to university must now consider whether they would be better off doing an apprenticeship, given the smaller differential in lifetime earnings that each qualification is expected to yield.

At the same time, it must be recognised that an apprenticeship might not be desirable for everyone. The choice of the type of post-secondary education that an individual pursues is dependent on a range of factors including their academic ability, interest in the subject, career goals and the cost of education. In this way, an apprenticeship could provide an attractive alternative for those for whom the decision between university and vocational education is marginal.

This research comes in the context of the rapid growth in the proportion of UK residents with a degree-level education. In the 30 to 34 age group, the proportion of the UK population with a degree has risen from 33.6% in 2004 to 47.7% in 2014. By comparison, the EU average for the 30 to 34-year-old age group is 38.0% and in Germany it is just 31.4% – where the vocational education system is well-developed and holds equal weight with university education.

This suggests that university education in the UK may now have reached saturation point, and that school leavers need to consider alternative routes into education and training. To illustrate this point, recent research from the Chartered Institute of Personnel and Development found that 58.8% of graduates are in jobs deemed to be non-graduate roles[16]. The research shows that there exists a mismatch between the number of university leavers and the number of available jobs that are appropriate to their skills. To address this skills imbalance, it seems imperative that the number of apprentices will need to rise to meet the demand from industry and the career earnings goals of individuals.

[16] http://www.cipd.co.uk/publicpolicy/policy-reports/overqualification-skills-mismatch-graduate-labour-market.aspx

# 3 Breakdown of the economic impact of engineering in the UK at the sub-sector level

In this chapter, Cebr extends our previous research on the economic impact of engineering by providing estimates of direct impact of engineering sectors on GVA and employment at the sub-sector (SIC 3-4-digit) level. A further breakdown is also provided for the engineering disciplines e.g. civil engineering, aerospace engineering etc. Finally, a comparison is provided of the direct impact of the engineering sector relative to some of the UK's other major sectors including financial services and retail.

This section is presented as a series of tables[17].

**Table 7: Breakdown of projected GVA and employment in engineering sub-sectors, 2014**

| SIC code | Description | GVA £m | Employment (average) '000s |
|---|---|---|---|
| 1.63 | Post-harvest crop activities | 49 | 1 |
| 1.64 | Seed processing for propagation | 14 | 0 |
| 05 (all) | Mining of coal and lignite | * | 5 |
| 06 (all) | Extraction of crude petroleum and natural gas | 18,454 | 15 |
| 07 (all) | Mining of metal ores | * | 0 |
| 8.1 | Quarrying of stone, sand and clay | 1,619 | 17 |
| | Mining and quarrying n.e.c. | * | 2 |
| 09 (all) | Mining support service activities | 3,132 | 21 |
| 10.13 | Production of meat and poultry meat products | 1,292 | 30 |
| 10.2 | Processing and preserving of fish, crustaceans and molluscs | 546 | 14 |
| 10.3 | Processing and preserving of fruit and vegetables | 2,068 | 32 |
| 10.4 | Manufacture of vegetable and animal oils and fats | 166 | 1 |
| 10.5 | Manufacture of dairy products | 1,870 | 25 |
| 10.6 | Manufacture of grain mill products, starches and starch products | 1,393 | 11 |
| 10.7 | Manufacture of bakery and farinaceous products | 3,764 | 100 |
| 10.8 | Manufacture of other food products | 5,982 | 93 |
| 10.9 | Manufacture of prepared animal feeds | 1,873 | 14 |
| 11 (all) | Manufacture of beverages | * | 43 |
| 12 (all) | Manufacture of tobacco products | * | **1** |
| 13 (all) | Manufacture of textiles | 2,287 | 55 |
| 14 (all) | Manufacture of wearing apparel | 947 | 32 |
| 15 (all) | Manufacture of leather and related products | 406 | **8** |
| 16 (all) | Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials | 2,703 | 66 |
| 17 (all) | Manufacture of paper and paper products | 3,776 | 52 |
| 18 (all) | Printing and reproduction of recorded media | 5,165 | 102 |
| 19 (all) | Manufacture of coke and refined petroleum products | 951 | **10** |
| 20 (all) | Manufacture of chemicals and chemical products | 8,963 | 102 |

[17] The GVA and employment estimates presented here may differ somewhat from those reported in Cebr's January 2015 'Contribution of Engineering to the UK Economy' report for several reasons: 1) there have been some revisions to the Annual Business Survey 2013 release, 2) Cebr has revised its GVA and employment sector projections for 2014 since the report was published 3) Cebr and Engineering UK have made some refinements to the sub-sectors that comprise the Engineering sector definition used for the analysis.

| SIC code | Description | GVA £m | Employment (average) '000s |
|---|---|---|---|
| 21 (all) | Manufacture of basic pharmaceutical products and pharmaceutical preparations | 6,577 | **41** |
| 22 (all) | Manufacture of rubber and plastic products | 8,654 | 159 |
| 23 (all) | Manufacture of other non-metallic mineral products | 3,981 | 76 |
| 24 (all) | Manufacture of basic metals | 4,459 | 69 |
| 25 (all) | Manufacture of fabricated metal products, except machinery and equipment | 14,733 | 290 |
| 26 (all) | Manufacture of computer, electronic and optical products | 8,301 | 130 |
| 27 (all) | Manufacture of electrical equipment | 4,993 | 84 |
| 28 (all) | Manufacture of machinery and equipment n.e.c. | 13,238 | 199 |
| 29 (all) | Manufacture of motor vehicles, trailers and semi-trailers | 13,648 | 142 |
| 30.1 | Building of ships and boats | 1,464 | **29** |
| 30.2 | Manufacture of railway locomotives and | 861 | 5 |
| 30.3 | Manufacture of air and spacecraft and | 9,492 | 87 |
| 30.4 | Manufacture of military fighting vehicles | 155 | 3 |
| 30.9 | Manufacture of transport equipment n.e.c. | 155 | **3** |
| 31 (all) | Manufacture of furniture | 2,922 | 75 |
| 32.2 | Manufacture of musical instruments | * | 5 |
| 32.3 | Manufacture of sports goods | 27 | **1** |
| 32.4 | Manufacture of games and toys | 194 | **5** |
| 32.5 | Manufacture of medical and dental instruments and supplies | 245 | 4 |
| 32.9 | Manufacturing n.e.c | 1,980 | 34 |
| 33 (all) | Repair and installation of machinery and equipment | 1,265 | 23 |
| 35.11 | Production of electricity | 7,775 | 104 |
| 35.12 | Transmission of electricity | 2,722 | 42 |
| 35.13 | Distribution of electricity | 1,740 | 4 |
| 35.21 | Manufacture of gas | 11,609 | 43 |
| 35.22 | Distribution of gaseous fuels through mains | * | 7 |
| 35.3 | Steam and air conditioning supply | * | **36** |
| 36 (all) | Water collection, treatment and supply | * | 0 |
| 37 (all) | Sewerage | 9,552 | 40 |
| 38.2 | Waste treatment and disposal | 1,679 | 18 |
| 38.3 | Materials recovery | 1,374 | 25 |
| 39 (all) | Remediation activities and other waste management services | 1,456 | 29 |
| 41.2 | Construction of residential and non-residential buildings | 173 | 4 |
| 42 (all) | Civil engineering | 19,155 | 291 |
| 43.1 | Demolition and site preparation | 15,145 | **192** |
| 43.2 | Electrical, plumbing and other construction installation activities | 747 | 19 |
| 43.99/9 | Specialised construction activities (other than scaffold erection) n.e.c. | 19,599 | **388** |
| 45.2 | Maintenance and repair of motor vehicles | 6,268 | 31 |
| 49.5 | Transport via pipeline | 7,551 | 221 |
| 51.22 | Space transport | 550 | 1 |
| 58 (all) | Publishing activities | * | 0 |
| 59.11 | Motion picture; video and television programme activities | 11,846 | 150 |

| SIC code | Description | GVA £m | Employment (average) '000s |
|---|---|---|---|
| 59.2 | Sound recording and music publishing activities | 984 | 65 |
| 61 (all) | Telecommunications | 1,091 | 8 |
| 62 (all) | Computer programming, consultancy and related activities | 27,820 | 219 |
| 63.1 | Data processing, hosting and related activities; web portals | 46,302 | **566** |
| 71.1 | Architectural and engineering activities and related technical consultancy | 6,858 | 46 |
| 71.2 | Technical testing and analysis | 30,864 | 411 |
| 72.19 | Other research and experimental development on natural science and engineering | 3,036 | **50** |
| | Environmental consulting & quantity surveying activities | 3,519 | 110 |
| 80.2 | Security systems service activities | 6,340 | **108** |
| 84.22 | Defence activities | 353 | **9** |
| 95.1 | Repair of computers and communication equipment | * | 54 |
| 95.21 | Repair of consumer electronics | 1,173 | 24 |
| 95.22 | Repair of household appliances and home and garden equipment | 151 | 3 |
| | Total | 412,195 | 5,636 |

*Source: Annual Business Survey 2013, Business Register and Employment Survey 2013 (numbers in bold), Cebr projections (GVA), European Commission CEDEFOP projections (employment), * denotes where data points cannot be reported as information is deemed disclosive*

**Table 8: Breakdown of projected GVA and employment in engineering sub-sectors, 2014**

| Engineering sector | GVA £m | Employment (average) '000s |
|---|---|---|
| Automotive engineering | 21,199 | 363 |
| General engineering | 28,731 | 380 |
| Civil engineering | 21,485 | 300 |
| Mechanical engineering | 13,547 | 205 |
| Aerospace engineering | 9,492 | 87 |
| Electronic and electrical engineering | 131,095 | 1,534 |
| Production and manufacturing engineering | 50,792 | 976 |
| Chemical, process and energy engineering | 84,516 | 943 |
| Other | 51,339 | 848 |
| Total | 412,195 | 5,636 |

*Source: Annual Business Survey 2013, Business Register and Employment Survey 2013, Cebr projections (GVA 2014), European Commission CEDEFOP forecasts (employment 2014)*

**Table 9: Comparison of GVA and employment in the Engineering sector[18] compared to other major sectors, 2014**

| Industry | GVA £m | Employment '000s |
|---|---|---|
| Engineering | 412,195 | 5,636 |
| Retail & wholesale | 187,453 | 4,300 |
| Professional, scientific and technical activities | 129,108 | 2,545 |
| Financial & insurance | 120,148 | 1,029 |
| Construction | 98,766 | 1,457 |

*Source: Annual Business Survey 2013, Business Register and Employment Survey 2013, Cebr projections (GVA 2014), European Commission CEDEFOP forecasts (employment 2014), UK Quarterly National Accounts low level aggregates*

[18] The engineering sector is comprised of sub-sectors that also form part of some of the industry sectors listed above. An overlap therefore exists and this should be taken into account when these figures are quoted.

# 4 Appendix – methodological approach and theory

This appendix sets out the methodological details of the two new pieces of analysis documented in this report. We also provide a short bibliography of references drawn upon to support the research.

## 4.1 Methodological approach to calculating the productivity impact of apprenticeships

To estimate the productivity impacts of engineering & manufacturing apprenticeship schemes, we follow the established methodology developed at Warwick University by Hasluck et al, as expanded and developed in the 2012 BIS research paper 67, 'Employer Investment in Apprenticeships and Workplace Learning'[19]. In this paper, in-depth surveys were carried out in companies with apprentices in the major subject areas to determine the costs and benefits of apprenticeship training for the typical company. Under this approach, the net benefit that each apprentice contributes each year is a function of the following factors:

- **Productive output of the apprentice** – BIS research paper 67 provides estimates of the proportion of a skilled employee's tasks that an apprentice can complete in each year of the programme. These estimates can be converted into monetary terms (using skilled employees' wages) and adjusted to the relevant industry in which the apprentice is working during the programme. These gains capture not only increases in apprentices' wages, but also the total productivity improvement each apprentice acquires as they progress through the programme. Some of these productivity improvements can be expected to be retained by the employee, resulting in perpetually higher wages from the point of completion of the programme.
- **Direct costs of training** – the costs directly related to teaching apprentices. This includes the costs of tuition, materials, and administration. Data on direct costs are sourced from BIS research paper 67, page 41.
- **Indirect costs of training** – the costs related to supervising and training apprentices while in the workplace. Employers incur an opportunity cost in terms of managers' productive time spent training these apprentices. This decreases with each year an apprentice has been employed. Data on indirect costs are sourced from BIS research paper 67, page 41.
- **Apprentice's wage** – Apprentices are paid lower wages than fully trained staff members to reflect their productive capacity and the training cost that the employer covers. Apprentices are paid at different wage rates depending on their age and year of training. Estimates of apprentice wages by age and NVQ level are provided in the latest BIS Apprenticeship Pay Survey[20] published in December 2014 and indexed to inflation-adjusted wage growth. Data representing the wages of experienced workers are sourced from the Annual Survey of Hours and Earnings 2014 – table 21.7a.[21] Employers National Insurance charged at the standard rate of 13.8% of gross salary is incorporated into the calculations.

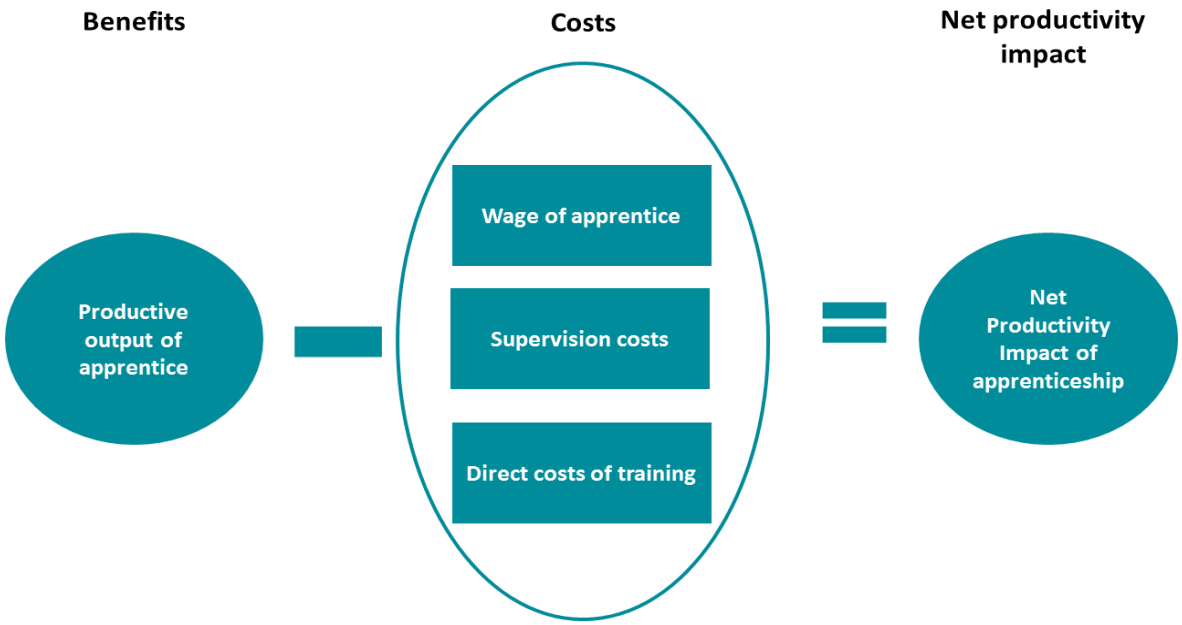
The formula for calculating net productivity impacts is captured in the graph below.

[19] Department for Business, Innovation and Skills, 2012, 'BIS Research Paper Number 67 - Employer Investment in Apprenticeships and Workplace Learning: The Fifth Net Benefits of Training to Employers Study', BIS. The data presented in the paper were derived from the Warwick University Institute for Employment Research / IFF Research Employer Net Benefit of Training Study 2011

[20] Department for Business, Innovation and Skills, 2014, 'BIS Research Paper Number 207 - Apprenticeship pay survey 2014', BIS.

[21] Weighted average annual gross pay of persons age 30 to 39 in the manufacturing, mining and utilities sectors.

Figure 7: Net productivity impact formula




Net productivity gains are calculated by applying gross productivity gains to total costs over the timeframe of the apprenticeship scheme. This allows for the costs to be recouped while avoiding the need to develop assumptions about the potential for employees to be promoted and thus moved to higher salaries.

A number of key assumptions underlie the analysis:

- An experienced worker has between fifteen and twenty years' work experience in a similar or related field to the apprentice;
- The costs of training are incurred at the end of the training period. While this may not be the case in practice, it significantly simplifies the calculation of net productivity benefits while not having a material impact on the accuracy of the results;
- Programmes are assumed to have a 3.5 year duration;
- On average, approximately 27% the starting cohort drop out of the course over the period, and the dropout rate is highest for the 16 to 18 and 25+ age groups;
- Productivity benefits accrue at the end of the training period. While in practice productivity gains are likely to steadily increase during the training period, this assumption also serves to simplify the estimation of net productivity benefits and is consistent with the approach to costs;
- All direct and indirect costs are incurred by the company. Government funding for apprenticeships is not considered;
- It is assumed that all apprentices enrolled on the training programme regardless of age produce the same productive output.

## 4.2 Methodological approach to calculating the earnings premium associated with education and training

The approach taken for the analysis was not to re-estimate earnings premia and employment probabilities associated with vocational qualifications – which would involve a substantial analysis which may not lead to substantially different results to those presented in this report. Instead, Cebr draws on existing estimates of the lifetime earnings premia of vocational qualifications and apprenticeships estimated in a recent London Economics' paper (London Economics, 2013[22]).

Assumptions and methods were employed that ensured that the findings were consistent with an equivalent analysis that estimated the lifetime earnings premium from a degree in a range of different subjects (London Economics, 2011). The estimated lifetime earnings premia estimated in Cebr's analysis were used alongside those estimates from the London Economics paper to create a consistent comparison of the relative payoff related to each type of qualification in their relevant subject area.

The following summarises the steps involved in calculating the net lifetime earnings premium associated with attaining an apprenticeship qualification:

1. Using the Labour Force Survey micro dataset, the annual employment-adjusted earnings[23] achieved by individuals in the counterfactual group were estimated. For level 1 and 2 apprenticeships, the relevant counterfactual group is assumed to consist of those individuals in possession of a GCSE qualification or equivalent. For level 3 and 4 apprenticeships, the relevant comparison group is those with A levels;
2. A lifetime after-tax earnings curve was estimated for each of the counterfactual groups, using data derived from the Labour Force Survey micro dataset Q1 2015;
3. Adjustments were made for the assumption that future earnings will grow in real terms over time (assumed to be 1% p.a.);
4. An estimate was made of the expected lifetime after-tax earnings achieved by individuals holding each type of qualification by inflating the earnings of the counterfactual group using the earnings premia and the employment probabilities for each subject area estimated in the London Economics (2014) analysis[24];
5. The discounted stream of additional (employment-adjusted) future earnings compared to the relevant counterfactual group were calculated. Discounting future earnings means that estimates of lifetime earnings are presented in today's money terms. The discount rate of 3.5% was used as is standard in the HM Treasury Green Book (the official Treasury guidance book for appraisal and evaluation in Central Government).

The net benefit of obtaining a degree/apprenticeship can be presented as the lifetime net earnings premium – the net present value of the stream of future earnings associated with the degree/apprenticeship less the sum of direct and indirect costs. The lifetime net earnings premium is composed of the following factors:

**Direct costs**

As described in chapter 2, apprenticeships are an investment for the employer, in that the direct costs of training and tuition are generally met by the employer. This is in contrast to the university degree, where the direct costs of tuition and living costs are generally borne by the individual, albeit normally through a

[22] The detailed employment and earning impact estimates from this paper are available on the Department for Business, Innovation and Skills website at this link: https://www.gov.uk/government/publications/disaggregated-analysis-of-the-long-run-impact-of-vocational-qualifications

[23] Adjusted for the probability that an individual will be in employment during their career.

[24] This paper used standard regression analysis (OLS) to estimate earnings premia and employment probabilities associated with different qualifications in each subject area.

student loan which is paid down over a long period and the loan repayments are dependent on the individual's income level.

**Indirect costs**

Attending university or working as an apprentice trainee represents an opportunity cost for the individual when it is possible to earn a higher wage in the labour market given their education level and experience.

For an apprentice, the individual receives a lower salary than they might hope to achieve in the labour market in the recognition that they are receiving employer-subsidised training – a benefit in kind – that will help the individual to earn a higher salary over their lifetime than they might have been able to achieve otherwise.

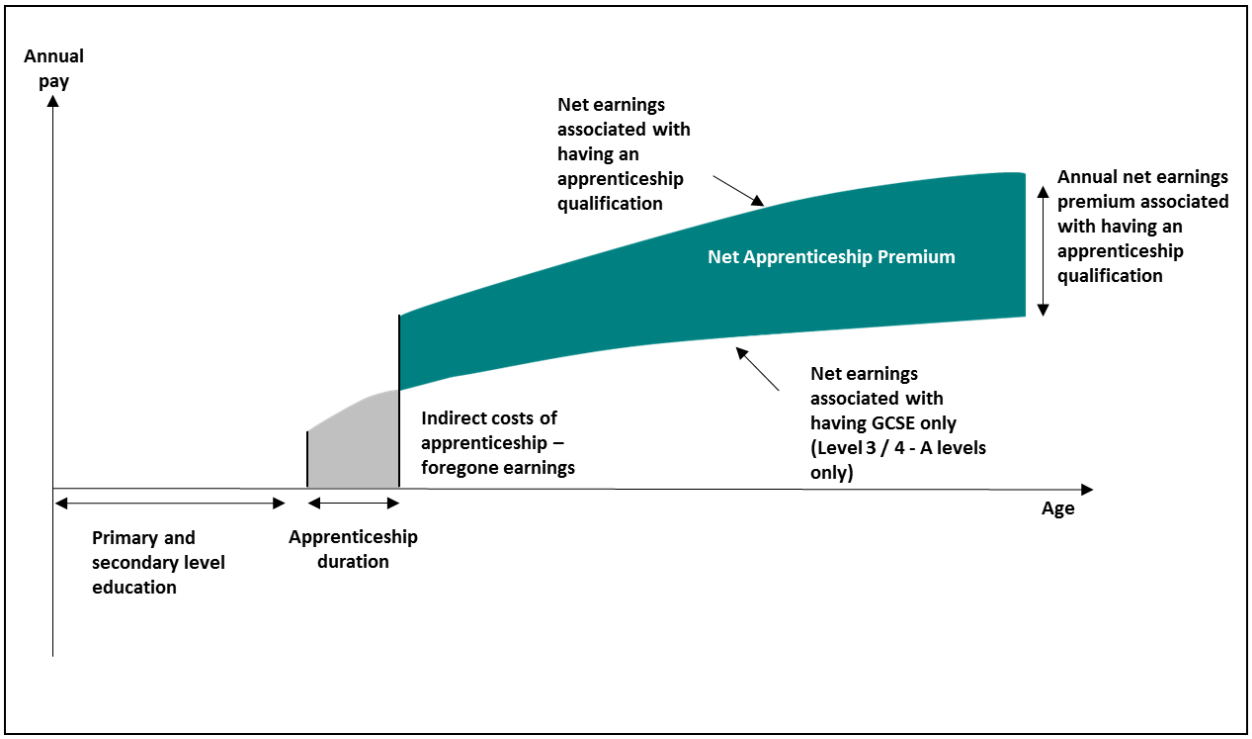
For a university student, attending university normally means foregoing a salary for the three or more years of their course. This is in the recognition that they stand to be able to command a higher salary when they graduate and gain experience.

**Net graduate/ apprenticeship premium**

It is generally understood that individuals with higher levels of qualifications can command higher pay in the labour market. On average, a full-time worker in the UK age 25 to 29 with an A level qualification earns a gross pay of £23,600 per year and this rises to a peak of £32,000 per year for an individual aged between 40 and 44. In contrast, a full-time worker with a degree qualification, aged 25 to 29, earns gross pay of £28,900 and this rises to a peak of £49,300 per year for an individual age 50 to 54.

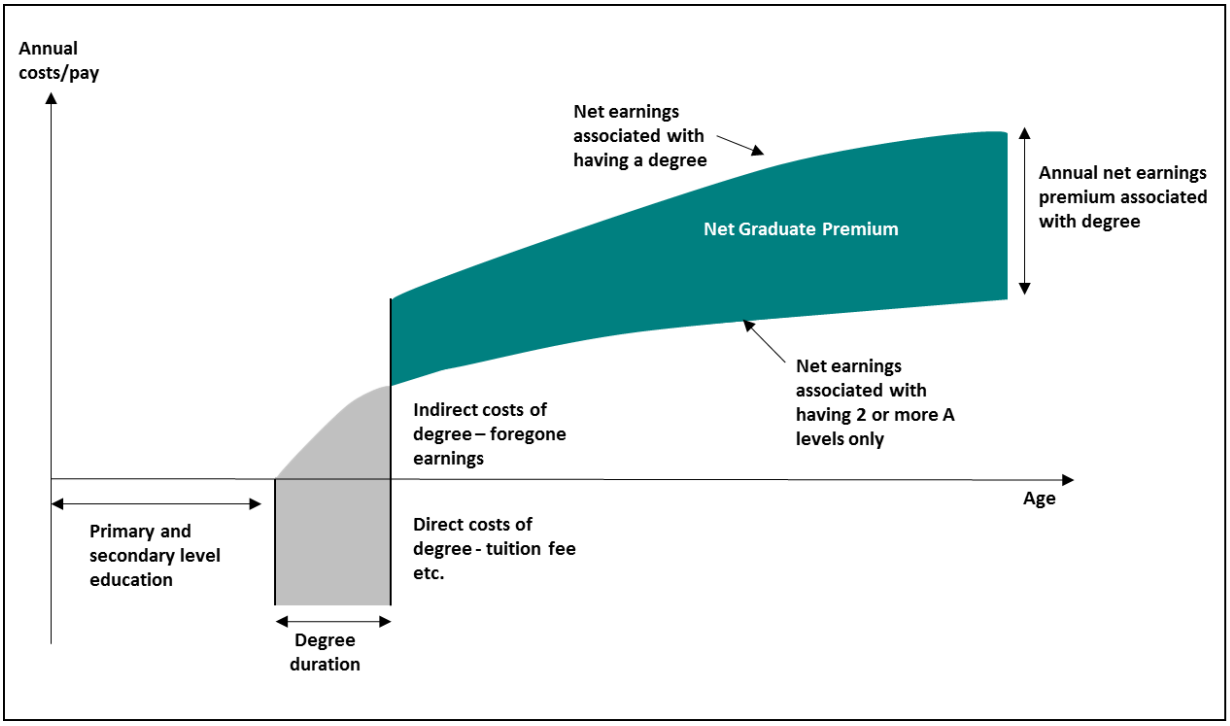
This gap between what an individual with an apprenticeship or degree qualification can earn and what they might have earned otherwise if they did not obtain such a qualification is called the gross earnings premium. Taking into account the higher amounts of income tax and national insurance that higher earners pay, we get the net earnings premium. Diagrams visually describing the costs and earnings premium associated with an apprenticeship and a degree are presented in Figure 8 and **Error! Reference source not found.**.

**Figure 8: Lifetime earnings premium associated with an apprenticeship qualification**




*Source: Cebr adaptation of diagram from London Economics (2013)*

**Figure 9: Lifetime earnings premium associated with a degree qualification**




*Source: Cebr adaptation of diagram from London Economics (2013)*

## 4.3 Academic literature on the returns to education and training

There exists a substantial body of academic literature aimed at quantifying the returns to education and training. In general, the literature finds that there exists evidence to suggest a positive employment and earnings returns for the vast majority of qualifications gained in adulthood, with some exceptions.

Listed below is a selection of relevant papers that were reviewed as part of the analysis:

### Degree level education

London Economics, 2011a, 'The Returns to Higher Education Qualifications', BIS Research Paper Number 45.

O' Leary and Sloane, 2005, 'The returns to a university education in great Britain', National Institute Economic Review, July 2005, vol. 193, no. 1, 75-89.

Walker and Zhu, 2013, 'The Impact of University Degrees on the Lifecycle of Earnings: Some Further Analysis', BIS Research Paper No. 112.

### Apprenticeships and vocational education

Jenkins, Greenwood, and Vignoles, 2007, 'The returns to qualifications in England: Updating the evidence base on level 2 and level 3 vocational qualifications', Centre for the Economics of Education Discussion Paper 89.

McIntosh, 2007, 'A Cost Benefit Analysis of Apprenticeships and Other Vocational Qualifications', Department for Education and Skills Research Report No. 834.

Cambridge Econometrics/ Warwick Institute for Employment Research, 2013, 'Review of the Economic Benefits of Training and Qualifications, as shown by Research based on Cross-Sectional and Administrative Data', BIS Research Paper No. 105.

Frontier Economics / IFS, 2011, 'Reporting on Employment and Earnings Using Experimental Matched Data', BIS Research Paper No. 48.

London Economics, 2011b, 'Returns to Intermediate and Low Level Vocational Qualifications', BIS Research Paper No. 53.

London Economics, 2013, 'A Disaggregated Analysis of the Long Run Impact of Vocational Qualifications', BIS Research Paper No. 106.