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National Apprenticeship Service

Adult Apprenticeships

Estimating economic benefits from apprenticeships – Technical paper

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Contents

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Summary

1 This paper summarises the analysis carried out to inform the National Audit Office Value for Money report *Adult Apprenticeships*, published in February 2012.

2 Research commissioned by the Department for Business, Innovation and Skills estimated that the economic return from apprenticeships was £24-£35 for every £1 of government funding. The Department also cited returns of £40 for every £1 of public investment in apprenticeships. This figure is higher because it is based solely on those apprentices who do not already have a qualification at an equivalent or higher level. The Department has focused on the £40 return even though it estimated that nearly three-quarters (72 per cent) of intermediate-level apprentices, and around half (50 per cent) of advanced-level apprentices, already had an equivalent or higher qualification.

3 We conducted statistical and economic analysis to carry out our own assessment of the return. We did this by estimating the wage and employment premiums to apprenticeships using the last seven years of Labour Force Survey 2004-2010. We then considered the Department's cost-benefit analysis for apprenticeships, including inserting our new figures for premiums.

Estimating wage premium to apprenticeships

4 The Department expects the Apprenticeship Programme to deliver financial returns to apprentices through higher wages over their lifetime. In line with other studies, our estimates suggest that there are indeed significant positive wage premiums in 2004-2010 associated with apprenticeships: around 18 per cent to Advanced apprenticeship (Level 3) and 11 per cent to Intermediate apprenticeship (Level 2), compared with individuals whose highest qualification is at Level 2 or Level 1 or 2 respectively and controlling for several other factors. However, part of these wage premiums may be due to the abilities or qualities of individuals doing an apprenticeship, rather than apprenticeship training itself. It was not possible to control for these factors with the data available. Therefore, the wage premium results should be interpreted as statistical association rather than the causal impact of apprenticeships on an individual's wages.

5 There is significant variation in the estimated wage premiums of apprentices depending on the sector of employment. The results of our analyses suggest that the highest wage premiums, with strong statistical significance, were in 'distribution, hotels and restaurants' and in 'public administration, education and health'. There are some differences in premiums between Advanced and Intermediate apprenticeships, with noticeably higher premiums to Advanced apprenticeships in 'manufacturing', 'transport and communication', and 'other services'.

6 We also analysed whether the wage premiums to apprenticeships have changed over time. For the period considered, between 2004 and 2010, there is indicative evidence that these premiums have declined over time for Intermediate apprenticeships, on average by about 2.4 percentage points per year. It was beyond the scope of this study to examine the possible causes of the decline and there is a need for further research in this area.

Estimating the employment premium to apprenticeships

7 In addition to higher wages, apprentices are also more likely to benefit from the greater likelihood of being employed. The estimates indicate that there is a positive association between the acquisition of apprenticeship and the likelihood of being in employment. Individuals with Advanced apprenticeship are 3.6 percentage points more likely to be in a full-time job, while those with Intermediate apprenticeship are 1.6 percentage points more likely to be employed, compared to similar individuals whose highest qualification is at Level 2 or at Level 1 and 2 respectively. These estimates are considerably smaller than the ones found in other studies, mostly due to the different treatment of economically inactive people in our analysis. We excluded economically inactive people from the comparison group, as this group of people have no attachment to the labour market, and therefore are less likely to have a motivation to acquire vocational qualifications.

8 As with the wage premium analysis, it was not possible to attribute any causality effect to the association between the apprenticeships and the probability of employment. This is because individuals doing apprenticeships are much more likely to be in employment in the first place.

Cost-benefit analysis of apprenticeships

9 The results of our cost-benefit analysis suggest that the economic returns to apprenticeships are around £18 per pound of government funding. This is substantially lower than the Department's 'headline' estimate of £40 per £1 of funding. Several factors that contribute to the difference between the Department's estimate and ours:

- Additional productivity effects, which accrue to parties other than the apprentices themselves, for example to employers through higher profits. Based on an assessment of the available evidence, the Department's view is that there are substantial benefits to employers, from higher productivity, as a result of apprenticeship training. It therefore allows for additional benefits of 100 per cent of the wage premium in its estimate. We believe that there is currently insufficient evidence to support the Department's position, and thus assume that spillover effects are 25 per cent of the wage premium.
- Prior qualifications of apprentices. The Department's £40 return is based on those cases where the apprenticeship is an individual's first qualification at that level. When taking all apprentices into account, the Department estimated that returns per pound of funding were £28. Because around half of apprentices are already qualified at the same level or above, our central estimate focused on economic returns based on all apprentices.
- Work expectancy – the average number of years that learners are expected to remain in the workforce after completing their course. Recent data suggest that the average age of apprentices has increased, leading to a fall in work expectancy. Therefore, the benefits accruing to apprentices during their working lifetime also drop, leading to a lower estimate of economic returns compared to the Department's estimate.

Part One

Estimating wage premium to apprenticeships

Introduction

1.1 Apprenticeships have a long history in Britain dating back to the middle ages. Traditionally apprenticeships existed in such sectors as manufacturing, construction and engineering. However, in 1994 apprenticeships were reintroduced in the UK as Modern apprenticeships, expanding into sectors with no tradition of apprenticeship, such as retail and IT. The Apprenticeship Programme has particularly rapidly expanded in recent years; between the 2006/07 and 2009/10 academic years, the number of people starting an apprenticeship increased from 184,400 to 279,700 (a 52 per cent increase). The Government spent £451 million on adult apprenticeships in 2010-11, forecast to rise to £726 million by 2013-14.

1.2 There are now three levels of Modern apprenticeship. The Government introduced Higher apprenticeships in 2009; it considers them to be at the same level as a one-year Certificate of Higher Education (Level 4). Advanced apprenticeships are considered to be at the same level as A levels (Level 3), while Intermediate apprenticeships (formerly known as Foundation apprenticeships, or just apprenticeships) are considered to be at the same level as GCSEs graded between A* and C (Level 2).[1]

1.3 There is little quantitative evidence on the benefits of apprenticeships in England for the individual, employer and the Government. McIntosh (2007),[2] commissioned by the then Department for Education and Skills, estimated wage and employment premiums[3] to apprenticeships based on the Labour Force Survey (LFS) in 2004-2005. He also examined how the wage premiums differed by sector of the economy. The Department of Business, Innovation and Skills commissioned a cost-benefit analysis of vocational training that was published in March 2011.[4] This paper used wage and employment premiums derived in McIntosh (2007) to assess the benefits of apprenticeships, and is discussed in detail in Part Three. Most recently, the Department commissioned Conlon *et al.* (2011) to estimate the wage and employment premiums to apprenticeships using the LFS from 2004-2009.[5] This study examined how premiums differ by economic sector for traditional apprenticeships, but did not do so for Modern apprenticeships.

1 The different qualification levels are described at http://www.direct.gov.uk/en/EducationAndLearning/QualificationsExplained/DG_10039017
2 S. McIntosh, *A Cost–Benefit Analysis of Apprenticeships and Other Vocational Qualifications*, 2007.
3 A wage premium is the increased wage associated with having a qualification, while an employment premium is the increased probability of being employed associated with that qualification. The glossary defines important terms.
4 Department of Business, Innovation and Skills Research Paper N38 (2011), *Measuring the Economic Impact of Further Education.*
5 G. Conlon, P. Patrignani, and J. Chapman, BIS Research Paper No. 53: *Returns to Intermediate and Low Level Vocational Qualifications*, 2011.

1.4 In this paper, we present the economic analysis we conducted as part of our fieldwork for the National Audit Office Value for Money study on *Adult Apprenticeships.*[6] The main objective of this analysis was to estimate the long-term economic benefits of apprenticeships to inform our assessment of the value for money of the programme. In addition, we aimed to validate and update the results obtained in the two papers mentioned above. In this chapter we show how we estimated the wage premium to apprenticeships using the Labour Force Survey form 2004 to 2010. Part Two presents the employment premiums to apprenticeships, while Part Three focuses on cost-benefit analysis of apprenticeships.

Data sources

1.5 We carried out the analysis using data from the Labour Force Survey (LFS). It is the largest household survey undertaken by the UK Office for National Statistics, involving around 0.2 per cent of the UK population, and contains extensive information about labour market circumstances of individuals. Every three months in each year, a nationally representative sample of approximately 100,000 people aged 16 and over in around 57,000 households is interviewed. All adults within responding households are interviewed face to face at their first inclusion in the survey and by telephone at quarterly intervals thereafter.

1.6 Respondents are interviewed for the LFS for five successive quarters. The composition of the panel of respondents changes over time, and around one fifth are replaced each quarter. Each respondent is only asked to report their wages on the first and last occasions that they are interviewed (waves 1 and 5), and only keeping the respondents from waves 1 and 5 when creating annual data sets ensures that no individual is placed in the same annual data set twice. When two annual data sets, for example 2009 and 2010, are pooled together, wave 5 respondents in 2010 are dropped, as they have already been observed in wave 1 in 2009, and so will already be in the pooled data set.

1.7 For the analyses reported here, we used data pooled from the successive Labour Force Surveys from 2004 to 2010 (the latest data currently available). We used 2004 as the starting year because this was the first year when the LFS included a question dividing Modern apprenticeships into Advanced and Foundation (now Intermediate), allowing the breakdown of analysis by the level of apprenticeship. When all the years 2004 to 2010 were pooled into a single data set, only wave 1 observations were used in each year as discussed above.

6 Comptroller and Auditor General, *Adult Apprenticeships*, Session 2010–12, HC 1787, National Audit Office, February 2012.

1.8 The data sample used in our analysis was restricted in various ways from the full LFS sample. First, the sample included only those people in full-time employment at the time of the survey. In separate analysis, reported in Part Two, we assessed the relationship between apprenticeships and the probability of finding work. The exclusion of part-time employees enables direct comparison with the research by McIntosh (2007) and Conlon *et al*. (2011). We show in paragraph 1.45 that the impact of including part-time employees in the sample was relatively small.

1.9 In order for our results to be comparable to the previous two studies mentioned above, the sample was restricted further by those individuals not currently in education and those living in England only. Individuals with very high reported wages, with hourly pay more than £99[7] were excluded from the analysis. The resulting sample size was 169,427 over the period 2004 to 2010.

1.10 We were unable to exclude reliably those former apprentices who studied for an apprenticeship before the age of 18, so both former adult and youth apprentices were included in our main results. As one way of checking the robustness of our results for adult apprenticeships, in our sensitivity analysis we excluded those people in the dataset who said that they received their highest qualification before they turned 18; this had a negligible impact on our findings.

1.11 In the LFS, there are two questions concerning apprenticeships that were used in our analysis, particularly: 'Are you doing or have you completed a recognised apprenticeship?' and if the answer was 'yes': 'Does/did your apprenticeship form part of the Modern apprenticeship initiative?' Therefore, in all the analysis in this report, individuals who have completed a Modern apprenticeship formed a subset of the group of individuals who have completed any recognised apprenticeship. Over the period considered from 2004 to 2010, those with a Modern apprenticeship represented an increasing proportion of all those with any recognised apprenticeship, from 6 per cent in 2004 to 21 per cent in 2010.

1.12 The majority of respondents in the LFS who reported they had completed a recognised apprenticeship said that it was not a Modern apprenticeship, since their training was undertaken before the creation of Modern apprenticeships. Given that they are the current form of apprenticeship, the results for the Modern apprenticeships are the most policy relevant and, thus, were the focus of this paper.

7 As recommended in the *Labour Force Survey User Guide – Volume 3: Details of LFS variables 2010*. In this case we excluded about 13 observations with hourly wage of more than £99.

Methodology

1.13 It is difficult to assess the impact of any particular qualification on someone's productivity. First, in many occupations it is impossible to measure productivity directly. As a proxy for productivity, we therefore followed many other researchers in this area by measuring how apprenticeships were associated with wage changes. When labour markets are competitive, wages are likely to be closely related to productivity, though the relationship is usually weaker in less competitive labour markets.

1.14 Second, the people who choose to study for an apprenticeship qualification are more likely to differ in many ways from those who do not. For instance, they may be more motivated by self-improvement. In turn, these other factors could affect their productivity even if they hadn't gained an apprenticeship; more motivated workers are usually more productive. This means that a straight comparison of the wages of people who have gained apprenticeships with those who have not could give a misleading impression of the effects of the qualification. This is particularly so when the selection process for a qualification is very competitive, as is the case with apprenticeships at some firms.

1.15 The data available in the Labour Force Survey did not allow us to take account of this selection effect directly. As a result, our estimates could in principle overestimate or underestimate the true returns to apprenticeships, depending on the type of selection effect involved. However, research by Dearden (1999) found that such biases do not appear to be large in practice, concluding that the 'results from this paper suggest that conventional Ordinary Least Squares[8] estimates of the returns to education can generally be relied upon for policy decisions.'[9]

1.16 We therefore used econometric modelling to examine whether the completion of a Modern apprenticeship tended to result in employees earning higher wages than other employees with similar characteristics who did not complete an apprenticeship. We employed an Ordinary Least Squares linear regression model, where the dependent variable was the natural logarithm[10] of gross weekly earnings and the independent variables included a range of personal, regional and job related characteristics that were expected to influence the earnings of an individual. The exact model specification was as follows:

$$\ln(w_i) = \alpha + \beta' X_i + \gamma Apprenticeship_i + \varepsilon_i, \text{ for } i = 1 \text{ to n}$$

where $\ln(w_i)$ is the natural logarithm of gross weekly earnings and X_i is a set of independent variables included in the analysis as follows:

- Age
- Age squared (to control for non-linear effects in age)
- Gender

8 Ordinary Least Squares is a statistical technique used to understand a relationship between an outcome variable (also called dependent variable) and predictor variables (also called independent variables).

9 L. Dearden, *Qualifications and earnings in Britain: how reliable are conventional OLS estimates of the returns to education?*, Institute for Fiscal Studies, 1999, p. 2.

10 Wages are usually expressed in logarithms in studies of labour earnings due to the skewness of the wage distribution. Logarithmic transformation makes skewed distributions more normal and this facilitates the computation and interpretation of the results.

- Ethnic origin
- Region of usual residence
- Other qualifications below apprenticeship level (e.g. BTEC Level 2)
- Experience at this firm (months continuously employed)
- Marital status
- Number of dependent children under the age of 16
- Temporary or permanent contract of employment
- Private or public sector employment
- Workplace size (number of employees)
- Yearly/seasonal dummy variables to control for yearly/seasonal effects
- Sector dummy variables

Beta (β) and gamma (γ) coefficients in the model are regression coefficients that express the estimated effect of each independent variable on dependent variable. Epsilon (ε) in the equation above represents an error term.

1.17 In the model specification presented above, the β and γ coefficients show how strongly each independent variable is influencing the dependent variable. The sign of the β and γ coefficients (positive or negative) shows the direction of the relationship between each independent and the dependent variable. The interpretation of estimated coefficients from the wage equation depends on the control group[11] used. In this case we wanted to obtain a wage premium from completing an apprenticeship compared to what the individual would have earned had they not done an apprenticeship. In line with McIntosh (2007), we assumed that individuals completing a Level 3 apprenticeship, or any apprenticeship of unknown level, would have achieved Level 2 qualification before starting their apprenticeship and so would have remained at Level 2 had they not completed an apprenticeship.

1.18 Therefore, when we estimated wage premiums to Advanced apprenticeships, the treatment group was all individuals for whom this apprenticeship was their highest qualification, while the control group was those who did not complete apprenticeship, but had Level 2 as their highest qualification. Therefore, the interpretation of the estimated premiums to apprenticeships is the extra earnings that an individual receives if he has completed an apprenticeship and this represents his highest qualification, compared to an individual with the same observed characteristics whose highest qualification remained at Level 2. When Intermediate apprenticeships were specifically considered, the control group was all those whose highest qualification was at Level 1 or Level 2. Since the model presented in paragraph 1.16 above is a log-linear model, when interpreting estimated γ coefficients we have corrected them using the transformation $e^{\gamma} - 1$ to get the actual wage premium.

11 Control (or comparison) group is a group of people whose characteristics may be measured against those of a treatment (intervention) group. Individuals in the control group have characteristics and demographics similar to those of the treatment, but members of the control group receive no intervention (in this case do not complete an apprenticeship).

1.19 As mentioned earlier, the main analysis in this chapter focuses on individuals with Modern apprenticeships (either at Level 3 or Level 2) as their highest qualification, while controlling for all other qualifications held below this. As a result, not all individuals who completed an apprenticeship were included in the estimated model, but only a subset for whom the completed apprenticeship represented their highest qualification. This means that any individual who held a higher-ranked qualification, such as A levels, degree or other Higher Education qualifications, was excluded from the analysis. We therefore excluded from the analysis the 7 per cent of apprentices who had already acquired A levels, and we could not say anything about their wage premiums. We decided to focus on individuals with the apprenticeship as their highest qualification, rather than all individuals with apprenticeship because the wages of the latter group might have reflected the acquisition of the higher qualification as well as the apprenticeship itself.

1.20 In addition to the main model specification presented in 1.16, we conducted analysis with several other model specifications. In particular, we tried to replicate the analysis using the models constructed by McIntosh (2007) and Conlon *et al*. (2011) to enable comparison of our results. We also conducted analysis with alternative control groups for each of the apprenticeship levels. These are presented at the end of this chapter.

Estimated wage premium – Aggregate results for 2004-2010

1.21 In **Figure 1** we presented estimated wage premiums for people with Advanced apprenticeships, compared to those whose highest qualifications are at Level 2 (GCSEs A* - C or similar).[12] We also presented our estimates of the wage premiums to traditional trade apprenticeships. Trade apprenticeships include both those that were completed before the Modern apprenticeship programme was introduced in 1994, and those who studied more recently outside the programme. In line with other research on wage premiums, we estimated wage premiums by gender, given the different determinants of earnings for men and women.

Figure 1
Wage premium to Advanced apprenticeships (%)

	All	Males	Females
Advanced apprenticeship	17.9***	23.9***	5.4
Trade apprenticeship	5.1***	3.7***	-1.6

NOTES

1 The numbers presented here are the actual wage premiums calculated from the estimated coefficients using log transformation described in paragraph 1.18.

2 *** 1 per cent level of statistical significance; ** 5 per cent level of statistical significance; * 10 per cent level of statistical significance; absence of asterisk on the number means no statistically significant results were found. The level of statistical significance gives the probability that the true return is zero or lower, on the assumption that the model is correctly specified.

Source: National Audit Office analysis of Labour Force Surveys 2004–2010

12 This is the same comparison group used by Conlon *et al.* (2011).

1.22 The results in Figure 1 suggest that there is a positive premium associated with apprenticeships. In particular, taking into account other factors, including other qualifications and sector of work, possession of an Advanced apprenticeship is on average associated with 18 per cent higher wages, compared to individuals with Level 2 qualifications. All regression results in this report should be interpreted as holding other characteristics constant. The results for Advanced apprenticeships compare favourably with the premium to trade apprenticeships, which is about 5 per cent.

1.23 Since we only had data for a small proportion of the entire population of apprentices, we could not be sure that the true wage premium is 18 per cent. However, we were able to quantify the inevitable uncertainty that remains, based on the size of the sample available. Assuming that the model was correctly specified, we found that there is a 95 per cent probability that the true premiums lie between 13 and 23 per cent.

1.24 There is some degree of variation in the wage premiums depending on the gender of individuals. The results in Figure 1 suggest that there are generally higher wage premiums for men compared to those obtained by women. Men with an Advanced apprenticeship obtain statistically significant premiums of approximately 24 per cent, while there are no statistically significant premiums found for women.

1.25 In **Figure 2** we present results for the estimated wage premiums to individuals in possession of Intermediate apprenticeships. The analysis indicated that compared to individuals in possession of either Level 1 or Level 2 qualifications, there is an 11 per cent wage premium associated with the Intermediate apprenticeship, with a 95 per cent probability that the true premium lies between 6 and 16 per cent. This is higher than the premium achieved by those with a traditional trade apprenticeship, which stands at about 4 per cent.

Figure 2
Wage premium to Intermediate apprenticeships (%)

	All	Males	Females
Intermediate apprenticeship	10.6***	13.0***	5.4
Trade apprenticeship	4.2***	3.4***	-0.2

NOTES

1 The numbers presented here are the actual wage premiums calculated from the estimated coefficients using log transformation described in paragraph 1.18.

2 *** 1 per cent level of statistical significance; ** 5 per cent level of statistical significance; * 10 per cent level of statistical significance; absence of asterisk on the number means no statistically significant results were found.

Source: National Audit Office analysis of Labour Force Surveys 2004–2010

1.26 As with Advanced apprenticeships, there are some gender differences in the wage premiums to Intermediate apprenticeships. The results in Figure 2 reveal that men achieve higher premiums to Intermediate apprenticeships, about 13 per cent, over those who remain at Level 1 or Level 2 compared to men with a traditional trade apprenticeship whose premium is 3.4 per cent. Women with an Intermediate apprenticeship achieve around 5.4 per cent, although these are not statistically significant. Women with trade apprenticeships achieve lower premiums compared to women with Level 2 or Level 1 qualifications, but again these were not statistically significant.

Estimated wage premium – Results by sector

1.27 This section considers the wage premiums achieved by former apprentices working in particular sectors of the economy. Ideally, we would like to estimate the premiums to apprenticeship by the sector in which apprenticeship was acquired, but due to the lack of such information, we need to rely instead on the current sector of apprentices' employment.

1.28 The estimates in **Figure 3** overleaf suggest that there are large variations in wage premiums by sector. In particular, there are significant positive premiums associated with apprenticeships in: 'energy and water'; 'manufacturing'; 'construction'; 'distribution, hotels and restaurants'; and 'public administration, education and health'. However, there are insignificant premiums in 'banking, finance and insurance'. There are some differences in premiums between Advanced and Intermediate apprenticeships, with noticeably higher premiums to Advanced apprenticeships in 'manufacturing, transport and communication', and 'other services'.

1.29 While we believe that important information can be gleaned from analysis of the sectoral premiums to apprenticeships, it should be made clear that, in some sectors, the Labour Force Survey does not include many Modern apprentices. For instance, there were only 13 Advanced apprentices in our treatment group in the 'energy and water' sector. This helps to explain the imprecision of our estimates of the premiums in some sectors. However, there were larger numbers in other sectors, so we can have more confidence in our results. For instance, there were 101 Advanced apprentices in our treatment group in the 'construction' sector.

Figure 3
Wage premiums to Modern apprenticeships by sector (%)

Sectors	Advanced apprenticeships	Intermediate apprenticeships	All
Energy and water	29.3*	2.6	23.4*
Distribution, hotels and restaurants	23.2***	17.4***	19.4***
Public administration, education and health	18.3***	22.5***	19.4***
Manufacturing	26.4***	8.1*	14.8***
Construction	10.9**	13.1***	11.6***
Transport and communication	21.8**	3.5	10.0
Other services	22.0***	-0.7	3.9
Banking, finance and insurance	-0.3	4.5	2.1
Agriculture and fishing	9.3**	10.2	2.0

NOTES

1 The numbers presented here are the actual wage premiums calculated from the estimated coefficients using log transformation described in paragraph 1.18.

2 *** 1 per cent level of statistical significance; ** 5 per cent level of statistical significance; * 10 per cent level of statistical significance, absence of asterisk on the number means no statistically significant results were found.

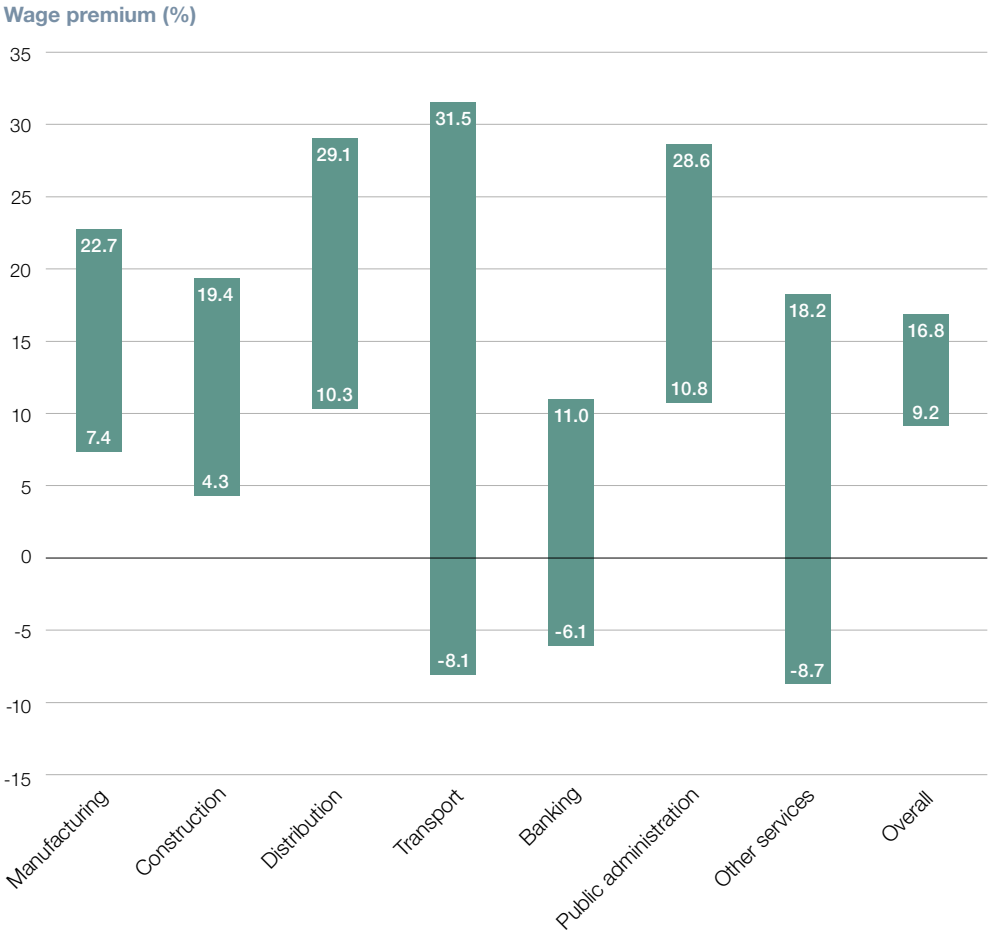
Source: National Audit Office analysis of Labour Force Surveys 2004–2010

1.30 **Figure 4** displays some of the uncertainty that remains; it shows the 95 per cent confidence intervals of our estimates for premiums to Advanced and Intermediate apprenticeships in different sectors. 'Agriculture and fishing' and 'energy and water' were excluded as they had fewer than 20 former apprentices in the treatment group.

Comparison of NAO analysis with other studies

1.31 As mentioned at the beginning of this chapter, there were two studies, commissioned by the Department which estimated wage premiums to apprenticeships using Labour Force Survey data. First, a study by McIntosh (2007) used Labour Force Surveys for 2004-2005 to estimate wage premium for all recognised apprenticeships, but also Advanced and Foundation (now Intermediate) apprenticeships. In addition, McIntosh (2007) used pooled LFS data for 1996-2005 to estimate wage premiums to all recognised apprenticeships and Modern apprenticeships by different sectors. Second, a study by Conlon *et al.* (2011) used pooled LFS data for 2004-2009 to estimate wage premium for trade apprenticeships, Advanced apprenticeships and Foundation (now Intermediate) apprenticeships. It also provided estimates for different industry sectors, but only for trade apprenticeships.

Figure 4
Wage premium by sector



Source: National Audit Office analysis

1.32 This study differed from the two studies mentioned above in a number of ways. Firstly, we used pooled LFS 2004–2010 data, adding one extra year, 2010, compared to Conlon *et al.* (2011). Secondly, we estimated wage premiums by industry sectors for Advanced apprenticeships and Intermediate apprenticeships separately. Thirdly, in addition to all the control variables used by McIntosh (2007) and Conlon *et al.* (2011) we also included a variable measuring the length of time an individual has been employed by his current company; and sector dummy variables to control for potential wage differences in various sectors.

1.33 There are also differences in the treatment group we used. McIntosh (2007) used all those whose highest qualification was an apprenticeship plus those who completed an apprenticeship and whose highest qualification was a National Vocational Qualification (NVQ) at Level 3. In the Labour Force Survey, NVQ Level 3 qualification ranks above all other Level 3 qualifications. This means that respondents with NVQ Level 3 qualification as their highest qualification could also hold other Level 3 qualifications (academic or vocational). Conlon *et al.* (2011) considered respondents in possession of an apprenticeship plus NVQ Level 3 while excluding from the treatment group all those holding any other qualifications at Level 3. We excluded only those respondents holding any other academic qualifications at Level 3.

1.34 **Figure 5** presents detailed comparison of our results with those of McIntosh (2007) and Conlon *et al.* (2011). When we replicated McIntosh's results following similar methodology, but over a longer time period, we found that the premiums to an Advanced apprenticeships stand at about 22 per cent. This is about four percentage points higher than McIntosh's estimates and is very close to the replication of McIntosh by Conlon *et al.* (2011). We also found that the premiums to an apprenticeship at Intermediate level stand at 13 per cent, which is approximately three percentage points lower than McIntosh and slightly higher than the replication of McIntosh by Conlon *et al.* (2011).

1.35 For our central specification, we followed McIntosh (2007) in concentrating on the relationship between weekly earnings and apprenticeships. By contrast, Conlon *et al.* (2011) concentrated on hourly pay. They found, as did we, that estimated premiums were substantially lower when the dependent variable was hourly pay rather than weekly earnings. This reflected former apprentices on average working longer hours than similar people who did not have apprenticeships.

Figure 5

Wage premium to apprenticeships – comparison table (%)

	McIntosh 2004-2005 (Weekly earnings)	Conlon et al. replicating McIntosh 2004–2009 (Weekly earnings)	Conlon et al. specification 2004–2009 (Hourly earnings)	NAO specification 2004–2010 (Weekly earnings)	NAO specification 2004–2010 (Hourly earnings)	NAO replicating McIntosh 2004–2010 (Weekly earnings)
Advanced apprenticeship	17.7***	22.4***	13.3***	17.9***	12.9***	21.5***
Foundation (Intermediate) apprenticeship	15.6***	11.7***	7.9***	10.6***	7.9***	13.1***

NOTES

1 The numbers presented here are the actual wage premiums calculated from the estimated coefficients using log transformation described in paragraph 1.18.

2 *** 1 per cent level of statistical significance; ** 5 per cent level of statistical significance; * 10 per cent level of statistical significance; absence of asterisk on the number means no statistically significant results were found.

Source: National Audit Office analysis of Labour Force Surveys 2004–2010

1.36 There is no clear answer to the question of whether hourly pay is a better measure of possible effects than weekly earnings, and which one to use depends partly on the question being asked. For instance, an employer might be more interested in how apprenticeships affect baseline productivity (perhaps best captured in hourly pay). An employee might be more interested in how apprenticeships affect their overall earnings, particularly if having the apprenticeship enables them to move into a job with longer hours from which they were previously excluded.

1.37 We decided to focus on weekly earnings, in order to follow both McIntosh's work and that of the Department's research paper (2011). But the large difference in estimates should be noted, and provides a possible reason for thinking that our central estimates could overestimate the relationship between apprenticeships and wages. In the sensitivity analysis for Part Three, we discuss the effects that using wage premiums based on hourly pay could have on our cost-benefit analysis.

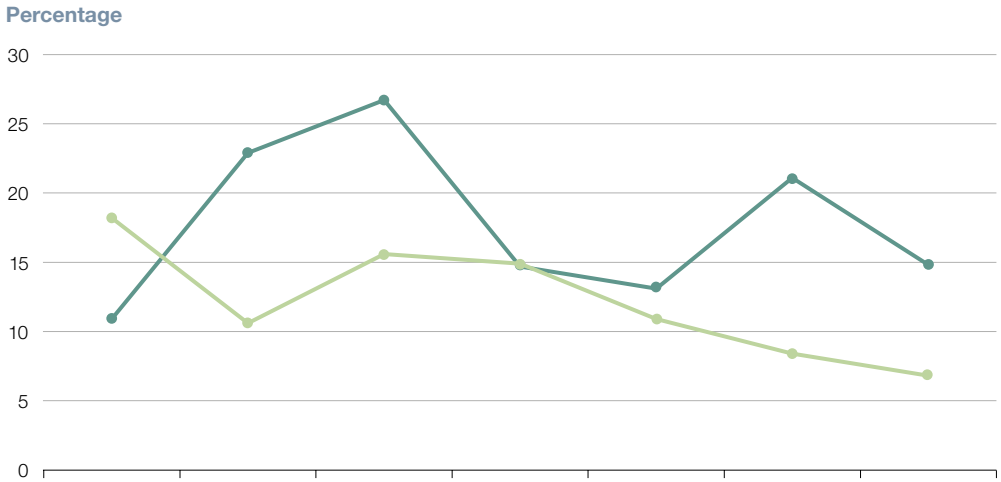
Further investigations

1.38 In addition to the main results presented above, we also examined whether the wage premiums to apprenticeships have changed over time. One way of analysing this was to split the LFS sample on the basis of the year in which data were collected, and then estimate our wage premium equation separately for each year from 2004 to 2010. The results of this analysis are presented in **Figure 6** overleaf. These results should be treated with caution since the samples available for each year were much smaller than for the same years combined. This inevitably reduced the precision of our estimates and caused volatility year-by-year. The 95 per cent confidence interval for our yearly estimates was usually 20 percentage points or more. For instance, in 2008, we found that there was a 95 per cent probability that the true premium to Advanced apprenticeships was between 0.3 per cent and 24.3 per cent.

1.39 These results indicate that for Advanced apprenticeships the wage premiums were highly variable through the time: they increased substantially in 2005 and 2006, then dropped in the next two years, increased again in 2009 and dropped in 2010. For Intermediate apprenticeships the findings seem to indicate a decline of wage premiums over time. Thus, for an individual who completed an Intermediate apprenticeship compared to an individual whose highest qualification was at Level 2, wages were initially about 18 per cent higher in 2004, declining to around 7 per cent in 2010.

1.40 Another approach to analysing wage premiums over time was to include an interaction variable Year*apprenticeship in the main model specification. This allowed us to test systematically whether premiums were changing over time. A negative coefficient would indicate that premiums were falling on average each year. For Advanced apprenticeships we found no statistically significant change in wage premiums over time, suggesting that these premiums remained stable over the period 2004–2010.

Figure 6
Wage premium for apprenticeships over time



	2004	2005	2006	2007	2008	2009	2010
Advanced apprenticeships	10.9	22.9	26.7	14.7	13.1	21.1	14.8
Intermediate apprenticeships	18.2	10.6	15.6	14.9	10.9	8.4	6.8

NOTE

1 Central estimates of wage premiums in each year of the LFS dataset are presented here.

Source: National Audit Office analysis of Labour Force Survey 2004-2010

1.41 For Intermediate apprenticeships, we found that the coefficient on this interaction variable was negative and statistically significant at the 5 per cent level, indicating that the premiums to Intermediate apprenticeships on average fell by about 2.4 percentage points per year. For example, if premiums were 10 per cent in 2005 we would expect them to be 7.6 per cent in 2006. This confirmed our finding of diminishing premiums over time for Intermediate apprenticeships as in Figure 6. We should note that our results here showed a different trend to that of McIntosh (2007) who found evidence of rising premiums to apprenticeships over the earlier 1996–2005 period.

1.42 We also examined whether the age when an individual completed the apprenticeship had any effect on wage premium. There was no evidence that premiums differ significantly depending on the age when an individual completed the apprenticeship. However, it should be noted that the sample sizes for apprentices in the age group of 25 and over were small.

1.43 A further issue we investigated was whether the amount of time since the person completed the apprenticeship had any effect on premiums. We found that the premiums to Advanced apprenticeships increase with the amount of time since a person completed the apprenticeship. On average, wages increase by an additional 1.5 per cent for each year after receiving Advanced apprenticeship compared to a similar individual with the highest qualification at Level 2. This is consistent with the hypothesis that gaining an Advanced apprenticeship can put an individual on a different, higher career trajectory. However, we have not found similar evidence for Intermediate apprenticeships.

Sensitivity analysis

1.44 There are several possible approaches to analysing wage premiums. We therefore carried out further regression analyses to check whether small changes to our specification had a substantial impact on our findings. In this section we present sensitivity analysis of wage premiums to different model specifications and any additional analysis conducted to complement the core regression results. In particular, we conducted analysis including part-time workers in the sample, excluding the experience variable from the model, analysed change in wage premiums over time and produced separate regression analysis for each industry sector.

1.45 The core regression results presented in previous sections were based on the sample of full-time workers only. As discussed in McIntosh (2007) restricting the sample to full-time workers only can create sample selection bias, which may undermine the validity of the results. We conducted additional regression analysis with both full-time and part-time workers included in the sample. The results were obtained separately for Intermediate and Advanced apprenticeships. We found that inclusion of part-time workers in the sample did not affect the results substantially. The estimated wage premiums for both apprenticeships levels reduced slightly: for Intermediate apprenticeships the actual wage premium decreased from 10.6 per cent to 10.1 per cent; for Advanced apprenticeships it decreased from 17.9 per cent to 17.6 per cent.

1.46 As outlined in paragraph 1.16 above, one of the explanatory variables included in our main model specification was experience at a particular company (months continuously employed at this particular firm). We included this variable to control for any work-specific experience that is not captured by age, but may contribute to the wage premium. Excluding the 'experience' variable from the main model specification resulted in slightly higher wage premiums for Intermediate apprenticeships (11.7 per cent compared to 10.6 per cent for the main specification) and Advanced apprenticeships (18.4 per cent compared with 17.9 per cent in the main specification).

1.47 We also included sector dummies in our main model specification to control for industry-specific effects. Excluding these dummies from the main model specification has had a substantial effect on the estimated wage premiums. The wage premiums to Intermediate apprenticeships increased to 13.5 per cent from 10.6 per cent, while premiums to Advanced apprenticeships increased to 21.1 per cent from 17.9 per cent. This effect was due to apprentices typically working in higher-earning sectors. Which specification is preferable depends on whether the possession of the apprenticeship enables people to enter these sectors. We believed that people were more likely to choose the sector first and then do an apprenticeship, thus we included sector dummy variables in our main specification.

Part Two

Estimating employment premium to apprenticeships

Introduction

2.1 In Part One we estimated wage premiums to Intermediate and Advanced apprenticeships. However, higher wage premiums are not the only benefit associated with acquiring an apprenticeship. Previous research (McIntosh, 2007; Conlon *et al*. 2011) suggested that individuals with apprenticeship have higher probability of being in employment over the course of their lifetime. In this part we estimate employment premiums associated with the Intermediate and Advanced apprenticeships. The main purpose of doing this is to validate the findings in other studies and produce more up-to-date estimates for the cost-benefit analysis presented in Part Three.

2.2 One important caveat should be applied to the results presented here; the selection effects discussed in paragraphs 1.14-1.15 could be particularly strong when assessing employment premiums. By definition, an apprentice will have a job when studying for the apprenticeship, which makes him or her substantially more likely to have a job in future. In the LFS dataset, we could not control for this by, for instance, excluding those people who have never had a job.

Data sources

2.3 As in Part One, we carried out analysis of employment premiums using data pooled from the successive Labour Force Surveys from 2004 to 2010. For consistency with the estimated wage equations, the sample was restricted in the same way as described in paragraphs 1.8-1.9: full-time workers, those individuals not currently in education and those living in England were included in the sample. Individuals with very high reported wages, with hourly pay more than £99, were excluded from the analysis. The resulting sample size was 169,427 over the period 2004 to 2010.

Methodology

2.4 We used econometric modelling to examine whether the completion of a Modern apprenticeship tended to result in higher probability of being employed compared to individuals with similar characteristics who did not complete an apprenticeship. We estimated a number of employment equations using probit regression analysis.[13]

13 Probit is a statistical technique where the dependent variable can only take a value of 0 or 1. In this case the dependent variable takes a value of one if an individual is employed and zero if the individual is unemployed.

2.5 It is important to specify exactly who is included in the unemployed, as this may affect the results considerably. For example, if the economically inactive are included in the sample together with unemployed,[14] the association between the completion of an apprenticeship and employment outcomes is stronger. However, if the economically inactive are excluded from the sample, this association is weaker. We believe that including economically inactive individuals in the comparison group would overestimate the true employment effect of the qualification, as this group of people have no attachment to the labour market, and thus are less likely to have a motivation to acquire vocational qualifications. Therefore, we excluded economically inactive people from the comparison group, as employed versus unemployed appeared to be a better measure of the welfare gain associated with employment.

2.6 The specification of the probit model (in aggregate and for men and women separately) was as follows:

$$PR(EMP_i \mid Z_i, Apprenticship_i) = \Phi\,(a+\beta' Z_i+\gamma Apprenticeship_i), \text{ for } i = 1 \text{ to n}$$

where $PR(EMP_i \mid Z_i, Apprenticship_i)$ is the conditional probability of being employed given the explanatory variables. It is equal to 1 if an individual has a full-time job and equal to 0 if unemployed (excluding inactive). Φ is the cumulative distribution function of the normal distribution. Z_i in the model represents a set of independent variables as follows:

- Age
- Age squared (to control for non-linear effects in age)
- Gender
- Ethnic origin
- Region of usual residence
- Other qualifications below apprenticeship level
- Marital status
- Number of dependent children under the age of 16
- Yearly/seasonal dummies

Gamma (γ) coefficients measure the relationship between having an apprenticeship and the probability of being employed. The employment premiums we report below show the average marginal effect of having an apprenticeship on this probability.

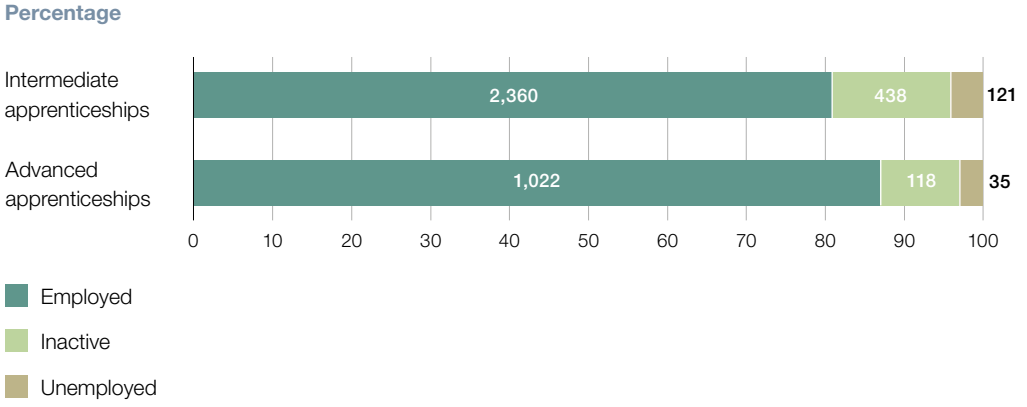
14 In the Labour Force Survey individuals are considered to be unemployed if they are available for work or actively seeking work but have not done an hour or more of paid work in the previous week. Individuals are considered to be economically inactive if they are not available for work and not seeking work.

Estimated employment premium – Aggregate results for 2004–2010

2.7 The descriptive statistics, presented in **Figure 7**, show the proportion of employed, unemployed and inactive individuals among those in possession of Advanced and Intermediate apprenticeship separately. These results were obtained using Labour Force Survey data for 2004–2010 and are based on a sample of around 1200 Advanced level apprentices and 2900 Intermediate level apprentices. We were interested in estimating the employment premium of apprenticeships who were employed compared to those who were unemployed, excluding the inactive group.

2.8 In **Figure 8** overleaf we present the employment premiums associated with Advanced apprenticeships at an aggregate level and also separate results for men and women. The results indicate that there are positive employment premiums associated with all forms of apprenticeships. Individuals with Advanced apprenticeship are 3.6 percentage points more likely to be in a full-time job compared to similar individuals whose highest qualification is at Level 2.

Figure 7
Employment rates for apprentices (%)



Source: National Audit Office analysis of Labour Force Survey 2004–2010

2.9 When the results are broken down by gender, men with Advanced apprenticeship have about 5 percentage points greater probability of being employed than men whose qualifications remain at Level 2; while women with Advanced apprenticeship are no more likely to be employed than women in possession of Level 2 vocational qualifications.

2.10 In **Figure 9** we provide the estimates of the employment premiums associated with the Intermediate apprenticeships. The results suggest that there are positive employment outcomes for individuals with Intermediate apprenticeships. In aggregate, possession of Intermediate apprenticeship results in 1.6 percentage points higher probability of being in employment compared to an individual with Level 2 qualifications. When considering disaggregated results by gender, we find interesting results for women. Compared to women with Advanced apprenticeships, who receive no significant employment premium, women with Intermediate apprenticeships are about three percentage points more likely to be in a full-time job. However, it should be noted here that the results for women were statistically significant only at the 10 per cent level.

Figure 8
Employment premium to Advanced apprenticeships

	All	Males	Females
Advanced apprenticeship	3.6***	4.9***	0.9
Trade apprenticeship	1.5***	1.5***	1.3**

NOTES

1 The numbers in this table present the employment premiums expressed in percentage points.

2 *** 1 per cent level of statistical significance; ** 5 per cent level of statistical significance; * 10 per cent level of statistical significance; absence of asterisk on the number means no statistically significant results were found.

Source: National Audit Office analysis of Labour Force Surveys 2004–2010

Figure 9
Employment premium to Intermediate apprenticeships

	All	Males	Females
Intermediate apprenticeship	1.6**	2.4**	3.0*
Trade apprenticeship	1.6***	1.6***	1.7***

NOTES

1 The numbers in this table present the employment premiums expressed in percentage points.

2 *** 1 per cent level of statistical significance; ** 5 per cent level of statistical significance; * 10 per cent level of statistical significance; absence of asterisk on the number means no statistically significant results were found.

Source: National Audit Office analysis of Labour Force Surveys 2004–2010

Comparison of NAO analysis with other studies

2.11 As with wage premiums, we compared the results for employment premiums with two studies mentioned in Part One – McIntosh (2007) and Conlon *et al.* (2011). **Figure 10** presents detailed comparison of our results. We noted in paragraph 2.5 that the definition of employment has a substantial effect on the estimated employment premiums. We did not include economically inactive individuals in our comparison group. As a result we found the association between apprenticeship completion and employment outcomes is weaker than in the previous two studies.

2.12 McIntosh (2007) and Conlon *et al.* (2011) included the economically inactive individuals in their comparison group. As a result their estimates of employment premium suggested that there was a strong association between the apprenticeship and probability of being in a full-time job. We replicated their analysis by including economically inactive in our sample, obtaining the estimates of similar magnitude.

2.13 It should be noted, however, that economically inactive individuals have no attachment to the labour market, and therefore are less likely to have a motivation to acquire vocational qualifications. Thus, the association between the apprenticeships and being in employment versus inactivity is greater than the association between the apprenticeships and being in employment versus unemployment, as the results in Figure 10 indicate.

Figure 10
Employment premium to apprenticeships – comparison table

	McIntosh 2004-2005 (including economically inactive)	Conlon et al. 2004–2009 (including economically inactive)	BIS analysis (excluding economically inactive)	NAO specification 2004–2010 (excluding economically inactive)	NAO specification 2004–2010 (including economically inactive)
Advanced apprenticeship	15.7***	13.8***	1.1	3.6***	13.7***
Foundation (Intermediate) apprenticeship	7.4**	9.5***	0.7	1.6**	7.6***

NOTES

1 The number in this table present the actual employment premiums in percentage points.

2 The Department's figures ('BIS analysis') are taken from the BIS Research paper N38 (2011), *Measuring the Economic Impact of Further Education*. The level of statistical significance of these estimates was not indicated in the paper.

Source: National Audit Office analysis of Labour Force Surveys 2004–2010

2.14 We excluded economically inactive individuals from our sample and obtained substantially lower estimates than the ones presented in McIntosh (2007) and Conlon *et al*. (2011). In their analysis of employment premiums for vocational qualifications, the Department (2011) also excluded economically inactive individuals from their sample, which again led to much lower employment premium estimates than in the other two studies mentioned.

2.15 We considered our employment premium estimates, excluding economically inactive, as our central estimates, as employed versus unemployed appeared to be a better measure of the welfare gain associated with employment. Consequently, we used these results for our cost-benefit analysis.

Part Three

Cost-Benefit analysis of apprenticeships

Introduction

3.1 In Parts One and Two we estimated some of the economic benefits associated with apprenticeships. In this section, we compare these benefits to the costs of providing apprenticeships.

3.2 Cost-benefit analysis aims to quantify in monetary terms the costs and benefits of a programme or project, and thus establish whether it represents value for money. In March 2011, the Department for Business, Innovation and Skills published a research paper which presented a cost-benefit analysis of apprenticeships and other vocational qualifications.[15] This paper reported that the economic returns to apprenticeships were around £35-£42 per pound of government funding for first qualifications (where the learner has reached this level of qualification for the first time), and £24-£35 per pound of government funding for all qualifications (where learners who already had a qualification at that level were included).

3.3 The Department's paper used the following inputs for the benefits:

- wage premium estimates from McIntosh (2007), based on Labour Force Survey data from 2004-2005;
- employment premium estimates from the Department's analysis of the 2008 (Q4) Labour Force Survey; and
- an assumption of 'spillover' (additional productivity) effects to vocational training from the work of Dearden *et al*. (2005), based on analysis of the aggregated LFS and Annual Business Survey panel data for 1983–1996.

It also includes the following inputs for costs:

- government funding;
- fees paid by employers; and
- cost to the economy in terms of foregone output due to employees spending their time learning rather than producing.

15 Department for Business, Innovation and Skills Research Paper N38 (2011), *Measuring the Economic Impact of Further Education*. This paper was written by the Cambridge Econometrics consultancy and the Institute for Employment Research at Warwick University with input from the Department's analytical team.

3.4 We conducted our own cost-benefit analysis using the Department's model, but updating it with our new estimates for wage and employment premiums, presented in Parts One and Two. We also altered the model's assumptions about the spillover effects of apprenticeships. Finally, we incorporated more recent data about:

- the number of apprenticeship starts;
- the gender split of apprentices;
- current and expected retirement ages of apprentices; and
- current wage levels.

The following sections present the detailed methodology, main results and sensitivity analysis.

Methodology

3.5 We used the cost-benefit model developed by Cambridge Econometrics for the Department[16] (referred to as the BIS model) to derive estimates of the Net Present Value (NPV) to the economy for Adult apprenticeships. We calculated the NPV by estimating the benefits to the economy from completing apprenticeships over the expected working life of the learner, and subtracting the costs to the economy associated with undertaking these apprenticeships. All future benefits and costs were discounted to calculate their value in present-day terms. This economy-wide NPV figure was then divided by the total direct Exchequer costs of apprenticeships to derive the return to apprenticeships per pound of government funding.

3.6 The BIS model identified and estimated separately the costs and benefits to the economy and those that affect the Exchequer specifically.

Benefits to the economy

3.7 The economic benefits of apprenticeships are:

- higher productivity due to the skills gained by those in possession of the apprenticeship, normally measured by the increase in wages of the learner;
- higher lifetime employment chances for those in possession of an apprenticeship; and
- additional (spillover) effects on productivity which include any output not captured in the learner's increased wages, for instance higher profits for employers.

We provide more detailed discussion for each of these benefits below.

16 Department for Business, Innovation and Skills Research Paper N38 (2011), *Measuring the Economic Impact of Further Education*.

Wage premium – the benefits to individuals who have completed an apprenticeship in terms of increased wages over the course of their lifetime compared with those who have not completed an apprenticeship. We used the same methodology for calculating the wage premiums associated with apprenticeships as in Part One, but conducted additional regression analysis to calculate the impact of apprenticeships on those who have different previous qualification levels from the central case examined there. **Figure 11** shows the wage premiums we discovered as the comparator group changed.

3.8 Employment premium – as well as increasing wages, qualifications can increase an individual's probability of being employed over the course of their lifetime. We used the same methodology as in Part Two, supplemented by additional regression analyses of employment premiums for different comparator groups (**Figure 12**).

Figure 11
Wage premium adopted in the model (%)

	Previous Highest Qualification				
	Below Level 1	**Level 1**	**Level 2**	**Level 3**	**Level 4**
Intermediate apprenticeship (Level 2)	15.4	8.9	8.7	10.0	5.9
Advanced apprenticeship (Level 3)	40.9	24.3	17.9	13.6	10.8

Source: National Audit Office analysis

Figure 12
Employment premium adopted in the model (%)

	Previous Highest Qualification				
	Below Level 1	**Level 1**	**Level 2**	**Level 3**	**Level 4**
Intermediate apprenticeship (Level 2)	2.5	2.6	1.2	0.8	-0.2
Advanced apprenticeship (Level 3)	5.9	4.9	3.6	1.5	1.4

NOTE

1 These show the change in the probability of being employed rather than unemployed associated with having an apprenticeship, in percentage points.

Source: National Audit Office analysis

3.9 Additional productivity effects (spillover) – the productivity effects of training which are not captured in learners' higher lifetime earnings. There are several reasons to think that not all of the effects of apprenticeships on productivity will be reflected in the wage and employment prospects of individual apprentices:

- Knowledge transfer. An apprentice might spread his or her knowledge to other employees, raising total productivity across the company or industry.
- Increased profits. Employers might be able to capture some of the benefits of increased productivity themselves, rather than paying all of them to the employee in the form of higher wages. This is more likely where labour markets are uncompetitive. Such benefits could be captured both by the learner's employer when they complete their apprenticeship and by any future employers.
- Non-wage labour costs. The cost of an employee to a firm is greater than the wages alone, for example the additional costs of employers' National Insurance and pension contributions. If employers are prepared to pay the extra amount, this suggests that total productivity has increased by more than wages.
- Signalling. Successful completion of training might serve as a signal to employers that an apprentice is a productive worker, without raising their productivity directly. In this case, the wage increase might exceed the productivity increase.

3.10 HM Treasury's Green Book provides guidance for evaluation and appraisal of policy across government.[17] It describes the possibility of spillover effects from training, but does not prescribe how spillover effects should be valued. BIS research paper (2011) assumed that the total increase in productivity is double the increase in wages implied by the wage premium. For example, in the case of Advanced apprenticeships compared to Level 2 qualifications, the wage premium of 18 per cent implies that total productivity increases by 36 per cent.

3.11 The Department's assumption was based on research by Dearden *et al*. (2005),[18] which studied manufacturing firms in the UK between 1983 and 1996, and found that work-related training was associated with an increase in productivity that was double the increase in wages. However, Lorraine Dearden advised us that it was inappropriate to use her results on work-related training to estimate the wider impacts of apprenticeships.[19] The original research focused on different programmes and came from a different labour market and training context. Furthermore, recent research by McIntosh *et al*. (2011) found no evidence of a statistically significant relationship between firms' engagement with apprenticeships and their productivity.[20] This study only assesses the relationship between productivity and engagement with apprenticeships in the past 12 months, so it could have been too early to identify any productivity impact.

17 HM Treasury (2003), *Appraisal and Evaluation in Central Government: Treasury Guidance: The Green Book,* The Stationery Office, London.
18 L. Dearden, H. Reed and J.Van Reenen (2005), *The Impact of Training on Productivity and Wages: Evidence from British Panel Data 1983-1996*, CEP Discussion Paper No 674, Centre for Economic Performance, LSE.
19 Interview with Lorraine Dearden, Institute for Fiscal Studies, 22 July 2011.
20 S. McIntosh, W. Jin and A. Vignoles (2011), *Firms' Engagement with the Apprenticeship Programme*, Centre for Analysis of Youth Transitions, Department for Education Research Report 180.

3.12 On the basis of our review of the literature, we concluded that there was insufficient evidence on the value of spillover effects of apprenticeships, such as the signalling and increased profit effects described above. Because the Green Book recognises that the true costs of an employee to an employer go beyond his or her wages, such as employer contributions to National Insurance and pensions, we therefore assumed that total productivity increases are higher than the increases in wages alone. Government departments have made different assumptions about the level of non-wage labour costs, ranging from 21 to 30 per cent.[21] We assumed that these costs are 25 per cent of the wage, so total productivity increases by 25 per cent more than the wage premium alone.

3.13 The Department acknowledges the uncertainty around the magnitude of these additional benefits from apprenticeships. However, it considers that our assumption that spillovers are 25 per cent of the wage premium is a lower bound estimate. In particular, the Department believes that, if apprenticeships did not help to improve employer profits substantially, firms would not engage with the Apprenticeship Programme. It cites research by the Institute for Employment Research, based on case studies and a telephone survey, which reported substantial benefits to employers from investment in apprenticeships.[22] The Department also believes that the level of spillover is higher because the share of UK national output that is taken as a return to capital (rather than to labour, through higher wages) is around 40 per cent. The Department considers that this implies that spillover is likely to be at least 66 per cent of the wage gain. We do not accept this argument for a number of reasons. In particular, the shares of national output are based on average returns across the whole economy, and so this does not provide any evidence about the marginal impact of any particular programme.

3.14 On balance, therefore, we remain of the view that the available evidence is not sufficiently robust to increase our central estimate of spillover effects. There are some uncertainties that could increase the estimate of spillovers, while another, the effect of signalling through training, could reduce the estimate. To take account of the significant uncertainty in this area, we conducted a sensitivity analysis, which is presented in paragraph 3.32 and Figure 16.

3.15 Length of benefits – the benefits from training, both in terms of wage and employment premiums for the individual and spillover effects on others, will occur for the rest of an individual's working life. Using data from the Office for National Statistics, we assume that male apprentices will on average retire at the age of 64.5, while female apprentices will retire at 62.[23] On the basis of the Individualised Learner Record, we assume that the average age of people finishing apprenticeships is between 32 and 33. In line with the Government's approach to policy appraisal, future benefits are then discounted at a rate of 3.5 per cent for the first 30 years, and 3 per cent thereafter.

21 HM Treasury (2003): *The Green Book,* paragraph 15, p.59; and www.dft.gov.uk/webtag/documents/expert/unit3.5.6.php
22 C. Hasluck, et al, *The Net Benefit to Employer Investment in Apprenticeship Training,* 2008.
23 Office for National Statistics, *Pension Trends*, Chapter 4, February 2011.

Costs to the economy

3.16 The costs to the economy consist of:

- **direct** costs of public funding and fees paid by employers; and
- **indirect** costs of foregone output while learning is taking place.

3.17 The **direct** cost of apprenticeships is the cost of provision, which consists of public funding and fees paid by employers. The funding paid to each provider flows from the number of qualification aims they deliver, with running costs and additional support costs expected to come from that funding. The BIS model assumes that, for adult apprenticeships, employers pay providers half of the Skills Funding Agency's tariff rates, while the rest is funded by the Government. We have found that employers do not always pay so much,[24] but we are not able to estimate exactly how much they do pay. The **indirect** cost in the model is the loss of economic output during the time the learner is undertaking training. The model uses average wages at the learner's previous highest qualification level as a proxy for this, and multiplies by the guided learning hours associated with that particular aim. This is therefore equivalent to assuming that no output is produced during guided learning hours.

3.18 In addition to the benefits and costs of apprenticeships to the economy as a whole, the BIS model also allowed assessment of the benefits and costs to the Exchequer. These included changes in tax receipts and benefit payments and direct public funding costs, excluding fees paid by employers.

Benefits to the Exchequer

3.19 The benefits to the Exchequer consist of the increased tax receipts from future increases in productivity and employment, and reduced benefit payments from increased employment. Individuals would earn more, leading to higher income tax payments and National Insurance Contributions. They would also spend a proportion of their higher income, therefore increasing the VAT receipts. Employers would also make higher corporation tax and VAT payments to the extent that they realised the benefits. Due to the lack of evidence, it is unclear how spillover effects would be apportioned between individuals and employers. This section of the model adopts a simplified approach by assigning the spillover effects to individuals' wages, and applying the appropriate tax, National Insurance Contributions and VAT rates.

24 Comptroller and Auditor General, *Adult Apprenticeships*, Session 2010–2012, HC 1787, National Audit Office, February 2012.

Costs to the Exchequer

3.20 The direct cost to the Exchequer is the cost of provision borne by the public sector, which forms one of the components of the direct costs to the economy described above. In line with the Department's approach, we included only these direct costs in our estimate of the societal returns to Government spending. We did not include indirect Exchequer costs, such as the lost income tax revenues, National Insurance Contributions and VAT associated with the output foregone during training.

Different measures of Benefit:Cost Ratio

3.21 According to the Green Book, the cost-benefit analysis should quantify in monetary terms as many of the costs and benefits of a programme as feasible.[25] One way of doing this was to calculate the Benefit:Cost Ratio (BCR) as follows:

$$BCR = \frac{\textit{Present Value of Total Future Benefits to the Economy}}{\textit{Present Value of Total Future Costs to the Economy}}$$

where the Total Future Benefits to the Economy includes all the elements described in paragraphs 3.7–3.12 (wage premiums, employment premiums, spillover effects); while the Total Future Costs to the Economy include all elements of the costs as described in paragraphs 3.16-3.18 (public funding for training, employers' fees for training, and foregone output).

3.22 In order to assess the economic impact of Government spending, the BIS research paper (2011), assessed the net present value to the economy that results from each £ of public funding, as below:

$$NPV/Public\ Funding = \frac{\textit{Net Present Value to the Economy}}{\textit{Total Public Funding}}$$

where the Net Present Value to the Economy is calculated by subtracting the Present Value of Total Future Costs to the Economy from the Present Value of Total Future Benefits to the Economy. Total Public Funding represents direct costs incurred by the public sector excluding the foregone tax. As with the BCR, this measure included private costs, although here they featured as a component of the net present value rather than the programme cost.

3.23 The question of whether to incorporate indirect Exchequer costs is a complicated one. Not including them could tend to produce more favourable assessments of programmes with low direct costs and high indirect costs, since these would appear to be relatively cheaper. But, if foregone taxes are included as a cost to the Exchequer, they should arguably be netted off from future increases in tax revenues, creating further serious difficulties of assessment.

25 HM Treasury (2003): *The Green Book*, paragraph 2.3, p.4.

3.24 In our main analysis, we have therefore followed the Department's approach in calculating the NPV/Public Funding Ratio (Net Present Value to the Economy per Total Public Funding) as our central case because of the tight constraints on public spending. In coming to an overall assessment of the Adult Apprenticeship programme, we also looked at several other measures, including the Benefit:Cost Ratio (see Figure 15).

3.25 Using more recent data, we have updated other elements of the BIS model as follows:

- **Number of starts** was updated with provisional 2010/11 data from the Individualised Learner Record (ILR) provided to us by the Department.
- **Gender split** was updated with 2009/10 data from the ILR. Provisional data for 2010/11 were not available when this analysis was conducted.
- **Base wage earnings** were updated with the most recent Labour Force Survey (LFS) data for 2010.
- **Fiscal** was updated the weekly values for Jobseeker's Allowances (JSA) payments in line with 2011 data.
- **Work expectancy** was updated using a weighted average of ages for the 2009/10 apprenticeship starts, and subtracting it from the latest ONS estimates for retirement age for men and women. We then subtracted the average duration of courses to find total work expectancy after finishing an apprenticeship (based on 2010/11 data from the ILR).

Main results

3.26 The results obtained from our cost-benefit analysis are presented in **Figure 13**, which shows our estimates using NPV/Public Funding formula, and those presented in the BIS research paper (2011), as described in the Methodology section above. Results in Figure 13 differentiate between 'first' qualifications, where the learner has reached this level of qualification for the first time, and 'all qualifications' where, in calculating the average, learners who already had that level of qualification are included. The Department presented the results for first qualifications as their central figures. However, the apprenticeship is a first qualification at that level for only about half of all apprentices. Furthermore, the Skills Funding Agency provides funding to all apprenticeships, regardless of whether someone is already qualified at an equal or higher level. Therefore, we believe it is more appropriate to focus on the returns to all qualifications. The results presented indicate that the economic return to apprenticeships is £16 to £21 per pound of government funding for all qualifications.

Figure 13
Estimated economic returns to public spending on apprenticeships

	The Department's estimates		The National Audit Office estimates
	First qualifications	All qualifications	All qualifications
Intermediate apprenticeships	£42:£1	£35:£1	£16:£1
Advanced apprenticeships	£35:£1	£24:£1	£21:£1

NOTE

1 First qualifications include only those apprenticeships where the apprentice was not previously qualified at the equivalent level (in any subject). All qualifications include apprenticeships where the apprentice was already qualified at equivalent level or above.

Source: Department for Business, Innovation and Skills (2011), Measuring the economic impact of further education; National Audit Office

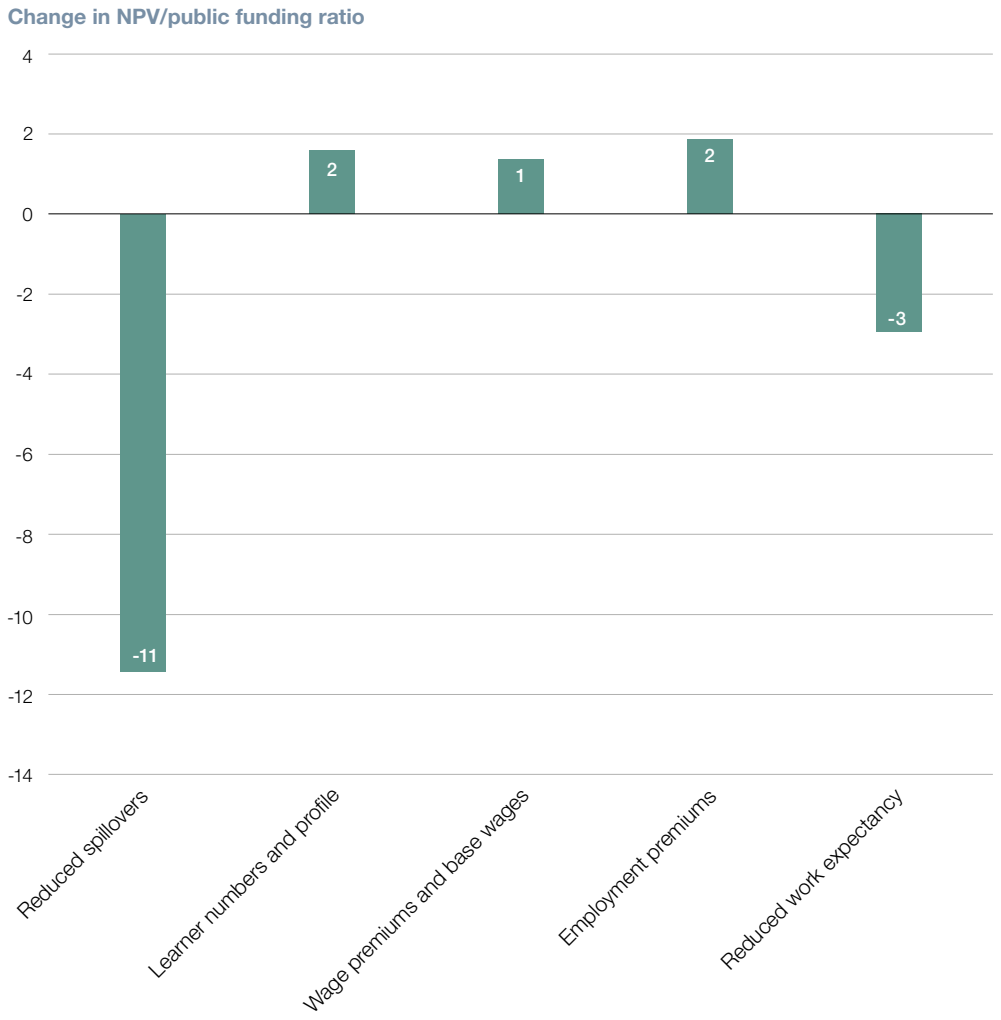
3.27 There are differences between our estimates and those provided by the Department. As well as including all prior qualification levels, rather than just first qualifications, five main factors contributed to these differences. These are presented in more detail in **Figure 14** overleaf.

3.28 The major factor that contributed to the decrease in our estimate of returns compared to the Department's figures was the treatment of spillover effects. Due to the lack of quantitative evidence on the magnitude of these other effects of apprenticeships, as outlined in paragraphs 3.9–3.14, we assumed that productivity increases associated with apprenticeships were reflected only in the employee's wage and in non-wage labour costs, not in profits to the employer or in the economy as a whole. We followed the Green Book guidance and assumed that these non-wage labour costs are 25 per cent of the wage premium. This assumption considerably lowered our estimates of returns compared to the Department's estimates, which assumed that spillover effects are 100 per cent of the wage premium.

3.29 Our adjustments to work expectancy – the average number of years that learners are expected to remain in the workforce after completing their course – also reduced our estimate of government returns compared to the Department's estimates. The Department calculated the average age of apprentices using the ILR data to arrive to 28 years for Intermediate Apprenticeship and 27 years for Advanced Apprenticeship. Individualised Learner Record data for 2010/11 show that apprentices are now on average older, and could be expected to complete their qualifications at between 32 and 33 years old on average. As the average age of apprentices increases, their work expectancy decreases and therefore the benefits accruing to them during their working lifetime also fall, leading to a lower estimate for the NPV/Public Funding ratio.

Figure 14

Factors contributing to the difference between the National Audit Office's and the Department's estimates



NOTE

1 Values may not appear exact due to rounding.

Source: National Audit Office analysis

3.30 As explained in paragraph 3.24, in addition to our central estimate, we also calculated the Benefit:Cost Ratio (paragraph 3.21) following the Green Book methodology. The results are presented in **Figure 15**.

Figure 15
Comparing different measures of Benefit:Cost Ratio

Formula	BIS estimate NPV to the Economy/Total Public Funding	NAO central estimate NPV to the Economy/Total Public Funding	NAO estimate following Green Book guidance Total Benefits to the Economy/Total Costs to the Economy
All apprenticeships	£28:£1	£18.4:£1	£4.7:£1
Intermediate apprenticeships	£35:£1	£16.1:£1	£5.3:£1
Advanced apprenticeships	£24:£1	£21.3:£1	£4.3:£1

NOTE
1 The numbers presented in this table are for all qualifications, rather than first qualifications.

Source: BIS Research Paper (2011) and National Audit Office analysis

3.31 The estimates in Figure 15 show that the societal benefit/cost ratio (Total Benefits to the Economy/Total Costs to the Economy) is expected to be between £4.3 and £5.3 of benefits for each pound of costs incurred. This is lower than the Department's initial estimates, that there were £6.3 of benefits for each pound of social costs. Comparisons across different types of projects are difficult, but the Department for Transport assesses a project with a benefit/cost ratio above four as providing very high value for money.[26]

Sensitivity analysis

3.32 In order to assess how sensitive our results were to varying important assumptions, we analysed how our estimates of the NPV/Public Funding ratio would change in the light of different assumptions. We looked at three areas:

- **The wage premium**. As discussed in Part One, it is unclear whether hourly pay or weekly wage provides a better measure of the wage premium associated with apprenticeships. For our sensitivity analysis we examined the effect of using wage premiums based on hourly pay, rather than weekly wage.

26 Department for Transport, *Value for money assessments*, www2.dft.gov.uk/about/howthedftworks/vfm/vfmassessments/pdf/vfmguidance.pdf

- **The employment premium**. Because apprentices are often already in employment when they begin training, employment premiums may be particularly likely to be overestimated due to selection effects.[27] We therefore assessed the impact of reducing our estimated employment premiums by one standard deviation. For instance, we assumed that the employment premium associated with an advanced apprenticeship is 3.1 per cent, rather than 3.6 per cent as assumed in our central estimates.

- **The spillover effects**. There is a high degree of uncertainty around the spillover effects of apprenticeships. In our central case, we assumed that spillover effects are 25 per cent of the wage increase, while the Department assumed that they were 100 per cent of the wage increase. For our sensitivity analysis, we assessed the impact of supposing that spillover effects are 50 per cent of the wage increase, so total productivity increases by 50 per cent more than the wage premium alone.

3.33 The results of these new analyses are shown in **Figure 16**. This shows that varying these assumptions could have a substantial impact on the NPV/Public Funding ratio, both in a positive and a negative direction.

Figure 16
The effect of varying assumptions on the NPV/Public Funding ratio

	Central estimate	Lower wage premiums	Lower employment premiums	Higher spillover effects
All apprenticeships	£18.4:£1	£13.1:£1	£16.2:£1	£22.2:£1
Intermediate apprenticeships	£16.1:£1	£11.2:£1	£13.3:£1	£19.4:£1
Advanced apprenticeships	£21.3:£1	£15.4:£1	£19.9:£1	£25.7:£1

NOTE
1 The numbers presented in this table are for all qualifications, rather than first qualifications.

Source: National Audit Office analysis

27 McIntosh, *A Cost-Benefit Analysis of Apprenticeships*, 2007, p.28.

Appendix One

Throughout the main body of the paper we presented actual wage premiums, calculated using the log transformation described in paragraph 1.18. This Appendix presents the corresponding tables with estimated regression coefficients and standard errors from the wage equation presented in paragraph 1.16.

Figure 17
Estimated wage premium coefficients to Advanced apprenticeships

	All	Males	Females
Advanced apprenticeship	0.165***	0.221***	0.043
	(0.023)	(0.027)	(0.04)
Trade apprenticeship	0.051***	0.037***	-0.016
	(0.010)	(0.012)	(0.022)

NOTES

1 The numbers here are the estimated coefficients from the wage equation described in paragraph 1.16. The control group used here are all individuals with no apprenticeship, but with Level 2 as their highest qualification. The numbers in parentheses are standard errors of the estimated coefficients.

2 *** 1 per cent level of statistical significance; ** 5 per cent level of statistical significance; * 10 per cent level of statistical significance; absence of asterisk on the number means no statistically significant results were found.

Source: National Audit Office analysis of Labour Force Surveys 2004–2010

Figure 18
Estimated wage premium coefficients to Intermediate apprenticeships

	All	Males	Females
Intermediate apprenticeship	0.101***	0.127***	0.053
	(0.023)	(0.027)	(0.050)
Trade apprenticeship	0.041***	0.034***	-0.002
	(0.008)	(0.008)	(0.021)

NOTES

1 The numbers here are the estimated coefficients from the wage equation described in paragraph 1.16. The control group used here are all individuals with no apprenticeship, but with Level 1 or Level 2 as their highest qualification. The numbers in parentheses are standard errors of the estimated coefficients.

2 *** 1 per cent level of statistical significance; ** 5 per cent level of statistical significance; * 10 per cent level of statistical significance; absence of asterisk on the number means no statistically significant results were found.

Source: National Audit Office analysis of Labour Force Surveys 2004–2010

Figure 19
Wage premiums to Modern apprenticeships by sector (%)

Sector	Advanced apprenticeships	Intermediate apprenticeships	All
Agriculture and fishing	9.3**	10.2	2.0
Energy and water	29.3*	2.6	23.4*
Manufacturing	26.4***	8.1*	14.8***
Construction	10.9**	13.1***	11.6***
Distribution, hotels and restaurants	23.2***	17.4***	19.4***
Transport and communication	21.8**	3.5	10.0
Banking, finance and insurance	-0.3	4.5	2.1
Public administration, education and health	18.3***	22.5***	19.4***
Other services	22.0***	-0.7	3.9

NOTES

1 The numbers presented here are the actual wage premiums calculated from the estimated coefficients using log transformation described in paragraph 1.18.

2 *** 1 per cent level of statistical significance; ** 5 per cent level of statistical significance; * 10 per cent level of statistical significance; absence of asterisk on the number means no statistically significant results were found.

Source: National Audit Office analysis of Labour Force Surveys 2004–2010

Figure 20
Estimated wage premium coefficients to apprenticeships – comparison table

	McIntosh 2004-2005 (Weekly earnings)	Conlon et al. replicating McIntosh 2004–2009 (Weekly earnings)	Conlon et al. specification 2004–2009 (Hourly earnings)	NAO specification 2004–2010 (Weekly earnings)	NAO specification 2004–2010 (Hourly earnings)	NAO replicating McIntosh 2004–2010 (Weekly earnings)
Advanced apprenticeship	0.163*** (0.034)	0.202*** (0.021)	0.125*** (0.024)	0.165*** (0.023)	0.121*** (0.023)	0.195*** (0.023)
Foundation (Intermediate) apprenticeship	0.145*** (0.032)	0.111*** (0.019)	0.076*** (0.019)	0.101*** (0.023)	0.076*** (0.022)	0.123*** (0.017)

NOTE

1 The numbers here are the estimated coefficients from the wage equation described in paragraph 1.17. The numbers in parentheses are standard errors of the estimated coefficients.

Source: National Audit Office analysis of Labour Force Surveys 2004–2010

Figure 21

Changes in the wage premium coefficients for Advanced and Intermediate apprenticeships over time

Year	Advanced apprenticeship	Intermediate apprenticeship
2004	0.103* (0.055)	0.167** (0.069)
2005	0.207*** (0.074)	0.101 (0.074)
2006	0.237*** (0.066)	0.145*** (0.051)
2007	0.137*** (0.046)	0.139 (0.087)
2008	0.123** (0.061)	0.104* (0.058)
2009	0.191*** (0.065)	0.081* (0.048)
2010	0.138*** (0.049)	0.066 (0.044)

NOTE

1 The numbers here are the estimated coefficients from the wage equation described in paragraph 1.16. The numbers in parentheses are standard errors of the estimated coefficients.

Source: National Audit Office analysis of Labour Force Surveys 2004–2010

Figure 22

Changes in the wage premiums for Advanced and Intermediate apprenticeships over time (%)

Year	Advanced apprenticeship	Intermediate apprenticeship
2004	10.9*	18.2**
2005	22.9***	10.6
2006	26.7***	15.6***
2007	14.7***	14.9
2008	13.1**	10.9*
2009	21.1***	8.4*
2010	14.8***	6.8

NOTES

1 The numbers presented here are the actual wage premiums calculated from the estimated coefficients using log transformation described in paragraph 1.18.

2 *** 1 per cent level of statistical significance; ** 5 per cent level of statistical significance; * 10 per cent level of statistical significance; absence of asterisk on the number means no statistically significant results were found.

Source: National Audit Office analysis of Labour Force Surveys 2004–2010

Glossary

Advanced apprenticeship	work-based government-funded training programme, where apprentices work towards qualifications, such as Level 3 Competence Qualification, Functional Skills and a relevant knowledge-based qualification.
Employment premium	the increased probability of being employed associated with the possession of a qualification.
Intermediate apprenticeship	work-based government-funded training programme, where apprentices work towards qualifications, such as a Level 2 Competence Qualification, Functional Skills and a relevant knowledge-based qualification.
Statistical significance	indicates that the result is unlikely to have occurred randomly, but rather is likely to be attributable to a specific cause. The calculation of statistical significance (significance testing) is subject to a certain degree of error. The researcher normally defines in advance the probability of a sampling error. Sample size is an important component of statistical significance in that larger samples are less prone to producing results that are based on flukes.
Wage premium	in this paper is defined as the percentage difference between the mean earnings of individuals with completed apprenticeships (where apprenticeship is their highest qualification) and the mean earnings of individuals who did not complete an apprenticeship, but obtained a Level 2 or Level 1 qualification.