Firms' engagement with the Apprenticeship Programme

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Executive Summary

In the UK there is strong evidence that individuals who acquire an apprenticeship qualification go on to have good labour market prospects, in terms of their earnings and indeed their employability.

This is consistent with international evidence on the high economic value of these qualifications for individuals.

However, in the UK there are insufficient numbers of firms who take on apprentices to meet the demand for apprenticeships from young people (Leitch, 2006; Wolf, 2011).

Given that apprenticeships are valuable for the individual, i.e. they improve individuals' earnings and by implication their productivity, we need to determine why more firms are not willing to engage with the apprenticeship programme.

In this report we explore what types of firms engage with the apprenticeship programme and ask: are there characteristics of firms that make them more or less likely to offer apprenticeships? The aim of the research is therefore to identify whether there are key determinants of firms' engagement with the apprenticeship programme that may be susceptible to policy intervention.

In the second part of the report we also ask whether firms that take on an apprentice have more rapid firm productivity growth. This would of course provide prima fascia evidence that apprentices have a direct impact on firm performance. We acknowledge this question is challenging to answer from a methodological perspective and our evidence on this is more tentative.

We used two data sets, namely the National Employers Skills Survey (NESS) and the Annual Business Inquiry (ABI) to undertake the research. The former contains detailed information on a range of skills issues faced by firms and variables measuring their engagement with the apprenticeship programme. The latter provides additional information on the productivity, capital investment and employment characteristics of firms. We linked these two data sets in the secure Virtual Micro Laboratory (VML) enabling us to create a data set which includes both good measures of firms' engagement with apprenticeship and information on their gross value added.

NESS09 data suggested that 8% of all establishments were offering an apprenticeship at the time they were surveyed in 2009. Not all of these establishments actually had an apprentice at the time of the survey, however, since overall only 4% of establishments reported having an apprentice.

We addressed the following research questions:

What are the characteristics of firms that take on apprentices?

- Larger establishments are more likely to offer apprenticeships than smaller establishments, with establishments with more than 500 employees being the most likely to offer apprenticeships. However, smaller establishments, with fewer than 24 employees, have a higher number of apprentices per 1000 employees than larger establishments.

- This result is not driven by small establishments that are part of larger organisations. We observe the same result of more apprentices per 1000 employees in smaller establishments even when we focus only on single-site establishments.

- Private sector establishments are more likely to offer apprenticeships than charities, local and central government establishments.

- Establishments belonging to the construction sector are the most likely to offer apprenticeships.

- Establishments in all areas of the country are more likely to offer apprenticeships than those in London.

Do firms tend to engage with apprenticeships as a response to facing particular kinds of skills shortages?

- Establishments suffering an external shortage of appropriately qualified skilled trade workers are more likely to engage with apprenticeships. They are more likely to take on new apprenticeship recruits particularly at age 19-24.

- Establishments suffering an internal skills gap amongst skilled trade or personal service workers are more likely to engage with apprenticeships than establishments that do not suffer such internal skill gaps, though they do this by taking on new recruits rather than training existing workers. Establishments with and without an internal skills gap for any other category of workers show no significant difference in their likelihood of engagement with apprenticeship.

Does apprenticeship training replace or complement other forms of training?

- Apprenticeships clearly complement, rather than replace, other forms of training.
- Firms that train also take on apprentices.
- This suggests that deadweight may not be as serious a problem as expected.

Do employers facing different levels of market competition vary in their engagement with apprenticeships?

- Establishments operating in national or international markets are less likely to engage with apprenticeships holding other things constant, particularly for new recruits.
- Hence although large firms are more likely to take on apprentices, where firms face more intense competition, i.e. from national or international firms, they are actually less likely to engage with the apprenticeship programme.

Is engagement with apprenticeships part of an overall business strategy by employers to gain competitive advantage in ways other than cost/price minimization?

- Engagement with apprenticeships does complement other business strategies.
- Being a market leader in product/service development means a firm is more likely to train apprentices.
- Firms that emphasise product/service quality are also more likely to train apprentices.

Is apprenticeship engagement lower in firms at greater potential risk of 'poaching', i.e. at risk of having trained workers that then leave and take their enhanced skills to another firm?

- High rates of worker turnover are associated with lower engagement with apprenticeship, though only for new recruits.
- Firms appear less willing to recruit new workers as apprentices where the risk of poaching may be higher, as might be expected.

Is apprenticeship engagement associated with productivity?

- We found no evidence of a statistically significant relationship between apprentice engagement and establishment productivity.

- This finding holds whether productivity and apprenticeship engagement are measured contemporaneously or with one year time differences, whether productivity is measured in levels or first differences (value-added) and whether apprenticeship engagement is treated as exogenous or endogenous.

- This finding was perhaps to be expected, given the limitations of the research imposed by data availability. In particular, we only have productivity data at most one year after the apprenticeship is observed, and employers typically use apprenticeships as a longer term investment in their workforce.[1] If an individual recorded as an apprentice one year is still an apprentice the following year when the establishment's average productivity is measured, then there is no reason to expect productivity to be higher, and indeed the presence of apprentices who are not fully trained may lower productivity. We might therefore expect an effect of apprenticeships on productivity to emerge only in the longer term.

- Ideally, we would therefore like to observe productivity some years after, once the apprenticeship is fully completed. This is not possible with the available data however.

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[1] Identifying sectors with prospects for expanding the number of Apprenticeships (Experian, 2009). http://www.apprenticeships.org.uk/About-Us/~/media/Documents/Publications/Sectors_for_expansion_Apprenticeships_Main_Report.ashx

Introduction

In the UK there is strong evidence that individuals who acquire an apprenticeship qualification go on to have good labour market prospects, in terms of their earnings and indeed their employability. Specifically, recent work has suggested that the rate of return to an apprenticeship is approximately 35-39%, depending on the level of the apprenticeship, and taking account of both the gain in earnings and improved employability associated with this qualification (McIntosh, 2007). Hence it is unarguably the case that in the UK, apprenticeships provide valuable training for workers and that those who acquire an apprenticeship become more productive in the work place than those who do not have this qualification. This is consistent with international evidence on the high economic value of these qualifications for individuals (for example, see Adda et al. 2010 for Germany; Fersterer et al. 2008 for Austria and Leigh, 2008 for Australia). However, in the UK there are problems engaging sufficient numbers of firms with the apprenticeship programme (Leitch, 2006; Wolf, 2011). There are too few firms offering apprenticeships to meet the demand from young people. Given that apprenticeships are valuable for the individual, i.e. they improve individuals' earnings and by implication their productivity, we need to determine why more firms are not willing to engage with the apprenticeship programme. In particular, we need to understand whether there are barriers that appear to prevent firms from taking on apprentices.

In this report we therefore consider two particular dimensions to this problem. Firstly, we explore what types of firms engage with the apprenticeship programme and ask: are there characteristics of firms that make them more or less likely to offer apprenticeships? We seek to identify whether there are key determinants of firms' engagement with the apprenticeship programme that may be susceptible to policy intervention and that could thus help government encourage more enterprises to take on apprentices.

For this first stage of the analysis, as well as exploring the firm characteristics that are correlated with taking on apprentices, we test a number of specific hypotheses, namely whether:

- firms tend to engage with apprenticeships as a response to facing particular kinds of skills shortages;
- apprenticeship training replaces or complements other forms of training, i.e. whether apprenticeship is associated with significant deadweight loss;

- employers facing different levels of market competition vary in their engagement with apprenticeships;

- engagement with apprenticeships is part of an overall business strategy by employers to gain competitive advantage in ways other than cost/price minimization;

- apprenticeship engagement is lower in firms at greater potential risk of 'poaching', i.e. at risk of having trained workers that then leave and take their enhanced skills to another firm.

In the second stage of the analysis, we seek evidence that might persuade more firms to train apprentices by investigating the relationship between training apprentices and firm productivity. We ask whether firms that train apprentices have higher levels of productivity or experience more rapid productivity growth. This issue is however, challenging to address from a methodological perspective. In particular it is not clear that we would expect firms who are currently training apprentices to have higher *current* productivity as a result of this. Apprentices are actually likely to be less productive than fully trained workers. It is true that apprentices potentially cost less in terms of wages; however, the net cost of an apprentice will depend on their training costs and could be higher than an untrained equivalent worker. In other words, we might expect current apprentices to be less productive and cost more. Hence ideally we would have data on whether the firm has trained apprentices in the past, whether they currently employ qualified apprentices (i.e. those who have already been trained) and whether they currently employ qualified apprentices who trained at that particular firm. Then we could explore the link between past engagement with the apprenticeship programme and current firm productivity. Unfortunately the data are not available to do this. Instead we are only able to look at the very short term relationship between training an apprentice and productivity just one year later. We might view a firm's current engagement with apprenticeships as a proxy for their past involvement with the programme but this would be an assumption and we do not have data to support this assumption. Our evidence on this second issue is therefore more tentative.

To undertake this work we use two data sets, namely the National Employers Skills Survey (NESS) and the Annual Business Inquiry (ABI). The former contains detailed information on a range of skills issues faced by firms and variables measuring their engagement with the apprenticeship programme. The latter provides additional information on the productivity, capital investment and employment characteristics of firms. We linked these two data sets

in the secure Virtual Micro Laboratory (VML) enabling us to create a data set which includes both good measures of firms' engagement with apprenticeship and information on their gross value added.

The structure of this report is as follows. In the next section we highlight briefly the key literature on both the value of apprenticeships to the individual and the issues around firms' engagement with apprenticeship. We then describe the two data sets we use. To use the most current data available, our first data set is the latest NESS survey (2009), which we can only use as a standalone data set as ABI 2009 is not available to be linked. The second data set is the linked NESS/ABI 2007 data. In our first results section we analyse the characteristics of firms that are currently engaged in the apprenticeship programme using both data sets. In the second results section we analyse only the linked NESS/ABI data set to investigate the relationship between firms' engagement with the apprenticeship programme and their productivity levels and growth. We then conclude with a discussion of how our findings are relevant for policy.

Literature

The difficulties faced by young people as they attempt to enter the labour market have been long recognised (OECD, 2000). As the demand for skilled workers has risen sharply (Goldin and Katz, 2008), so too have policy concerns about how to ensure young people enter the labour market with sufficient skill to gain stable and well remunerated employment. The work of McIntosh (2005; 2007) and others (e.g. Jenkins et al. 2007) has confirmed that in the UK apprenticeships provide a valuable route for young (and not so young) people into well paid employment.

In the UK McIntosh (2007) found that the wage return to a modern apprenticeship (funded by government) was around 18% at level 3 and 16% at level 2 in 2004/5. This was based on analyses which compared these apprentices to those with level 1 or 2 qualifications. Taking account of higher employment rates amongst apprentices, McIntosh (2007) found that the total internal rate of return to modern apprenticeships was 35% at level 3 and 39% at level 2 in 2004/5 and that the return to an apprenticeship had increased between 1996 and 2005. McIntosh (2007) did however acknowledge that the demand for apprenticeship places exceeds supply in the UK. This may enable firms to select the best workers to train and hence estimates of the wage and employment benefits from apprenticeships may be upwardly biased estimates due to ability bias, an issue we return to below.

Apprenticeships are a major route into employment and have a positive impact on wages in a range of other countries too, particularly those offering the so called "dual system" (Germany, Austria, Switzerland) where more than half of each cohort proceeds into employment via an apprenticeship. In Germany, for example, the return to the individual from investing in an apprenticeship is 14% in terms of average life-cycle returns (Adda et al. 2009.) In Austria, Fersterer et al. (2008) found that the return to apprenticeships was approximately 8.1%, controlling for both the different work experience of those who are trained as apprentices and also potentially the selection or ability bias arising from the fact that those who are selected to be an apprentice may have higher ability and hence would earn more anyway.

The fact that apprenticeships are so valuable is consistent with other evidence that firm-provided training in general can be highly beneficial to individuals and indeed even more so to firms (Blundell et al, 1999; Goux and Mourin, 2000; Feinstein et al. 2004). Apprenticeships may however, have particular features that make them more valuable in the labour market. Firstly, apprenticeships by their nature impart a broad range of skills, including non cognitive skills such as work attitudes, which may be less easy to develop in formal education or on short training courses. There is now a body of work that confirms the high value of these non-cognitive skills in the labour market (Carneiro and Heckman, 2003; Cunha and Heckman, 2007). Secondly, as already noted earlier, the shortage of apprenticeship places means that firms can be selective about who they recruit into their apprenticeship programmes. Thus some of the value of apprenticeships may arise because of the selective nature of the people who train as apprentices. This is consistent with the fact that in contrast to apprenticeship programmes, universal state interventions that are designed to boost the skills of less educated/skilled workers have often proved ineffective and associated with significant dead weight loss (Abramovsky et al. 2011).

In summary, it is clear that in today's labour market the apprenticeship is still a valuable route to good employment. However, in the UK, and increasingly in other countries that offer apprenticeships (Germany, Austria) there is insufficient supply of apprenticeship places. This problem has been highlighted in the UK context by both Leitch (2006) and the recent Wolf review (2011) and is the focus of this report.

A small literature has therefore developed to investigate why this might be the case.

As has been said, the issue of whether a sufficient number of firms are willing to train apprentices is pressing, even in the traditional "dual system" countries that have a long established system of apprenticeship (Steedman, 2005). Steedman (2005) studied seven European countries, including "dual system" countries such as German, Austria and Switzerland and others without such an established apprenticeship system, such as the UK, Netherlands and France. Although she argued that employer commitment to apprenticeships is high in Austria, German and Switzerland, she recognized that these countries increasingly faced issues with insufficient supply of apprenticeship places. "Dual system" countries have high employer input in the design of apprenticeship prorgrammes which may be beneficial but they also are required to provide more demanding training that is hence more costly than in other countries. The high costs of training therefore may be the main limit on the supply of apprenticeship places. Steedman also suggested that global competition and rapidly increasing and changing demand for skill put greater pressure on apprenticeship systems, partly as their ability to adapt quickly to these changing needs of the labour market may be more limited. For these reasons, Steedman questioned whether the apprenticeship system would continue to thrive and concluded it needed to adapt if it were to do so. This is consistent with other evidence (Thelen, 2007) that even in the "dual system" countries, the nature of apprenticeships and the balance of firm provided/ state provided training was being renegotiated with some increase in subsidy for firm providers.

Wolter et al. (2006) found that the net return to firms in Switzerland from apprenticeship training was positive. They investigate why some firms are not willing to offer apprenticeship places if this is the case. They found that for firms that do not offer apprenticeships, the costs of apprenticeships would have been high and the benefit minimal. In other words, firms are rational and those that do benefit from apprentices do indeed train them. The implication of this work for Switzerland is also that were regulation to require non training firms to offer apprenticeships this may not be optimal because of the high costs they would incur and the limited benefit.

Mohrenweiser and Zwick (2009) also investigated the benefits of apprenticeships to firms. They use matched employer-employee data and can therefore consider the impact of firms increasing the share of apprentices in their workforce on firm productivity. They find that apprenticeships in some occupations (trade, commercial, craft, construction) are valuable to firms in terms of increasing their productivity. Interestingly however, they do not find that apprenticeships in manufacturing do so. Since traditionally apprenticeships have largely

been in manufacturing industries this is a striking result. The study highlights that the implications of this finding is that firms will only be willing to offer apprenticeships where the skills they produce are valuable in the sense of being scarce and that there is a low probability of that worker leaving to another firm. This raises a number of issues that in this report we are able to test in the UK context.

Muehlemann et al. (2007) also considered the determinants of the decision to recruit apprentices using data from Switzerland. This study found considerable variability in the net costs of offering apprenticeships for firms and the majority (60%) of firms incurred net costs during the training period. This implies that firms need to retain apprentices for some time after the training period in order to recoup these costs. The study also confirmed that the net cost of offering apprenticeships was a significant determinant of whether a firm offered apprentice places (though not the number offered). This is a particularly striking result since it implies that subsidies aimed at firms who currently do not offer apprenticeships may induce them to train apprentices. However, subsidies aimed at firms who currently offer apprenticeships may not induce them to take on more. The potential for deadweight loss from any subsidy in this situation is therefore likely to be high.

Thus far we have discussed structural reasons why firms may be unwilling to engage in the apprenticeship programme, focusing largely on the high costs of doing so. Brunello (2009) however, investigated the role of the cyclical factors and found that the ratio of apprentices to employees in a firm is broadly pro-cyclical though the effect is not pronounced. Hence firms are less willing to engage apprentices in a recession, perhaps not surprisingly. By contrast evidence on training generally has often found that training is counter-cyclical. Hence firms often send employees on training courses during downturns. Brunello (2009) suggests that this is rational in that firms train their existing employees in a down turn when the opportunity costs of doing so are limited but are unwilling to make the long term commitment to new apprentice recruits.

Data

2009 National Employers Skills Survey (NESS)

This research uses data from the 2009 National Employers Skills Survey (NESS). This dataset is establishment based, and contains information obtained from employers at 79,152 workplaces. Of particular use in this project is detailed information about engagement with apprenticeships. Employers are asked whether, at the time that they are surveyed, they

currently offer apprenticeships, and whether they currently have any apprentices. For those who offer apprenticeships (and therefore incorporating those that currently have apprentices) they are asked whether they offer apprenticeships to 16-18 year olds, 19-24 year olds and people aged 25 and over, with the three categories not being mutually exclusive. Further questions ask whether such apprenticeships are typically offered only or mainly to existing staff, offered only or mainly to specific recruits, or offered to both existing staff and to specific recruits equally (in this case the categories are mutually exclusive). This range of questions therefore allows us to investigate not only whether employers engage with apprenticeships, but also how they engage with apprenticeships in terms of the type of apprentices involved. Separate analyses can therefore be run to investigate overall engagement with apprenticeships, and engagement with particular types of apprentices. A final set of questions in the apprenticeship section asks employers to report how likely they are to have an apprentice in the establishment in the next 12 months, and again the age and recruitment status of those predicted apprentices.

In addition to the apprenticeship questions, the NESS also contains a wide range of other information about the establishments, which can be used to examine the characteristics of establishments associated with apprenticeship engagement. Background information on the establishments includes their size (in terms of number of employees), whether the establishment is part of a larger organisation, the sector (indicated by 2 digit 2007 SIC code), the sector type (private company, charity, local government, central government or 'other').

As well as these background characteristics, a number of other variables allow us to test specific hypotheses about why firms engage with apprenticeship. For example, the NESS has long sections of the questionnaire to measure external skills shortages and internal skill gaps. The former is defined as having a vacancy that is proving hard to fill due to a lack of appropriate skills, qualifications or experience in the external labour market. An internal skills gap is defined as existing when some employees do not have the skills to be fully proficient in their jobs. Both of these skills shortage variables are measured for each 1 digit occupation separately, so we can see for which occupational grouping the employer is currently experiencing a skills shortage.[2] The hypothesis to be tested is then whether firms

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[2] The 9 1-digit occupations are managers, professional workers, associate professional workers, administrative staff, skilled trade workers, personal service workers, sales workers, machine operatives and elementary staff.

engage with apprenticeships as a response to facing skills shortages, and if so, whether a shortage of a particular type of worker is more likely to lead to offering apprenticeships.

Another set of variables, also related to the human capital of workers, describe the qualification levels of the existing workforce. The results on these variables allow us to see whether apprenticeship training is a substitute or complement to formal qualifications. In addition, another variable used measures the proportion of the establishment's workforce who have been trained in the previous 12 months. This allows us to determine whether apprenticeship training replaces or complements other forms of training, and so provide some indication of the amount of deadweight involved with apprenticeship funding.

The next hypothesis to be tested is whether employers facing different levels of competition vary in their engagement with apprenticeships. NESS asks respondents to report whether they sell their product or service most in local, regional, national or international markets. Does competing nationally or internationally make firms more likely to engage with apprenticeships to perhaps obtain a comparative advantage, or less likely to engage, due perhaps to competitive pressures to minimise costs? The NESS survey also asks about the business strategy of the employer, along a number of dimensions. These ask, on a scale of 1 to 5, whether establishments produce one-off goods and services as opposed to high volume, the extent to which their competitive position does not only depend on price (with, say, quality, also being important), the extent to which the establishment leads the way in terms of developing new products, services or techniques, and the extent to which the establishment offers a premium quality product or service. Analysis of these variables allows us to investigate whether or not engagement with apprenticeships is part of an overall business strategy by employers to gain competitive advantage in ways other than cost/price minimisation. Since all of the variables in this paragraph (market extent and business strategy) apply only to private sector establishments, the analysis of these variables will be undertaken in regression equations estimated on private sector workplaces only.

A final hypothesis we investigate is related to the 'poaching' argument in the theoretical economics literature on training. This theory says that firms are less likely to engage in training if they fear that having spent money on training workers, those trained workers then leave and take their enhanced skills to another firm. Whilst we cannot measure poaching fears directly, one indicator is the worker turnover rate in the establishment's sector. This is measured by the proportion of workers in a sector who have been with their

current employer for less than one year, as observed in the 2009 Labour Force Survey. This sector specific labour turnover rate is then matched into the NESS dataset by 2 digit industry (SIC07) code. In a similar way, we also matched into NESS the proportion of workers in each sector who are young (aged below 25) to investigate whether establishments are more likely to engage with apprenticeships in typically 'youthful' sectors.

Annual Business Inquiry

This section describes the Annual Business Inquiry (ABI), and explains how we matched ABI (2007 and 2008 respectively) with NESS 2007[3].

ABI

ABI is an annual large-scale survey of firms in the UK. Its sample design is based on the Inter-Department Business Register (IDBR). It covers most firms with more than 250 employees, and a sample of smaller firms.

It is important to note that there are three different levels of entities in ABI. First, the firm, also called the enterprise, refers to the whole organisation. This is very different from the concept of workplace (also called local unit in ABI), which is a site that (part of) the firm operates at. In ABI, firms can report information on all their workplaces individually or on one or various groups of workplaces/local units. Data is therefore collected at what is known as reporting unit (RU) level. A reporting unit can be a workplace or a group of workplaces, or the entire firm.

For example, Tesco has many stores across the country, each of which is a local unit. Tesco can report all its stores in London as a reporting unit. In this case, the reporting unit is a group of workplaces and is smaller than the entire firm.

Each reporting unit has its own unique RU identification number, and each firm has a unique enterprise reference number (IDBR). There are 45755 reporting units in ABI 2007, which correspond to 44908 firms. The numbers for ABI 2006 and 2008 can be found in the Appendix table C1. The ABI sample covers about 2.1 million workplaces every year.

Meanwhile, there is some information at the local unit level. In particular, we can find the postcode for most local units.

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[3] At the time of writing, ABI data from 2009 were not available, which is why we used NESS 2007 rather than NESS 2009 in this matching process.

Note that NESS is at the level of establishments (meaning workplaces or sites). Therefore, information from ABI is, in most cases, at a more aggregated level than information from NESS.

NESS 2007 contains about 79,000 establishments. About 43,000 of them have the corresponding IDBR number, and together they correspond to about 36,000 firms.[4] There is no RU reference number in NESS.

Linking ABI and NESS

The differences in the level of aggregation in the two datasets create some difficulty in their linkage. In this paper, we match establishments from NESS with reporting units from ABI. For each NESS establishment, the aim is to find the RU that covers the establishment. The matched dataset will be at the establishment level, with some business information relating to the RU that the establishment belongs to. An alternative approach would be to aggregate data up to the firm level in both datasets, which would require more potentially arbitrary assumptions.

Our linkage has two main steps. We differentiate firms based on whether they have one or more RUs. At the first step, we use IDBR to link NESS establishments to RUs which represent whole enterprises in ABI. Second, for firms that have at least two RUs in ABI, we use both IDBR and postcode to match the RUs with NESS establishments wherever possible.

First, 97% of RUs in the ABI are the only RUs in the corresponding firms. Correspondingly, 99% of firms in the ABI have only one RU each, and we'll refer to these firms as single-RU firms. Clearly, each single RU has a unique IDBR number. Whenever an establishment in NESS has the same IDBR number as a single RU, it is matched to the single RU. Figure 1 illustrates this.

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[4] The IDBR numbers were added to NESS by ONS. They use a software to match NESS establishments to the firms in the IDBR by business name, address, and postcode.

Figure 1: Matching to Single Reporting Unit Firms in ABI
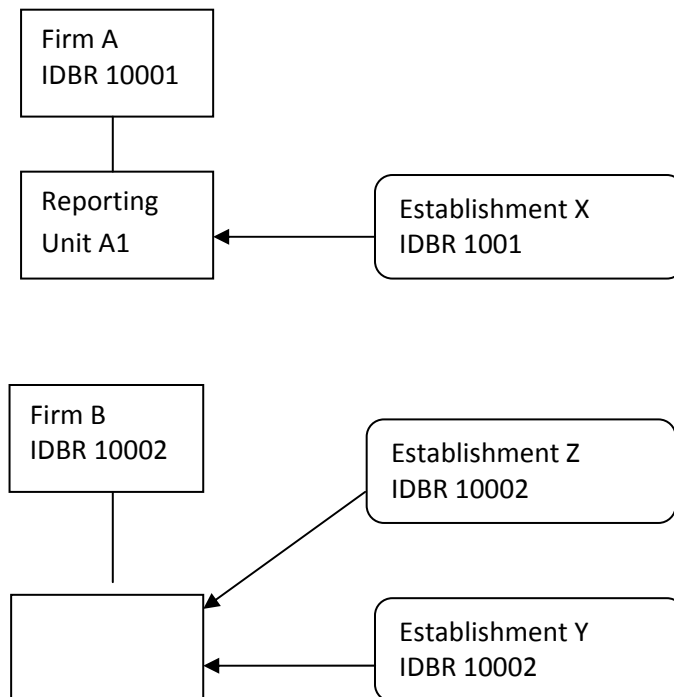
Establishment X in NESS shares the same IDBR as the single-RU firm A, and is therefore linked to the reporting unit A1. Both establishment Y and Z have the same IDBR as the single-RU firm B, and so both are linked to B1.

In the linkage between NESS and ABI 2007, we have matched 7843 establishments to single RUs. Among them, 2728 establishments appear to be the only workplace of the firm; though there can be other workplaces of the same firm that are not sampled in NESS.

The matching process is a bit more complicated for firms that have at least two RUs ('multi-RU' firms). In order to differentiate between reporting units within the same firm, we use the postcodes of their local units. We identify combinations of IDBR and postcode that are unique to the RU. Consider firm C that has two RUs C1 and C2, as illustrated in Figure 2.

Figure 2: Matching to Multi-Reporting Unit Firms in ABI
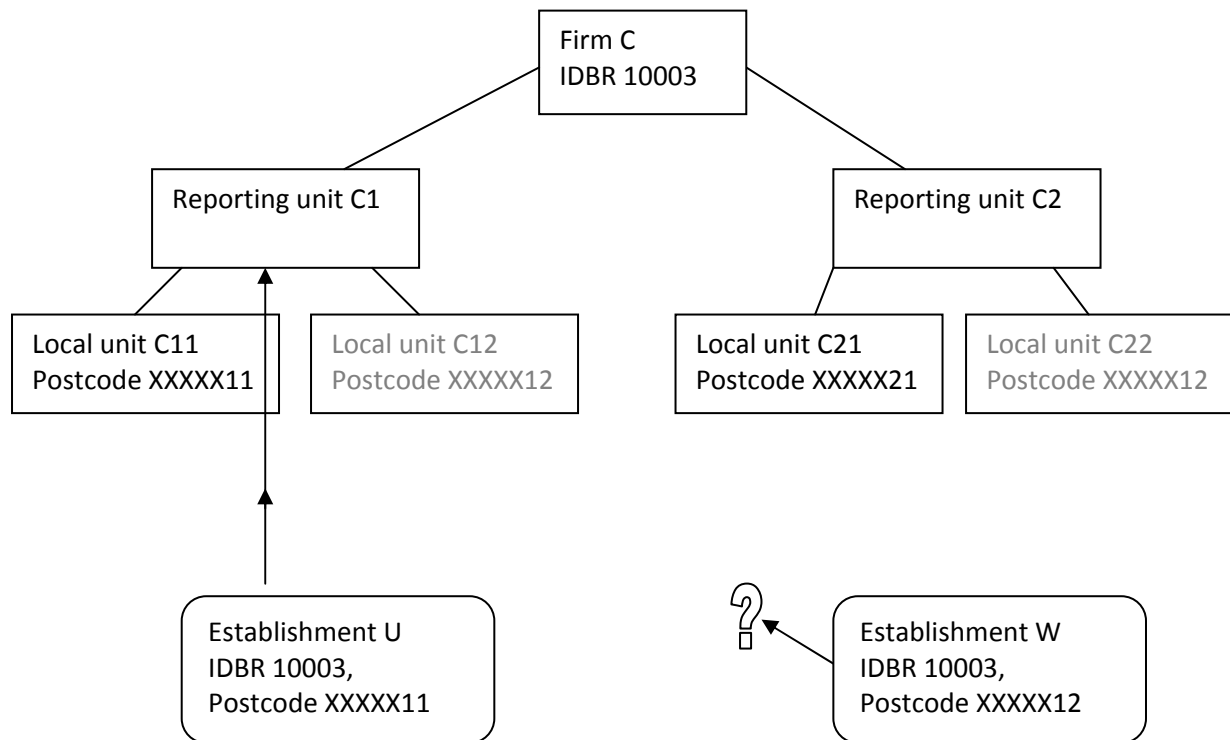
Both the RUs have two local units. In this particular example, one local unit under one RU (C12) has the same postcode as another local unit under another RU (C22). So the combination of IDBR 10003 and postcode XXXXX12 will not allow us to uniquely identify a RU. Therefore, we won't be able to tell whether the NESS establishment W (IDBR= 10003 and postcode=XXXXX12) should be matched to RU C1 or RU C2.

In cases where only one RU has a particular combination of IDBR and postcode (such as the combination of IDBR 10003 and postcode XXXXX11), we can match the NESS establishment with the same combination to the RU. So the NESS establishment U is matched to RU C1. If there is another establishment V with the same IDBR and postcode, it will also be matched to RU C1.

In ABI 2007, we have found about 224,000 unique combinations of IDBR and postcodes. They allowed 801 additional matches between multi-RUs and NESS establishments.

In total, we have matched 8644 NESS establishments with RUs from ABI. Most of them are a part of larger organisations. Just 32% (2776 out of 8644) of the matched establishments are the only NESS establishment in the firm; but we can never tell whether all the sites within a

firm are included in the NESS sample. More numbers of the matching process especially for 2006 and 2008 can be found in Appendix Table C1.

Results – NESS09

(i) Descriptive Statistics

Before beginning the multivariate analysis that is presented subsequently, this section describes the raw NESS09 data on apprenticeship use, and investigates some of the 2-way correlations with other variables of interest.[5]

Overall, 8% of all establishments were offering an apprenticeship at the time they were surveyed in 2009. Not all of these establishments actually had an apprentice at the time of the survey, however, since overall only 4% of establishments report having an apprentice.

Of those establishments that offer apprenticeships, 11% offer only to existing employees, 5% mainly to existing employees, 27% only to new recruits and 12% mainly to new recruits. The remaining 44% offer to both equally.

Larger establishments are more likely both to offer and to currently have apprentices, as shown in Figure 3 below.[6] This is presumably related to the costs of providing training, both in terms of monetary costs and opportunity costs of employees spending time training. These costs can be spread more widely by larger establishments.

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[5] All descriptive statistics discussed in this sub-section are weighted, using the appropriate weights in the NESS dataset, to ensure that the results are representative of the full population of workplaces.

[6] UKCES provided the dataset coded to SIC (Standard Industrial Classification) 2007 to assist with this study. Because of the different industry coding used, proportions of establishments by sector, and the weights used to make small samples representative for the UK population, are not identical to the SIC 2003 dataset used to write the published NESS reports. This difference accounts for small discrepancies between numbers based on NESS09 in this report and in UKCES publications. See Appendix B for more information about the survey and the change to the new SIC.

Figure 3: Establishment Engagement with Apprenticeship, by Establishment Size
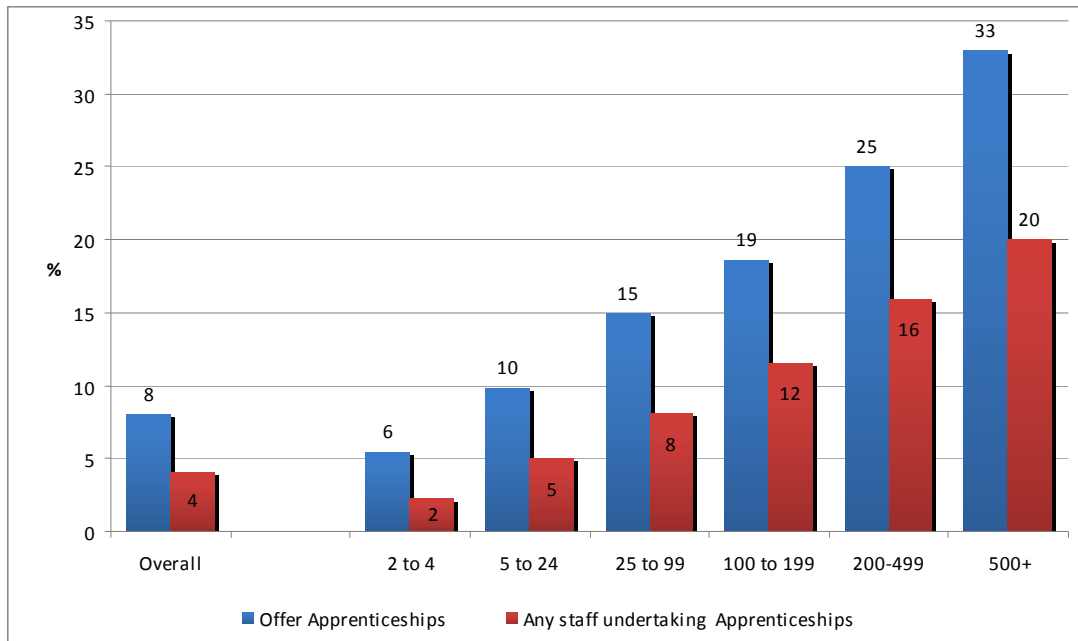
In terms of whom apprenticeships are offered to, larger establishments are marginally less likely to only offer apprenticeships to new recruits, and so are more likely to find apprentices amongst their existing employees. Just 20% of the largest establishments would only offer apprenticeships to new recruits, compared to 29% of the smallest establishments. This is shown in Figure 4 below.

Figure 4: Type of Worker Apprenticeships Offered to, by Establishment Size
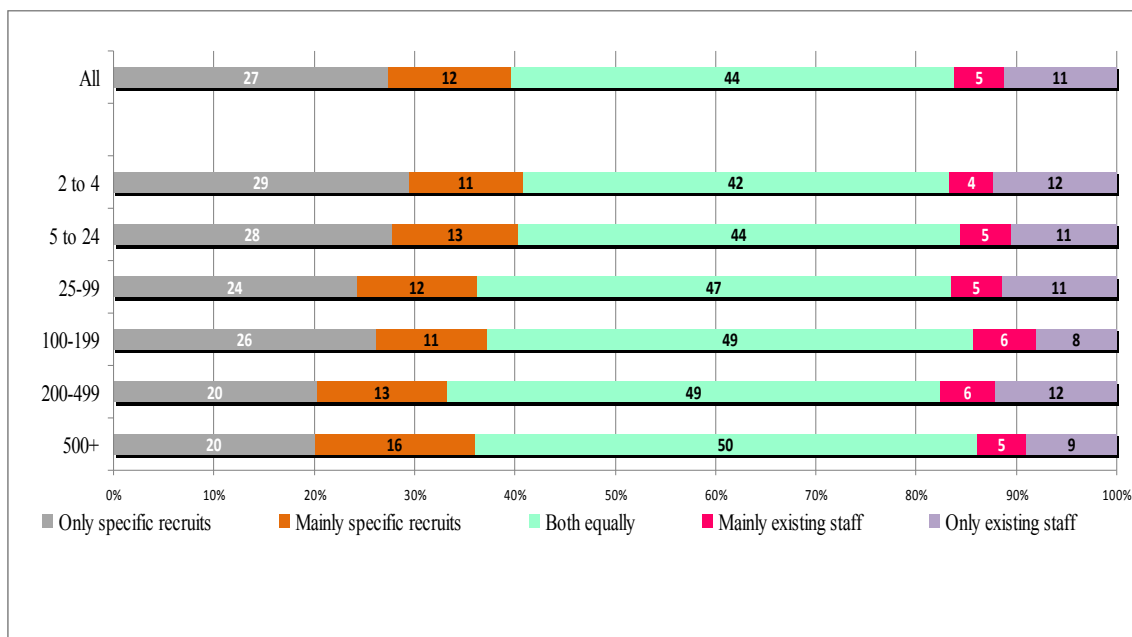
Rather than look at the proportion of establishments offering apprenticeships, as in the previous two diagrams, Figure 5 counts the number of apprentices by banded establishment size, expressed as a percentage of all apprentices. In other words it shows what percentage of apprentices are working in large and small establishments. For comparison, the percentage of all employees working in each of the establishment size bands is also shown.

Figure 5: Percentage of Apprentices and All Employees in each Establishment Size Band
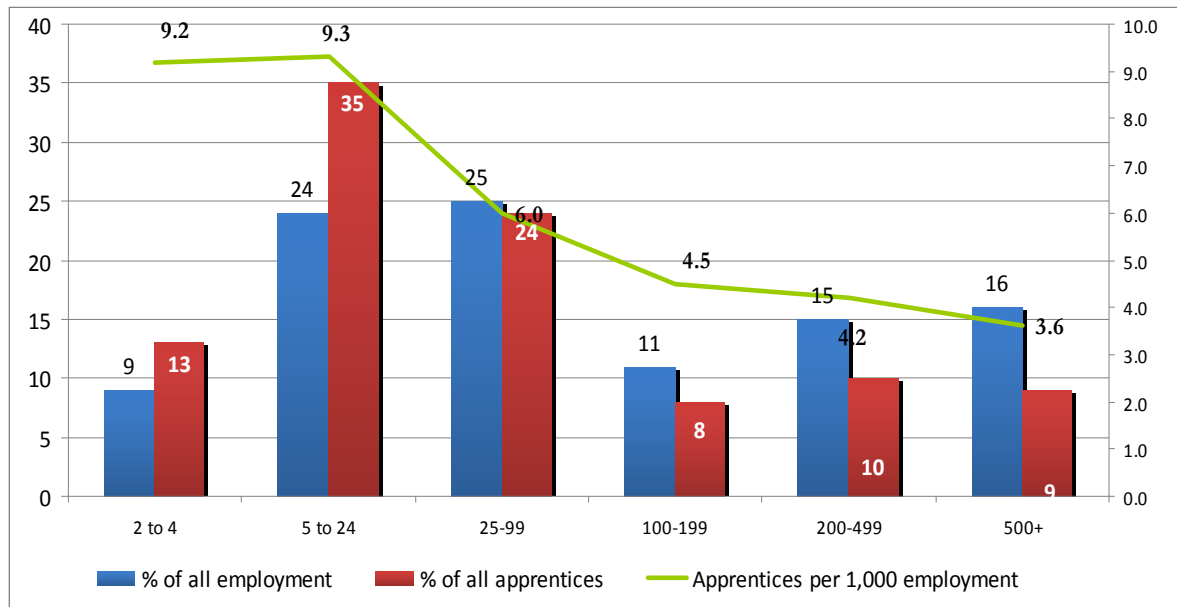
Although we saw earlier, in Figure 3, that large workplaces are more likely to have apprentices than small establishments, Figure 5 shows that actually apprentices are over-represented in smaller establishments. Thus, there are about 9 apprentices for every 1000 employees working in establishments with fewer than 25 workers, whereas this falls to only 3.6 per 1000 workers in the largest firms. So, although proportionally fewer small establishments offer apprenticeships than larger apprenticeships, the small establishments that do offer apprenticeships will have a higher proportion of their staff being apprentices than the larger establishments. Note that, amongst the small establishments, it does not appear to be only those that are part of a larger organisation who are engaging all of the apprentices. If the analysis in Figure 5 is re-run only for stand-alone establishments that are not part of a larger organisation, it is still the case that there are more apprentices per 1000 workers in small stand-alone establishments than in large stand-alone establishments.

The next section begins the multivariate analysis of engagement with apprenticeships, where establishment size will be considered alongside a range of other variables.

(ii) Whether Establishments Offer Apprenticeships

All of the multivariate equations were estimated by probit analysis, to allow for the fact that the dependent variable is a binary variable, for example in this sub-section indicating whether or not the establishment offers apprenticeships. The full results are displayed in Table A1 in the appendix. The reported numbers in Table A1 are marginal effects, showing the estimated change in the probability of an establishment offering an apprenticeship for a one unit change in a continuous explanatory variable, or for binary explanatory variables when such variables take the value of one, relative to the reference category (as reported in the table). Six specifications are reported, considering first simply whether or not establishments offer apprenticeships, and then in subsequent columns analysing the determinants of whether establishments offer apprenticeships to particular types of workers (existing workers/new recruits and three age bands of apprentices).

All of the estimated equations control for establishment size, whether it belongs to a larger organisation or not, sector type, as well as (not reported in the table) sector and region. Summarising the results on these control variables, the likelihood of an establishment offering an apprenticeship increases with establishment size. For example, holding other characteristics constant, an establishment with 200 or more employees is 36 percentage points more likely to offer an apprenticeship than an establishment with only 2-4 employees. Across all size bands, the likelihood of an establishment offering apprenticeships increases monotonically with size. The subsequent columns show that the size effect exists when offering apprenticeships to existing workers, new recruits, 16-18 year olds, 19-24 year olds and individuals ages 25+; all are much more likely to be offered apprenticeships in large establishments than smaller ones.

Note that it is the size of the establishment that seems to be important, and not necessarily the size of the whole organisation. Whether or not the establishment is part of a larger organisation has a statistically insignificant effect on the likelihood of offering apprenticeships. Furthermore, when this variable is interacted with the various establishment size variables, none of the interaction coefficients are statistically significant, suggesting that the establishment-size effects are present and similar in size whether or not an establishment is part of a larger organisation.

With respect to sector type, private sector establishments are the most likely to offer apprenticeships. Charities, local and central government establishments are all around 4-5

percentage points less likely to offer apprenticeships than private sector establishments. This private sector effect is observed for all types of workers.

Estimated effects not reported in Table A1 reveal that, holding all other establishment characteristics constant, establishments belonging to the construction sector are the most likely to offer apprenticeships. With respect to region, establishments in all areas of the county are more likely to offer apprenticeships than those in London, by 2-4 percentage points, again holding all other characteristics constant.

Turning to the various hypotheses set out earlier, these will now be investigated, beginning with the question about whether firms facing skills shortages and gaps are more likely to take on apprentices. This is tested by including measures of external skill shortages and internal skill gaps in the model for each of the nine 1-digit occupations (see Table A1 in the appendix). Most of these effects are statistically insignificant. Table 1 below reproduces only the skill shortage rows from Table A1 that contain statistically significant effects.

As can be seen, a shortage of appropriately qualified skilled trade workers (skilled manual workers) has the largest effect on the likelihood that a firm will offer an apprenticeship. Indeed, in terms of external skills shortages, it is only in the case of skilled trade workers that a statistically significant effect is observed. The result in the second column shows that the probability of an establishment offering an apprenticeship increases by 2.1 percentage points, for each extra hard-to-fill vacancy for skilled trade workers that the establishment has. In no other occupation category does a shortage of appropriately skilled workers lead establishments to offer more apprenticeships. Apprenticeships had their origin in training workers for craft/skilled manual jobs, and it seems as though this occupation is still the most associated with apprenticeships.

Looking across the first row of results, they show that when establishments are experiencing a shortage of appropriately qualified skilled trade workers in the external labour market, they are more likely to offer apprenticeships to new recruits. They do not seem to respond, however, by being more likely to offer apprenticeships to their existing workforce, the marginal effect in this equation being negative, very small and statistically insignificant. Such external skills shortages also seem to increase the likelihood of offering apprenticeships to 19-24 year olds, more than to any other age group.

Table 1: Skills Shortages and the Probability of Offering Apprenticeship: All Establishments

	Offer apprentice-ships	Offer only or mainly to existing workers	Offer only or mainly to new recruits	offer to 16-18 year olds	offer to 19-24 year olds	offer to 25+ year olds
Number of hard to fill vacancies, by occupation						
Skilled trades	0.021	-0.004	0.011	0.002	0.017	0.000
	(0.006)**	(0.004)	(0.003)**	(0.002)	(0.005)**	(0.002)
Skills gaps – proportion of staff not fully proficient, by occupation						
Professionals	0.034	0.005	0.010	0.029	0.035	0.025
	(0.016)*	(0.006)	(0.009)	(0.013)*	(0.013)**	(0.012)*
Skilled trades	0.156	0.013	0.063	0.113	0.116	0.063
	(0.009)**	(0.003)**	(0.004)**	(0.007)**	(0.008)**	(0.007)**
Personal services	0.116	0.008	0.035	0.080	0.090	0.061
	(0.014)**	(0.005)	(0.008)**	(0.012)**	(0.012)**	(0.010)**
Sales workers	-0.030	-0.001	-0.012	-0.015	-0.022	-0.014
	(0.010)**	(0.004)	(0.006)*	(0.008)	(0.009)*	(0.008)

Standard errors in parentheses
* significant at 5%; ** significant at 1%
Full results in Table A1

Turning to skills gaps amongst existing workers, it is again a shortage of skills amongst skilled trade workers that is most related to an increased likelihood of offering apprenticeships. A one percentage point increase in the proportion of skilled trade workers who are not fully proficient in their job is associated with a 0.16 percentage point increase in the likelihood of the establishment offering apprenticeships. Note that a shortage of skills amongst existing staff also leads establishments to look externally, with an increase in internal skill shortages having a larger effect on the likelihood of offering apprenticeships to new recruits than to

existing workers. The remaining rows in Table 1 show that a lack of appropriate skills amongst personal service workers and, to a much smaller extent, amongst professionals, are also associated with a higher probability of an establishment offering apprenticeships.

Table 2 reports the coefficients on the workforce human capital variables.

Table 2: Workforce Human Capital and the Probability of Offering Apprenticeship: All Establishments

	Offer apprentice-ships	Offer only or mainly to existing workers	Offer only or mainly to new recruits	offer to 16-18 year olds	offer to 19-24 year olds	offer to 25+ year olds
Workforce Human Capital						
Proportion trained	0.040	0.003	0.015	0.030	0.033	0.027
	(0.003)**	(0.001)*	(0.002)**	(0.003)**	(0.003)**	(0.002)**
Proportion level 4+ qualifications	-0.047	-0.011	-0.015	-0.043	-0.028	-0.019
	(0.004)**	(0.002)**	(0.003)**	(0.004)**	(0.004)**	(0.003)**
Proportion level 3 qualifications	0.057	0.002	0.024	0.045	0.048	0.031
	(0.004)**	(0.002)	(0.002)**	(0.003)**	(0.004)**	(0.003)**
Sales workers	-0.030	-0.001	-0.012	-0.015	-0.022	-0.014
	(0.010)**	(0.004)	(0.006)*	(0.008)	(0.009)*	(0.008)

Standard errors in parentheses
* significant at 5%; ** significant at 1%
Full results in Table A1

The results show that establishments that train a higher proportion of their workers are also more likely to offer apprenticeships. Note that the training variable is not simply picking up the apprenticeship training, which would have made the result a tautology. The mean value for the percentage of workers trained is 48%, and a further question reveals that the average duration of such training is 7 days. The 'proportion trained' variable is therefore clearly picking up more than just apprenticeship training. This result suggests that

establishments do not necessarily have lower levels of training when they engage with apprenticeships, thus reducing any displacement that might be involved with apprenticeship funding. As far as the formal qualification levels of establishments' workforces are concerned, the results show that establishments with a higher proportion of workers qualified to level 3 (the equivalent of upper secondary school education) are more likely to offer apprenticeships, while a higher proportion of workers qualified to level 4 or above (tertiary education) is associated with a lower probability of offering apprenticeships. Thus, apprenticeships seem to complement intermediate, though not higher qualification levels.

Turning to the sector level characteristics matched in from the Labour Force Survey, the results, displayed in Table 3, reveal that a higher average turnover rate in a sector is strongly associated with a lower likelihood of establishments offering an apprenticeship. The results show that each 1 percentage point increase in the establishment's sector's labour turnover rate is associated with a 0.27 percentage point reduction in the probability of an establishment offering an apprenticeship. It is possible that the 'poaching' argument is a genuine concern for establishments, so that when establishments regularly see their workers leaving, they are less likely to offer apprenticeship training. Alternatively it may be that sectors that have factors that lead to high labour turnover may also be less likely to train apprentices. However, the subsequent columns show that establishments are particularly less likely to offer apprenticeships to new recruits. This is consistent with the poaching argument, namely that employers are more wary of offering apprenticeships to new recruits that they do not know, when there is a high turnover rate, compared to existing workers who employers at least have some familiarity with. A higher labour turnover rate also reduces the likelihood of offering apprenticeships to younger workers, particularly 16-18 year olds but also 19-24 year olds. The likelihood of offering apprenticeships to older workers aged 25+ is unaffected by the sector turnover rate. It therefore seems that establishments are particularly wary of offering apprenticeship training to younger workers when the turnover rate is high, suggesting that they fear that it is younger workers in particular who are more likely to leave after their apprenticeship training ends.

The final row in Table 3 shows that establishments in sectors that typically employ a higher proportion of younger workers (aged under 25) are more likely to offer apprenticeships, particularly to existing workers and to younger workers. Presumably those establishments that employ mostly older workers have alternative methods to train their employees.

Table 3: Sector Characteristics and the Probability of Offering Apprenticeship: All Establishments

	Offer apprentice-ships	Offer only or mainly to existing workers	Offer only or mainly to new recruits	offer to 16-18 year olds	offer to 19-24 year olds	offer to 25+ year olds
Sector Characteristics						
sector turnover rate	-0.269	-0.043	-0.171	-0.257	-0.190	0.002
	(0.052)**	(0.021)*	(0.030)**	(0.045)**	(0.046)**	(0.040)
Proportion young (sector)	0.075	0.040	-0.005	0.070	0.058	0.037
	(0.027)**	(0.011)**	(0.016)	(0.023)**	(0.024)*	(0.021)

Standard errors in parentheses
* significant at 5%; ** significant at 1%
Full results in Table A1

In order to investigate the association between apprenticeship engagement and both market size and business strategy, we focus on private sector establishments only, for whom these variables have more relevance. We therefore re-ran the six equations in Table A1, but this time for private sector establishments only. The results are shown in Table A2 in the appendix. Comparing the results in Tables A1 and A2, it can be seen that the various factors that are associated with apprenticeship engagement amongst all establishments, continue to be so amongst private sector establishments only. The results are qualitatively similar, in terms of the same coefficients acquiring statistical significance, in both tables. We will therefore not repeat the discussion of all the variables discussed above for the case of all establishments, and instead focus on the new variables added to the specification for private sector establishments only. Table 4 below displays the estimated marginal effects for the 'business strategy' variables.

Table 4: Business Strategy and the Probability of Offering Apprenticeship: Private Sector Establishments Only

	Offer apprentice-ships	Offer only or mainly to existing workers	Offer only or mainly to new recruits	offer to 16-18 year olds	offer to 19-24 year olds	offer to 25+ year olds
Business Strategy						
One-off product strategy	-0.006	-0.002	0.004	-0.004	-0.006	-0.007
	(0.003)	(0.001)	(0.002)*	(0.003)	(0.003)*	(0.002)**
Strategy not price dependent	0.004	0.000	-0.000	0.005	0.004	0.004
	(0.003)	(0.001)	(0.002)	(0.002)*	(0.002)	(0.002)*
Leader in new products/services	0.019	0.003	0.004	0.015	0.015	0.013
	(0.003)**	(0.001)*	(0.002)**	(0.002)**	(0.002)**	(0.002)**
Premium quality strategy	0.010	0.000	0.004	0.009	0.009	0.007
	(0.003)**	(0.001)	(0.002)*	(0.002)**	(0.002)**	(0.002)**

Standard errors in parentheses
* significant at 5%; ** significant at 1%
Full results in Table A2.

The various strategies were introduced and discussed in the previous section. The actual variables used are dummy variables, recording whether the establishment reported their strategy as being 4 or 5 on the 5-point scale in each case. Recall that the aim of investigating these variables was to determine whether engagement with apprenticeship is actually part of an overall business strategy to gain competitive advantage in terms of providing unique, high-spec products and services and to be a market leader, rather than gaining competitive advantage through mass production, cost and price minimisation. The results in Table 4 provide at least some evidence of coherent business strategies. For example, establishments that saw themselves as market leaders in terms of developing new products/services/techniques and that aim to produce a premium quality product/service

were in both cases more likely to offer apprenticeships. The effect sizes are small, however, with such establishments being more likely to offer apprenticeships by 1.9 percentage points and 1.0 percentage point respectively. The next two columns show that, particularly for establishments aiming to offer a premium quality product or service, they are more likely to offer apprenticeships to new recruits than to existing workers. With respect to the age of potential apprentices, such establishments do not seem to favour one age group over another.

Table 5 reports the results for the market type variables. These variables are included to test the hypothesis that firms in markets with different degrees of competitiveness (local, national and international) may differ in their engagement with apprenticeships.

Table 5: Market Type and the Probability of Offering Apprenticeship: Private Sector Establishments Only

	Offer apprentice-ships	Offer only or mainly to existing workers	Offer only or mainly to new recruits	offer to 16-18 year olds	offer to 19-24 year olds	offer to 25+ year olds
Market Type (reference category: local)						
Market: regional	0.004	-0.001	-0.001	0.003	0.005	0.006
	(0.004)	(0.001)	(0.002)	(0.003)	(0.003)	(0.003)*
Market: national	-0.019	-0.001	-0.010	-0.017	-0.013	-0.005
	(0.003)**	(0.001)	(0.002)**	(0.003)**	(0.003)**	(0.002)*
Market: international	-0.017	-0.003	-0.010	-0.015	-0.010	-0.004
	(0.004)**	(0.001)*	(0.002)**	(0.003)**	(0.003)**	(0.003)

Standard errors in parentheses
* significant at 5%; ** significant at 1%
Full results in Table A2.

The results in Table 5 might be seen as slightly surprising. It might have been expected that establishments facing national or international competition may have been more likely to have both the means and the incentive to engage more with apprenticeships. In fact, Table 5

shows that such establishments are *less* likely to offer apprenticeships, by about 2 percentage points relative to establishments that compete locally, with offers of apprenticeships to new recruits and younger workers in particular being reduced. In response to the potential surprise concerning these results, it should be pointed out that, firstly the marginal effect is very small, so it is not a large effect anyway, and secondly, the result should be interpreted as holding everything else in the equation constant. Thus, after controlling for establishment size, sector etc, there does not seem to be much additional effect of market size (but what effect there is suggests a slightly lower engagement with apprenticeships amongst establishments facing national or international competition).

(iii) Whether Establishments Currently Have Apprentices

Tables A3 (all establishments) and A4 (private sector establishments only) analyse the characteristics of establishments associated with actually having apprentices. The size of the estimated marginal effects in these tables is in many cases smaller than the equivalent marginal effects in Tables A1 and A2. This is due to the fact that the percentage of establishments with apprentices (at 4%) is less than the percentage of establishments that offer apprenticeships (8%), as discussed above. Qualitatively, however, the results are extremely similar. Thus, the characteristics of establishments that are associated with the likelihood of offering apprenticeships are the same characteristics that are associated with actually having apprentices. As such, the results do not need to be discussed in detail again. It would therefore seem that there are no observed characteristics of establishments that are associated with a likelihood of failing to fill offered apprenticeship places, i.e. there are no establishment characteristics associated with having a higher likelihood of *offering* apprenticeships, but not associated with having a higher likelihood of actually employing apprentices. We might have expected to find for example that the characteristics of firms that are in sectors that have been most affected by the recession might be correlated with whether or not the firms offer apprenticeships but not with actually employing apprentices. This is not the case however.

(iv) Whether Establishments are Likely to Offer Apprenticeships in the Next Year

The NESS asks employers to report how likely they are to offer apprenticeships in the next 12 months, on a 1-5 scale. Their answers revealed that 20% of employers reported that they were likely or very likely to offer apprenticeships in the next year. This is considerably higher than the current offer rate at the time of the survey (8%), and suggests a possible increase in

engagement with apprenticeships, or probably more likely that employers *plan* to offer apprenticeships in the future, but when the future arrives they do not, for a variety of possible reasons.

We estimated a further set of equations, investigating the establishment characteristics associated with planning to offer an apprenticeship in the next year. The results are shown in Tables A5 (all establishments) and A6 (private sector establishments only). The estimated marginal effects are qualitatively similar to those observed for both currently offering apprenticeships and currently having apprentices. Thus, the characteristics that led establishments to offer apprenticeships in the past are largely the same as the characteristics that lead them to want to offer apprenticeships in the future. An exception is that skills shortages in a wider range of occupations are associated with planned future engagement with apprenticeship than with current engagement with apprenticeship. Thus, skills-based hard-to-fill vacancies for associate professionals, administrative staff, skilled trade workers, personal services workers, sales workers and elementary workers, plus internal skills gaps amongst existing managers, professionals, associate professionals, administrative staff, skilled trade workers, personal services workers and elementary workers, are all positively and statistically significantly associated with a stated aim to offer apprenticeships in the next year. It could be that establishments are planning on widening the scope of apprenticeships to more occupation groups in the future, or that they always plan this, but in the end just respond to shortages of skilled trade workers. Another year or two of data is required to confirm which of these scenarios is correct.

The future engagement with apprenticeship equations in Tables A5 and A6 each include an additional explanatory variable. This is an indicator of whether the establishment had an apprentice at the time of the survey (in the appropriate age group for the age-related equations). The aim of including these variables was to see whether the experience of having apprentices influences the likelihood of offering apprenticeships again in the future. The estimated marginal effects on these variables are shown in Table 6.

The results make clear that there is a strong positive relationship between having apprentices this year and planning to offer apprenticeships next year. One interpretation of this result is that establishments that experience apprenticeships find it beneficial and so want to repeat the experience. Of course, an alternative interpretation is that conditions or establishment characteristics favourable to apprenticeships have persisted over time, so

that if an establishment engaged with apprenticeships this year, it is more likely to engage again next year. In either case, this is information that might be usefully fed through to employers i.e. that those firms that do train apprentices are favourably inclined to take on more apprentices in the future.

Table 6: Current Engagement with Apprenticeship and the Probability of Offering Apprenticeship Next Year: All Establishments

	Likely to have an apprentice in next year	Likely to have a 16-18 y.o. apprentice in next year	Likely to have a 19-24 y.o. apprentice in next year	Likely to have a 25+ y.o. apprentice in next year
Current engagement with apprenticeships				
Has apprentices	0.363			
	(0.009)**			
Has apprentices aged 16-18		0.362		
		(0.012)**		
Has apprentices aged 19-24			0.317	
			(0.012)**	
Has apprentices aged 25+				0.432
				(0.018)**

Standard errors in parentheses
* significant at 5%; ** significant at 1%
Full results in Table A5.

(v) Whether Establishments are Likely to Offer Apprenticeships: SMEs Only

The results in Table A7 in the appendix repeat the analysis of Table A1, looking at the characteristics of establishments that offer apprenticeships, but in this case considering

SMEs only (here defined as establishments with fewer than 25 employees).[7] The aim is to examine whether small establishments that engage with apprenticeships have different characteristics to the larger establishments that engage, in turn to potentially obtain information on how more SMEs can be encouraged to engage with apprenticeships. Comparing the marginal effects in Tables A1 and A7 however, they are qualitatively very similar, with the same effects achieving statistical significance in both equations. Quantitatively as well, the results are very similar, suggesting SMEs are affected by the same factors as larger establishments when deciding whether to engage with apprenticeships. It would seem that the labour turnover effects are larger for SMEs (in Table A7) than for all establishments in (Table A1), suggesting that SMEs have more to fear from poaching of their trained workers, though the difference between the effects is not statistically significant. It would therefore appear that particular policies are not required to persuade SMEs to engage with apprenticeships, as they are subject to the same influence as all establishments.

(vi) Whether Establishments are Likely to Offer Apprenticeships: Non-Traditional Sectors Only

The final piece of analysis considers only those sectors that have not traditionally engaged with apprenticeships.   This means that the establishments in the manufacturing and construction sectors are not included. The aim is to determine whether there are particular factors that only affect establishments in non-traditional sectors, in which case appropriate policies could be devised to deal with these particular factors for establishments in non-traditional sectors. The results are reported in Table A8 in the appendix. Comparing these results to those in Table A1, it can be seen that they are qualitatively and quantitatively very similar. It therefore does not appear that there are any factors specific to establishments in non-traditional sectors that influence their decision to engage with apprenticeships.

Results – ABI

This section of the report turns to an analysis of the merged NESS07 and ABI dataset. The aim is to investigate the relationship between engagement with apprenticeship and information about establishments that is not available in the NESS, in particular looking at

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[7] These specifications therefore do not include the establishment size variables. In addition, the local government and central government control variables are dropped, since no such establishments have fewer than 25 employees.

productivity (measured as gross value added per head). The direction of causation in this relationship could go in either direction. We are interested in determining whether engagement with apprenticeships increases an establishment's productivity. However, it may also be the case that engagement with apprenticeship could be influenced by existing levels of productivity. The latter effect could take either sign, potentially being positive if high productivity creates a surplus to be re-invested in training, or negative if establishments react to a low level of productivity by offering more training in an attempt to increase productivity.

We investigate each possible direction of causality separately, in sections (ii) and (iii) below, after first providing some descriptive statistics for the merged data set.

(i) Descriptive Statistics

Table 7 compares the matched sample of NESS07+ ABI07 to the whole of NESS07 for a few key measures.

Table 7: Summary Statistics - NESS 07 Versus NESS07 Matched to ABI07

	NESS 07	NESS 07 + ABI 07
Number of establishments	79,018	8,644
Proportion that offer apprenticeships	16.0%	20.7%
Proportion that had apprentices	7.7%	9.8%
Proportion of establishments that fall in the size band		
2 to 4	30.5%	8.5%
5to24	46.5%	43.1%
25-99	17.5%	33.3%
100-199	3.1%	7.7%
200-499	1.8%	5.3%
500+	0.6%	2.0%

The numbers in Table 7 make clear that only a minority of NESS07 establishments (just over 10%) are matched to a reporting unit in the ABI. In the full data set, 16% of establishments offer apprenticeships and 8% actually have apprentices[8]. In the smaller, matched, data set,

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[8] These numbers compare to figures of 8% and 4% respectively in NESS09. This does not mean, however, that apprenticeship engagement has halved between 2007 and 2009. Rather, the wording of the apprenticeship question changes between the two questionnaires. The 2009 questionnaire

these numbers are higher at 21% and 10% respectively, showing that establishments that engage with apprenticeships are over-represented in the matched data set. The reason for this is apparent from the numbers in the lower half of Table 7, which show that larger establishments are more likely than smaller ones to be in the matched data set.[9] Given this sample selection issue, ideally we would like to correct for it in some way. However, there are no variables available that could be used to explain selection into the matched data set, which should not also be in the estimated equations themselves.[10] Therefore all results in this section of the report should be read as conditional on the establishment being matched.

(ii) Productivity and the likelihood of employing apprentices

This sub-section considers the direction of causation from productivity to apprenticeship engagement. Specifically, the dependent variable is whether establishments have apprentices. The regression specification is as close as possible to the specification used in the NESS09 analysis above. The results are, however, not completely comparable for three reasons. First, the two analyses are clearly considering two different points in time, 2007 and 2009 which, furthermore, are very different considering the onset of recession in 2008. Second, the samples are different given, as discussed above, the 2007 sample is dependent on establishments being matched to the ABI, which is non-random. Finally, there is some variation in questions between the 2007 and 2009 surveys, for example with the apprenticeship variables themselves as discussed above.

Table 8 reports the coefficients on the variables of interest, namely the new variables that have been merged in from the ABI. The full results for all coefficients are reported in Table A9 in the Appendix.

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asks respondents whether they offer or have apprenticeships specifically at the point in time of the survey. The 2007 questionnaire, however, considers a broader time frame and asks whether establishments have any apprentices at the time of the survey *or have had apprentices in the previous 12 months.* Similarly, the 2007 question asking whether the establishment offers apprenticeships simply asks whether establishments offer them or not, with no reference timeframe at all, compared to the 2009 questionnaire that is specifically at the time of the survey. We would therefore expect the 2007 survey to yield higher figures for engagement.

[9] Figure 3 above showed that larger establishments have a higher likelihood of engagement with apprenticeships than smaller establishments.

[10] For example, establishment size clearly affects the likelihood of being in the matched data set, but establishment size is also required as an explanatory variable in apprenticeship use or productivity equations, and so is not available to use in a selection equation.

Table 8: Production Measures and the Probability of Having Apprentices: NESS07 matched to ABI07

Variables from ABI	Basic	Quintile	Polynomial
Gross Value Added per head	2.27e-05		4.16e-05
	[2.34e-05]		[4.31e-05]
Gross Value Added per head squared			-5.26e-09
			[8.51e-09]
Capital expenditure per head	8.73e-07	-3.84e-06	2.27e-07
	[5.98e-06]	[1.19e-05]	[6.38e-06]
Labour cost per head	6.19e-05	0.000119	9.07e-05
	[7.57e-05]	[4.10e-05]**	[8.33e-05]
GVA per head quintile 2		-0.00439	
		[0.0126]	
GVA per head quintile 3		-0.0274	
		[0.0115]*	
GVA per head quintile 4		-0.00880	
		[0.0112]	
GVA per head quintile 5		-0.00908	
		[0.0111]	

Robust standard errors in brackets
** $p<0.01$, *$p<0.05$
Full regression results can be found in Appendix A9.

The first column of results shows that establishments with higher productivity are then more likely to have an apprentice. The effect is far from being statistically different from zero, however. In the middle column we investigate whether there are non-linearities in this relationship, by including dummy variables to indicate in which quintile of the GVA distribution an establishment falls. The coefficient on the third quintile is negative and statistically significant at the 5% significance level, therefore providing some evidence that the relationship between productivity and apprenticeship engagement is U-shaped. This is possible, given the dual and opposite-signed effects that productivity could have on apprenticeship engagement, as discussed above. Therefore, as productivity initially rises, establishments become less likely to offer apprenticeships, possibly because they have less need to do so as productivity rises out of the 'crisis zone' of the bottom quintile. Beyond a certain point, however, as productivity continues rising, apprenticeship engagement also rises again, possibly because the higher productivity creates a greater surplus to fund training.

The full tabulated results in Table A9 also report the results when establishments' productivity performance is broken down into deciles rather than quintiles. These results again suggest that apprenticeship engagement is lowest amongst establishments with a mid level of productivity, though the pattern of coefficients and statistical significance is not smooth across the ten deciles.

The final column of results in Table 8 above include a quadratic in productivity, to allow for more general non-linearities. The results are, however, statistically insignificant.

Table 9 below presents the results from some other investigations that were possible with the matched NESS07-ABI dataset. These results show that establishments that hire young people (specifically whether they hire 16 year olds straight from school or 17-18 year olds straight from school or college) are more likely to offer apprenticeships. As expected, therefore, apprenticeship engagement is complementary with a young workforce, particularly young people who did not attend Higher Education. This result is invariant to how productivity is measured across the three columns.

Table 9: Demand for young workers and the Probability of taking Apprenticeship: NESS07 matched to ABI07

Variable from ABI	Basic	Quintile	Polynomial
Whether recruited any 16-year-olds straight from school in the past 12 months	0.0680	0.0670	0.0681
	[0.0125]**	[0.0124]**	[0.0125]**
Whether recruited any 17-to-18-year-olds straight from school/college in the past 12 months	0.0700	0.0695	0.0702
	[0.00960]**	[0.00935]**	[0.00958]**
Whether recruited anyone straight from higher education in the past 12 months	-0.000822	-0.000367	-0.000832
	[0.00692]	[0.00690]	[0.00692]

Robust standard errors in brackets
** $p<0.01$, * $p<0.05$
Full regression results can be found in Appendix A9.

Although the analysis in this section is limited to 2007 as far as the NESS data are concerned, information from ABI in years other than 2007 can be matched in. Data from the 2006 ABI was therefore merged into the joint NESS07-ABI07 dataset. This allowed us to control for lagged productivity as well as current productivity in the apprenticeship use equations. An

extra specification involved using lagged productivity (i.e. productivity in the 2006 ABI) as an instrument for current productivity (i.e. productivity in the 2007 ABI). However, in none of these additional specifications does the productivity variable attract a statistically significant coefficient (the full results can be found in the Appendix Table A10).

(iii) The impact of employing apprentices on productivity

This section now considers the direction of causality from apprenticeship engagement to productivity.

It is important to acknowledge that many other factors have been shown to affect productivity. Here we only focus on apprenticeships whilst controlling for other characteristics of the establishment that affect productivity and that are available in the data set.[11] The literature on productivity is clear that there are large and persistent differences in productivity levels across different firms, even within the same sector (Bartelsman and Doms, 2000; Chad, 2011). A recent review of the extensive evidence base for the *Journal of Economic Literature* identified the following factors as determinants of productivity:

- Competition Technology (Syverson, 2004b; Schmitz 2005)
- Sunk costs (Collard-Wexler, 2008)
- Product markets and technology spillovers (Bloom, Schankerman, and Van Reenen 2007)
- Firms' organisational structures (Hortaçsu and Syverson 2007, 2009)
- Incentive pay (Lazear, 2000)
- Other human resource practices (Ichniowski and Shaw, 2003)
- Managerial talent (Bloom and Van Reenen, 2007)

The list above is not comprehensive however (see Syverson, 2011 for full account) and there is growing recognition of the importance of external drivers, i.e. things external to the firm, such as the regulatory environment and competition faced by the firm (Syverson, 2011). Certainly human capital, including training, is also an important determinant of productivity

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[11] Not all the factors that affect productivity, listed here, can be controlled for, because of a lack of suitable data. To the extent that the missing determinants are correlated with the apprenticeship variable, then the latter will pick up some of the effects of the former. This is at least a possibility, with variables such as human resource practices and managerial talent potentially correlated with apprenticeship engagement. We would argue, however, that the correlation should not be so strong as to seriously bias the apprenticeship coefficient.

(Abowd et al. (2005), Fox and Smeets (2009). However, Syverson concludes that "The relative quantitative importance of each [factor], however, is still unclear." and this is an area for future research.

Table 10 below contains the results on the variables of interest from OLS specifications. The estimated equations also control for capital expenditure per head, labour costs per head, firm type, whether the establishment is the only one in the firm, as well as the extent of external skill shortages and internal skills gaps. The full results showing the coefficients on all explanatory variables are shown in Tables A11 and A12 in the appendix.

Table 10: impact of use of apprentices on productivity – OLS approach

Apprenticeship engagement	NESS07+ABI07	NESS07+ABI07	NESS07+ABI07+ABI06, controlling for productivity in 2006	NESS07+ABI07+ABI06, controlling for productivity in 2006
Whether took any 16-24 apprentices	2.393		1.480	
	[2.575]		[2.115]	
Number of 16-24 apprentices taken		0.0606		-0.115
		[0.202]		[0.125]
Total proportion of staff trained	3.657	3.703	2.219	2.240
	[2.002]	[2.022]	[1.783]	[1.788]
Observations	8644	8644	6503	6503

Robust standard errors in brackets
** p<0.01, *p<0.05
Full regression results can be found in Appendix A11 and A12.

Apprenticeship engagement is measured by whether the establishment had any apprentices in the previous 12 months, or by the actual number of apprentices employed. As shown by the coefficients in the first two columns of results in Table 10, both of these variables are positively associated with productivity, though not statistically significantly so. The estimated equations also include an indicator of general training, measured by the proportion of staff in the establishment to have received training in the previous 12 months. As Table 10 shows, such general training is also positively, though not statistically significantly, related to productivity.

The results in the last two columns of Table 10 are from a specification that includes the level of productivity in the previous year, 2006, as an additional control variable.[12] This

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[12] In order to estimate this equation, it is necessary for a NESS07 establishment to be matched to the ABI in both 2006 and 2007. Since some establishments may have had a match in the 2007 ABI, but

specification estimates a 'value added' equation, and in effect considers the influence of apprenticeship engagement on the annual *change* in productivity. The idea behind this specification is that engagement with apprenticeship in the last year might be expected to be more correlated with the change in productivity in the last year, than with the long-term level of productivity. In addition, controlling for the lagged level of productivity is a first way to attempt to control for the endogeneity of apprenticeship use. If the previous level of productivity is the main determinant of engagement with apprenticeship, then holding the previous level of productivity constant will remove the impact of this endogenous variation in apprenticeship use from the estimated coefficient. The results in the last two columns show that the estimated coefficients on the apprenticeship use variable, however measured, remain statistically insignificant.

Other specifications were estimated, introducing lags of the apprenticeship variable, which was achieved by matching the NESS07 establishments to the 2008 ABI. In this way, apprenticeship use in 2007 could be related to productivity in the following year, 2008. This specification therefore allows more time for the apprenticeship engagement to have an effect on productivity, rather than expecting an instantaneous response. The results are shown in Tables A11 and A12 in the appendix. These results show that, whether in a levels specification (Table A11, columns 3 and 4) or in a value added specification with lagged productivity (Table A12, columns 1 and 2), the coefficients on lagged apprenticeship use remain positive but statistically insignificant.

The endogeneity of apprenticeship engagement was mentioned above, where it was argued that controlling for lagged productivity can account for this endogeneity, to the extent that apprenticeship choices are determined by past levels of productivity. We know from the analysis of NESS09 above, however, that many factors influence engagement with apprenticeship, and so a more formal treatment for endogeneity is required, using instrumental variables. A suitable instrumental variable must be exogenous to the establishment, correlated with its apprenticeship choice, but have no effect on productivity. We used various sector levels variables as possible instruments, as shown by the column headings in Table 11 below. The first instrument used was the proportion of establishments in the (2 digit industry) sector, that had taken any apprentices in the previous twelve

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not in the 2006 ABI as well, the sample size in these two columns is smaller than in the first two columns.

months. The argument here is that some sectors have traditionally had more involvement with apprenticeships than others, and so have a stronger framework in place for delivering apprenticeships and greater institutional support. An establishment that happens to be in a sector with a greater tradition of apprenticeship may therefore be more likely to engage with apprenticeships. The proportion of establishments in the sector who offer apprentices is therefore used as the indicator of the tradition of apprenticeship in that sector.

Other instruments used measure the extent of skill shortages in each establishment's sector. Specifically, skills shortages of skilled trade workers are used, as a shortage of this group of workers in particular seemed to influence engagement with apprenticeship, in the analysis of NESS09 undertaken above. The four instruments used, each tried separately one-by-one, were the proportion of establishments in the sector experiencing an external skills shortage of skilled trades workers, the average value of the external skills shortage variable in the sector (i.e. the average number of hard to fill vacancies, for skills reasons, for skilled trades workers), the average proportion of skilled trades workers per establishment not fully proficient in their jobs, and the average number of skilled trades workers per establishment not fully proficient in their jobs. Table A13b in the appendix reports the coefficient on each of these instruments in the first stage, apprenticeship engagement equation. In every case, the coefficient is positive and statistically significant.

Note that all of these instruments are measured at the sector level, and so their use means that we cannot simultaneously include sector level dummy variables. This means that we cannot control for sector level differences in productivity. There is therefore a danger that the instrumented variables will therefore also pick up sector level differences in productivity.

Table 11 below reports the results on the instrumented apprenticeship variable. The full results are reported in Table A13 in the appendix. As can be seen, after being instrumented, the apprenticeship engagement variable attracts a negative coefficient in every specification, although the effect remains statistically insignificant in every case except the first. Similar IV equations were estimated in a value-added framework, controlling for 2006 productivity levels. In every case, however, the coefficient on the instrumented apprenticeship engagement variable was statistically insignificant (full results in Table A14a in the appendix).

Table 11: impact of use of apprentices on productivity - IV approach

	Instrumented Variable: whether took any 16-24 apprentices				
Instrumental Variable (in addition to all other exogenous regressors)	Proportion of workplaces in the sector that took any 16-24 apprentices	Proportion of workplaces with skilled-trades skill shortage in the sector	Average number of skilled-trades skill shortage in the sector	Average proportion of skilled trades staff being NFP in the sector	Average number of NFP skilled trades staff among all workplaces in the sector
2nd stage estimates					
Estimated effect of the fitted apprenticeship measure	-58.50	-37.27	-88.52	-24.30	-42.55
	[26.87]*	[38.33]	[61.00]	[23.26]	[37.99]
Total proportion of staff trained	5.423	4.999	6.023	4.740	5.104
	[1.754]**	[1.756]**	[1.808]**	[1.782]**	[1.900]**
Observations	8644	8644	8644	8644	8644

Robust standard errors in brackets
** p<0.01, *p<0.05
All the five regressions are based on the matched sample of NESS07 and ABI07. Full regression results can be found in Appendix A13.

Conclusions

In the UK there is strong evidence that individuals who acquire an apprenticeship qualification go on to have good labour market prospects. However, there are insufficient numbers of firms who take on apprentices to meet the demand for apprenticeships from young people (Leitch, 2006; Wolf, 2011). Given that apprenticeships are valuable for the individual, i.e. they improve individuals' earnings and by implication their productivity, we need to determine why more firms are not willing to engage with the apprenticeship programme.

In this report we explored the characteristics of establishments that engage with the apprenticeship programme and attempted to identify whether there are determinants of engagement with the apprenticeship programme that may be susceptible to policy intervention. We then explored whether firms that train apprentices have more rapid productivity growth, to provide prima fascia evidence that apprentices have a direct impact on firm performance. If true this would provide clear evidence to promote engagement with the programme to firms. We acknowledge however, that this latter question is challenging to answer from a methodological perspective and our evidence on this is more tentative.

We identified a number of key characteristics of establishments that train apprentices. Firstly, we found that larger establishments are indeed more likely to train apprentices, as

one might have hypothesised. However, it is the case that smaller establishments that do train apprentices have proportionately more trainees (i.e. a higher number of apprentices per 1000 employees). This result holds even for small single site firms. This suggests that if policy-makers can engage small and medium sized enterprises (SMEs) in the apprenticeship programme, these firms have the potential to play a significant role in employing apprentices.

It is also striking that private sector establishments are more likely to offer apprenticeships than charities, local and central government establishments. It may be that private firms are more likely to train apprentices because they find such investment yields a good return, whereas this profit motive is not as strong in the public or charitable sectors. This does give government a clear steer however, that policy to encourage state owned establishments to train apprentices is needed.

Apprenticeships are a tradition in some sectors. Where apprenticeships are well established a higher proportion of firms train apprentices. Thus establishments belonging to the construction sector are the most likely to offer apprenticeships, for example. This implies that in sectors without a tradition of apprenticeships, it will take longer and potentially more policy effort for apprenticeships to become more widespread. However, it should be acknowledged that apprenticeships are just not suited to some sectors, and resources should not be wasted by imposing apprenticeships on sectors for which they are not suited.

Proportionately, apprenticeships are least likely to be offered in London. Previous research has also found a particular shortage in the supply of apprenticeship positions in London, with implications for the proportion of Black and Minority Ethnic students accessing apprenticeship due to the high proportion of BME young people who live in the capital (Peacock, 2008). A recent study by IES (Marangozov et al. 2009) confirmed that there are significant regional variations in the supply of apprenticeships, largely driven by differences in both demographic and industrial characteristics of different regions. Apprenticeship starts are highest in the North West and lowest in Greater London, despite the size of the youth population in the latter region. The report also suggests that in London there are disproportionately few apprenticeships in engineering, an historically strong sector for apprenticeship. This may provide a partial explanation of why there are fewer apprenticeships in London. Again this might suggest that further policy work is needed to encourage firms in this region to train. However, the data we are using are from 2009 and

since that time the situation in London may have changed as a result of efforts to engage London firms with the programme.

One of the objectives of this work was to better understand why firms train apprentices. To do this we analysed key features of firms that train apprentices. In general firms that are more productive, i.e. have higher gross value added, were no more likely to train apprentices than those with lower productivity levels. Hence firms do not appear to train apprentices in response to low productivity levels. On the other hand, we did find that establishments suffering skill shortages were more likely to train apprentices, suggesting that engagement with the apprenticeship programme may be a response to problems either in recruitment or in the skill levels of existing employees. Certainly we found that firms with an external shortage of appropriately qualified skilled trade workers are more likely to engage with apprenticeships, as are those suffering an internal skills gap amongst skilled trade or personal service workers. In both cases, the response from the firm was generally to recruit new workers to train as apprentices rather than to offer apprenticeships to their existing workforce. This evidence suggests that, in those sectors where apprenticeships are appropriate, apprenticeship policy targeting those establishments who identify themselves as having skills shortages is likely to be most successful in terms of the response of employers. However, the results also imply that establishments without a current skills shortage are less likely to engage with apprenticeship. Another policy initiative is therefore to convey the message to establishments for whom apprenticeships are an appropriate training route, to view apprenticeship training as an ongoing, continuous process, rather than simply an occasional solution to a short-term skills shortage crisis.

We also found quite clearly that apprenticeships complement, rather than replace, other forms of training. This is an important finding. Incentives to train apprentices do not appear, at least from this analysis, to be associated with firms cutting back on other types of training. This is extremely encouraging, suggesting firms see ongoing training and continuing professional development of their existing work force as distinct from training new apprentices.

In terms of the types of establishments that train apprentices, our evidence suggests that where firms face more intense competition, i.e. from national or international firms, they are actually less likely to engage with the apprenticeship programme. We are not able to determine from the analysis why this might be, though it may be that in these markets the pressure to compete on the basis of low costs may be greater and this may limit firms' ability

to take on apprentices. Certainly we found that firms that are market leaders in product/service development and emphasise product/service quality are more likely to train apprentices. Thus apprenticeships may be part of a high quality business strategy but may be less common in markets where there is intense cost pressure.

Lastly, we also investigated whether engagement with apprenticeships was associated with lower rates of worker turnover. Certainly those firms who train apprentices have lower worker turnover. However, the direction of causality is unclear. Indeed we found that firms appear less willing to recruit new workers as apprentices where the risk of poaching may be higher. Thus an expectation of reasonably low worker turnover may be needed to encourage firms to take on new apprentices. Clearly this is another issue that government could consider as a potential area of intervention to encourage greater engagement with the apprenticeship programme. However, we need to be mindful that policy aimed at limiting workers' ability to change jobs in the initial years after receiving apprenticeship training may have undesirable consequences on labour market flexibility.

In the second part of the report we went on to consider whether taking on an apprentice was associated with higher productivity concurrently or one year later. Earlier we acknowledged that establishing a clear relationship between apprenticeship training and productivity is problematic, not least because it may take many years for firms to reap the benefits of having trained an apprentice, since in the initial years the apprentice is likely to be less productive than a fully trained worker. In our analysis we were unable to find any statistically significant association between training apprentices and productivity levels or productivity growth. From this we conclude that any positive relationship between apprenticeship engagement and productivity is not observable just one year later. This does not mean that over a longer time period one might see a positive impact from apprenticeships on firm productivity. The lack of an immediate, short-term boost to productivity, could however be one reason for some establishments not engaging with apprenticeships.

In conclusion, there are some distinguishing features of firms that train apprentices and this analysis has suggested various possibilities for interventions to further increase the number of firms engaging with the apprenticeship programme. However, we must also be mindful that firms are likely to know whether apprenticeship training is going to be beneficial for them and hence choosing not to train may be their most rational choice. We would urge

further research into why some of these firms do not train apprentices. Is it the high costs of providing apprenticeship training, particularly in those firms facing intense national and international competition? Is it lack of familiarity with the apprenticeship scheme? These are important questions that require further, possibly qualitative, research to determine answers to.

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Appendix A: Full Regression Results Tables

Table A1 – Whether Establishment Offers Apprenticeships: All Establishments

	Offer apprenticeships	Offer only or mainly to existing workers	Offer only or mainly to new recruits	offer to 16-18 year olds	offer to 19-24 year olds	offer to 25+ year olds
Number of hard to fill vacancies, by occupation:						
Managers	0.004	0.001	0.005	0.005	0.007	0.001
	(0.011)	(0.004)	(0.006)	(0.009)	(0.009)	(0.008)
Professional worker	-0.001	-0.001	-0.002	-0.001	-0.001	-0.000
	(0.001)	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)
associate profs	-0.000	-0.002	0.001	0.001	-0.001	0.000
	(0.003)	(0.003)	(0.001)	(0.002)	(0.003)	(0.002)
administrative staff	0.004	-0.002	0.003	0.001	0.003	0.001
	(0.009)	(0.005)	(0.004)	(0.007)	(0.007)	(0.006)
skilled trade workers	0.021	-0.004	0.011	0.002	0.017	0.000
	(0.006)**	(0.004)	(0.003)**	(0.002)	(0.005)**	(0.002)
personal services	0.006	0.002	-0.001	0.005	0.003	0.004
	(0.005)	(0.001)	(0.004)	(0.004)	(0.004)	(0.003)
sales workers	-0.006	-0.002	-0.002	0.003	-0.008	0.002
	(0.011)	(0.005)	(0.007)	(0.007)	(0.010)	(0.007)
machine operatives	0.006	-	0.004	0.002	0.001	0.005
	(0.006)		(0.003)	(0.005)	(0.005)	(0.004)
elementary workers	0.002	0.001	0.001	0.000	0.001	0.000
	(0.006)	(0.002)	(0.004)	(0.006)	(0.006)	(0.005)
Skills gaps – proportion of staff not fully proficient, by occupation						
managers	0.009	0.002	-0.000	0.005	0.003	0.010
	(0.008)	(0.003)	(0.004)	(0.006)	(0.007)	(0.006)

professionals	0.034	0.005	0.010	0.029	0.035	0.025
	(0.016)*	(0.006)	(0.009)	(0.013)*	(0.013)**	(0.012)*
associate professionals	0.020	-0.003	0.013	0.014	0.012	0.016
	(0.014)	(0.006)	(0.007)	(0.012)	(0.012)	(0.010)
administrative staff	0.003	-0.001	-0.000	0.012	0.003	0.010
	(0.008)	(0.003)	(0.004)	(0.006)	(0.007)	(0.006)
skilled trade workers	0.156	0.013	0.063	0.113	0.116	0.063
	(0.009)**	(0.003)**	(0.004)**	(0.007)**	(0.008)**	(0.007)**
personal services	0.116	0.008	0.035	0.080	0.090	0.061
	(0.014)**	(0.005)	(0.008)**	(0.012)**	(0.012)**	(0.010)**
sales workers	-0.030	-0.001	-0.012	-0.015	-0.022	-0.014
	(0.010)**	(0.004)	(0.006)*	(0.008)	(0.009)*	(0.008)
machine operatives	0.017	-0.004	0.007	-0.004	0.011	0.011
	(0.015)	(0.006)	(0.008)	(0.013)	(0.013)	(0.012)
elementary workers	0.000	0.003	-0.001	-0.003	-0.004	-0.005
	(0.009)	(0.003)	(0.005)	(0.008)	(0.008)	(0.007)
Sector Characteristics						
sector turnover rate	-0.269	-0.043	-0.171	-0.257	-0.190	0.002
	(0.052)**	(0.021)*	(0.030)**	(0.045)**	(0.046)**	(0.040)
Proportion young (sector)	0.075	0.040	-0.005	0.070	0.058	0.037
	(0.027)**	(0.011)**	(0.016)	(0.023)**	(0.024)*	(0.021)
Workforce Human Capital						
Proportion training	0.040	0.003	0.015	0.030	0.033	0.027
	(0.003)**	(0.001)*	(0.002)**	(0.003)**	(0.003)**	(0.002)**
Proportion level 4+ qualifications	-0.047	-0.011	-0.015	-0.043	-0.028	-0.019
	(0.004)**	(0.002)**	(0.003)**	(0.004)**	(0.004)**	(0.003)**
Proportion level 3 qualifications	0.057	0.002	0.024	0.045	0.048	0.031
	(0.004)**	(0.002)	(0.002)**	(0.003)**	(0.004)**	(0.003)**
Establishment Size (reference category: 2-4 workers)						

Establishment size 5-24	0.061	0.010	0.026	0.047	0.054	0.035
	(0.006)**	(0.002)**	(0.004)**	(0.005)**	(0.005)**	(0.005)**
Establishment size 25-99	0.132	0.024	0.056	0.096	0.116	0.074
	(0.009)**	(0.005)**	(0.007)**	(0.009)**	(0.009)**	(0.007)**
Establishment size 100-199	0.227	0.038	0.099	0.182	0.199	0.119
	(0.018)**	(0.009)**	(0.015)**	(0.017)**	(0.018)**	(0.015)**
Establishment size 200+	0.358	0.076	0.140	0.284	0.325	0.235
	(0.021)**	(0.014)**	(0.018)**	(0.021)**	(0.021)**	(0.019)**
Only establishment in firm	0.008	0.002	0.011	0.009	0.005	-0.000
	(0.006)	(0.002)	(0.004)**	(0.005)	(0.005)	(0.004)
Only estab*5-24 workers	0.000	-0.004	-0.000	0.001	0.000	0.002
	(0.007)	(0.002)	(0.004)	(0.006)	(0.006)	(0.005)
Only estab*25-99 workers	0.004	-0.003	-0.001	0.006	0.001	0.005
	(0.008)	(0.002)	(0.004)	(0.007)	(0.007)	(0.006)
Only estab*100-199 workers	-0.004	0.000	-0.011	-0.008	-0.003	-0.002
	(0.014)	(0.005)	(0.006)	(0.011)	(0.013)	(0.011)
Only estab*200+ workers	-0.021	-0.003	-0.011	-0.005	-0.015	-0.019
	(0.014)	(0.005)	(0.007)	(0.013)	(0.012)	(0.009)*
Sector Type (reference category: private sector)						
charity / voluntary sector	-0.043	-0.006	-0.012	-0.032	-0.035	-0.027
	(0.003)**	(0.001)**	(0.002)**	(0.003)**	(0.003)**	(0.002)**
local government body	-0.051	-0.008	-0.010	-0.036	-0.041	-0.034
	(0.003)**	(0.001)**	(0.003)**	(0.003)**	(0.003)**	(0.002)**
central government body	-0.044	-0.005	-0.011	-0.023	-0.036	-0.025
	(0.006)**	(0.002)*	(0.004)**	(0.006)**	(0.005)**	(0.004)**
Other firm type	-0.016	-0.009	-0.012	-0.019	-0.017	0.005
	(0.020)	(0.004)	(0.010)	(0.015)	(0.016)	(0.018)
Observations	65316	64874	65108	65162	65137	65051

Standard errors in parentheses
* significant at 5%; ** significant at 1%
Equations also control for sector and region.

Table A2 – Whether Establishment Offers Apprenticeships: Private Sector Only

	Offer apprenticeships	Offer only or mainly to existing workers	Offer only or mainly to new recruits	offer to 16-18 year olds	offer to 19-24 year olds	offer to 25+ year olds
Number of hard to fill vacancies, by occupation:						
Managers	0.007	0.004	0.007	0.000	0.011	-0.003
	(0.015)	(0.005)	(0.008)	(0.013)	(0.012)	(0.011)
Professional worker	-0.015	-0.007	-0.001	-0.019	-0.009	-0.014
	(0.009)	(0.008)	(0.004)	(0.010)	(0.008)	(0.008)
associate profs	0.005	-0.003	0.001	0.006	0.003	0.005
	(0.005)	(0.004)	(0.003)	(0.004)	(0.005)	(0.004)
administrative staff	0.007	-0.003	0.004	0.008	0.006	0.006
	(0.009)	(0.007)	(0.004)	(0.006)	(0.007)	(0.006)
skilled trade workers	0.032	-0.003	0.014	0.022	0.024	0.012
	(0.008)**	(0.004)	(0.004)**	(0.006)**	(0.007)**	(0.006)*
personal services	0.008	0.002	-0.002	0.006	0.006	0.007
	(0.006)	(0.002)	(0.004)	(0.005)	(0.005)	(0.004)
sales workers	-0.007	-0.002	-0.003	-0.001	-0.007	-0.001
	(0.012)	(0.005)	(0.007)	(0.009)	(0.011)	(0.008)
machine operatives	0.008		0.004	-0.000	0.003	0.005
	(0.006)		(0.003)	(0.006)	(0.005)	(0.004)
elementary workers	0.001	0.001	-0.001	0.000	-0.001	-0.001
	(0.007)	(0.002)	(0.005)	(0.006)	(0.006)	(0.005)
Skills gaps – proportion of staff not fully proficient, by occupation						
managers	0.007	0.003	-0.002	0.005	0.002	0.011
	(0.008)	(0.003)	(0.005)	(0.007)	(0.008)	(0.006)
professionals	0.024	0.003	0.005	0.017	0.029	0.020
	(0.019)	(0.007)	(0.010)	(0.016)	(0.016)	(0.014)
associate professionals	0.025	0.000	0.015	0.013	0.015	0.019

	(0.016)	(0.007)	(0.008)	(0.013)	(0.014)	(0.012)
administrative staff	0.001	-0.001	-0.002	0.010	-0.000	0.009
	(0.009)	(0.004)	(0.005)	(0.007)	(0.008)	(0.007)
skilled trade workers	0.154	0.010	0.062	0.113	0.112	0.056
	(0.010)**	(0.004)*	(0.005)**	(0.008)**	(0.008)**	(0.008)**
personal services	0.119	0.011	0.036	0.087	0.086	0.050
	(0.018)**	(0.007)	(0.010)**	(0.015)**	(0.016)**	(0.013)**
sales workers	-0.033	-0.000	-0.015	-0.017	-0.024	-0.017
	(0.011)**	(0.004)	(0.006)*	(0.009)	(0.010)*	(0.008)*
machine operatives	0.027	-0.004	0.013	0.000	0.020	0.017
	(0.016)	(0.007)	(0.008)	(0.014)	(0.014)	(0.012)
elementary workers	0.014	0.004	0.005	0.004	0.009	0.003
	(0.010)	(0.004)	(0.006)	(0.009)	(0.009)	(0.008)
Sector Characteristics						
sector turnover rate	-0.383	-0.055	-0.190	-0.349	-0.273	-0.033
	(0.060)**	(0.024)*	(0.034)**	(0.051)**	(0.052)**	(0.045)
Proportion young (sector)	0.087	0.039	-0.013	0.070	0.068	0.050
	(0.031)**	(0.012)**	(0.018)	(0.026)**	(0.028)*	(0.024)*
Workforce Human Capital						
Proportion training	0.036	0.002	0.014	0.028	0.029	0.023
	(0.003)**	(0.001)	(0.002)**	(0.003)**	(0.003)**	(0.003)**
Proportion level 4+ qualifications	-0.044	-0.008	-0.016	-0.042	-0.027	-0.017
	(0.005)**	(0.002)**	(0.003)**	(0.004)**	(0.005)**	(0.004)**
Proportion level 3 qualifications	0.055	0.002	0.023	0.043	0.046	0.027
	(0.005)**	(0.002)	(0.003)**	(0.004)**	(0.004)**	(0.004)**
Business Strategy						
One-off product strategy	-0.006	-0.002	0.004	-0.004	-0.006	-0.007
	(0.003)	(0.001)	(0.002)*	(0.003)	(0.003)*	(0.002)**
strategy not price dependent	0.004	0.000	-0.000	0.005	0.004	0.004

	(0.003)	(0.001)	(0.002)	(0.002)*	(0.002)	(0.002)*
leader in new products/services	0.019	0.003	0.004	0.015	0.015	0.013
	(0.003)**	(0.001)*	(0.002)**	(0.002)**	(0.002)**	(0.002)**
premium quality strategy	0.010	0.000	0.004	0.009	0.009	0.007
	(0.003)**	(0.001)	(0.002)*	(0.002)**	(0.002)**	(0.002)**
Market Type (reference category: local)						
Market: regional	0.004	-0.001	-0.001	0.003	0.005	0.006
	(0.004)	(0.001)	(0.002)	(0.003)	(0.003)	(0.003)*
Market: national	-0.019	-0.001	-0.010	-0.017	-0.013	-0.005
	(0.003)**	(0.001)	(0.002)**	(0.003)**	(0.003)**	(0.002)*
Market: international	-0.017	-0.003	-0.010	-0.015	-0.010	-0.004
	(0.004)**	(0.001)*	(0.002)**	(0.003)**	(0.003)**	(0.003)
Establishment Size (reference category: 2-4 workers)						
Establishment size 5-24	0.068	0.013	0.026	0.051	0.055	0.037
	(0.007)**	(0.003)**	(0.004)**	(0.006)**	(0.006)**	(0.005)**
Establishment size 25-99	0.157	0.029	0.065	0.120	0.132	0.085
	(0.012)**	(0.006)**	(0.009)**	(0.011)**	(0.011)**	(0.010)**
Establishment size 100-199	0.264	0.051	0.111	0.205	0.222	0.142
	(0.022)**	(0.013)**	(0.018)**	(0.021)**	(0.022)**	(0.019)**
Establishment size 200+	0.360	0.096	0.120	0.289	0.324	0.238
	(0.025)**	(0.019)**	(0.020)**	(0.025)**	(0.025)**	(0.024)**
Only establishment in firm	0.017	0.004	0.009	0.015	0.012	0.007
	(0.007)**	(0.003)	(0.004)*	(0.006)**	(0.006)	(0.005)
Only estab*5-24 workers	-0.006	-0.005	0.000	-0.004	-0.002	-0.001
	(0.007)	(0.003)	(0.005)	(0.006)	(0.007)	(0.006)
Only estab*25-99 workers	-0.009	-0.005	-0.001	-0.004	-0.006	-0.003
	(0.008)	(0.003)	(0.005)	(0.007)	(0.007)	(0.006)
Only estab*100-199 workers	-0.022	-0.005	-0.013	-0.018	-0.010	-0.015
	(0.014)	(0.004)	(0.006)*	(0.011)	(0.013)	(0.010)
Only estab*200+ workers	-0.014	-0.006	-0.004	0.003	-0.010	-0.017

	(0.018)	(0.004)	(0.010)	(0.017)	(0.016)	(0.011)
Observations	51236	50883	51085	51124	51111	51035

Standard errors in parentheses
* significant at 5%; ** significant at 1%
Equations also control for sector and region.

Table A3 – Whether Establishment Currently Has Apprenticeships: All Establishments

	Has apprentices	Has 16-18 year old apprentices	Has 19-24 year old apprentices	Has 25+ year old apprentices
Number of hard to fill vacancies, by occupation:				
Managers	0.003	-0.003	0.003	0.001
	(0.006)	(0.005)	(0.004)	(0.002)
Professional worker	-0.000	-0.000	-0.000	-0.000
	(0.001)	(0.000)	(0.000)	(0.000)
associate profs	0.001	0.000	0.000	0.000
	(0.002)	(0.001)	(0.001)	(0.001)
administrative staff	-0.013	-0.006	-0.004	-0.001
	(0.010)	(0.006)	(0.006)	(0.003)
skilled trade workers	0.006	0.001	0.003	-0.005
	(0.003)	(0.001)	(0.002)	(0.003)
personal services	0.000	-0.001	-0.000	-0.000
	(0.003)	(0.002)	(0.002)	(0.001)
sales workers	-0.023	-0.009	-0.010	-0.006
	(0.011)*	(0.007)	(0.007)	(0.006)
machine operatives	0.005	0.001	0.002	0.002
	(0.003)	(0.002)	(0.002)	(0.001)*
elementary workers	0.002	0.000	0.001	0.000
	(0.004)	(0.002)	(0.002)	(0.001)
Skills gaps – proportion of staff not fully proficient, by occupation				
managers	0.000	-0.003	-0.003	0.004
	(0.005)	(0.003)	(0.003)	(0.002)*
professionals	0.022	0.010	0.014	0.004
	(0.009)*	(0.006)	(0.006)*	(0.004)
associate professionals	0.020	0.010	0.010	0.009
	(0.008)*	(0.005)*	(0.005)*	(0.003)**
administrative staff	0.001	0.002	-0.000	0.000
	(0.005)	(0.003)	(0.003)	(0.002)
skilled trade workers	0.089	0.044	0.043	0.011
	(0.005)**	(0.003)**	(0.003)**	(0.002)**
personal services	0.061	0.031	0.036	0.012
	(0.008)**	(0.005)**	(0.005)**	(0.003)**
sales workers	-0.017	-0.001	-0.010	-0.006
	(0.006)**	(0.004)	(0.004)*	(0.003)*
machine operatives	0.011	-0.000	-0.001	0.002
	(0.009)	(0.005)	(0.006)	(0.004)
elementary workers	-0.003	-0.001	-0.003	-0.002
	(0.006)	(0.003)	(0.004)	(0.003)
Sector Characteristics				
sector turnover rate	-0.242	-0.124	-0.134	-0.032
	(0.034)**	(0.022)**	(0.023)**	(0.015)*

Proportion young (sector)	0.036	0.001	0.020	0.022
	(0.017)*	(0.011)	(0.012)	(0.008)**
Workforce Human Capital				
Proportion training	0.020	0.011	0.009	0.006
	(0.002)**	(0.001)**	(0.001)**	(0.001)**
Proportion level 4+ qualifications	-0.040	-0.027	-0.013	-0.009
	(0.003)**	(0.002)**	(0.002)**	(0.001)**
Proportion level 3 qualifications	0.028	0.014	0.019	0.004
	(0.003)**	(0.002)**	(0.002)**	(0.001)**
Establishment Size (reference category: 2-4 workers)				
Establishment size 5-24	0.050	0.028	0.029	0.010
	(0.005)**	(0.004)**	(0.004)**	(0.002)**
Establishment size 25-99	0.112	0.069	0.077	0.022
	(0.011)**	(0.010)**	(0.010)**	(0.005)**
Establishment size 100-199	0.226	0.157	0.160	0.056
	(0.022)**	(0.023)**	(0.022)**	(0.012)**
Establishment size 200+	0.334	0.241	0.264	0.107
	(0.026)**	(0.029)**	(0.029)**	(0.019)**
Only establishment in firm	0.019	0.011	0.007	-0.000
	(0.004)**	(0.003)**	(0.003)*	(0.002)
Only estab*5-24 workers	-0.011	-0.007	-0.003	-0.001
	(0.004)**	(0.003)*	(0.003)	(0.002)
Only estab*25-99 workers	-0.008	-0.005	-0.004	0.001
	(0.004)	(0.003)	(0.003)	(0.003)
Only estab*100-199 workers	-0.009	-0.005	-0.004	-0.003
	(0.007)	(0.004)	(0.005)	(0.003)
Only estab*200+ workers	-0.010	-0.003	-0.003	-0.001
	(0.008)	(0.005)	(0.005)	(0.004)
Sector Type (reference category: private sector)				
charity / voluntary sector	-0.018	-0.010	-0.011	-0.004
	(0.002)**	(0.001)**	(0.001)**	(0.001)**
local government body	-0.021	-0.010	-0.012	-0.006
	(0.002)**	(0.001)**	(0.001)**	(0.001)**
central government body	-0.018	-0.007	-0.012	-0.003
	(0.004)**	(0.003)**	(0.002)**	(0.002)
Other firm type	-0.016	-0.015	-0.009	0.005
	(0.010)	(0.002)**	(0.006)	(0.008)
Observations	65316	65316	65316	65316

Standard errors in parentheses
* significant at 5%; ** significant at 1%
Equations also control for sector and region.

Table A4 – Whether Establishment Currently Has Apprenticeships: Private Sector Only

	Has apprentices	Has 16-18 year old apprentices	Has 19-24 year old apprentices	Has 25+ year old apprentices
Number of hard to fill vacancies, by occupation:				
Managers	0.010	-0.006	0.009	0.003
	(0.008)	(0.007)	(0.005)	(0.003)
Professional worker	-0.005	-0.003	-0.000	-0.011
	(0.005)	(0.004)	(0.001)	(0.007)
associate profs	0.003	0.001	0.001	0.000
	(0.003)	(0.002)	(0.002)	(0.001)
administrative staff	-0.012	-0.000	-0.006	-0.001
	(0.012)	(0.004)	(0.007)	(0.003)
skilled trade workers	0.008	0.006	0.003	-0.005
	(0.004)	(0.003)*	(0.003)	(0.004)
personal services	0.001	-0.001	-0.000	0.000
	(0.003)	(0.003)	(0.002)	(0.001)
sales workers	-0.033	-0.025	-0.011	-0.005
	(0.014)*	(0.014)	(0.007)	(0.006)
machine operatives	0.006	0.001	0.002	0.002
	(0.003)	(0.002)	(0.002)	(0.001)*
elementary workers	0.001	0.000	-0.000	0.000
	(0.004)	(0.002)	(0.003)	(0.001)
Skills gaps – proportion of staff not fully proficient, by occupation				
managers	-0.003	-0.003	-0.006	0.003
	(0.005)	(0.003)	(0.004)	(0.002)
professionals	0.023	0.006	0.016	0.005
	(0.011)*	(0.007)	(0.007)*	(0.004)
associate professionals	0.025	0.010	0.015	0.009
	(0.009)**	(0.006)	(0.006)*	(0.003)**
administrative staff	-0.001	-0.001	-0.002	0.002
	(0.005)	(0.003)	(0.004)	(0.002)
skilled trade workers	0.089	0.046	0.044	0.008
	(0.005)**	(0.003)**	(0.004)**	(0.002)**
personal services	0.069	0.037	0.038	0.010
	(0.010)**	(0.006)**	(0.007)**	(0.004)**
sales workers	-0.018	-0.001	-0.011	-0.005
	(0.007)**	(0.004)	(0.005)*	(0.003)
machine operatives	0.016	0.003	0.002	0.003
	(0.009)	(0.006)	(0.007)	(0.004)
elementary workers	0.004	0.001	0.002	-0.001
	(0.006)	(0.004)	(0.004)	(0.003)
Sector Characteristics				
sector turnover rate	-0.289	-0.154	-0.168	-0.036
	(0.038)**	(0.025)**	(0.027)**	(0.016)*
Proportion young (sector)	0.019	-0.015	0.021	0.021
	(0.020)	(0.013)	(0.014)	(0.009)*

Workforce Human Capital				
Proportion training	0.019	0.011	0.009	0.005
	(0.002)**	(0.001)**	(0.002)**	(0.001)**
Proportion level 4+ qualifications	-0.036	-0.024	-0.012	-0.007
	(0.004)**	(0.002)**	(0.002)**	(0.001)**
Proportion level 3 qualifications	0.028	0.014	0.019	0.004
	(0.003)**	(0.002)**	(0.002)**	(0.001)**
Business Strategy				
One-off product strategy	-0.002	-0.001	-0.002	-0.001
	(0.002)	(0.001)	(0.001)	(0.001)
strategy not price dependent	0.002	0.000	0.000	0.000
	(0.002)	(0.001)	(0.001)	(0.001)
leader in new products/services	0.003	0.003	0.001	0.001
	(0.002)	(0.001)*	(0.001)	(0.001)
premium quality strategy	0.004	0.003	0.004	-0.000
	(0.002)**	(0.001)*	(0.001)**	(0.001)
Market Type (reference category: local)				
Market: regional	-0.003	-0.002	-0.001	0.000
	(0.002)	(0.001)	(0.002)	(0.001)
Market: national	-0.014	-0.009	-0.006	-0.000
	(0.002)**	(0.001)**	(0.001)**	(0.001)
Market: international	-0.013	-0.008	-0.006	-0.001
	(0.002)**	(0.001)**	(0.001)**	(0.001)
Establishment Size (reference category 2-4 workers)				
Establishment size 5-24	0.056	0.030	0.029	0.011
	(0.006)**	(0.005)**	(0.005)**	(0.003)**
Establishment size 25-99	0.140	0.090	0.088	0.029
	(0.015)**	(0.014)**	(0.013)**	(0.007)**
Establishment size 100-199	0.272	0.187	0.180	0.076
	(0.028)**	(0.029)**	(0.027)**	(0.019)**
Establishment size 200+	0.372	0.258	0.277	0.147
	(0.032)**	(0.035)**	(0.034)**	(0.030)**
Only establishment in firm	0.023	0.012	0.008	0.002
	(0.005)**	(0.003)**	(0.004)*	(0.002)
Only estab*5-24 workers	-0.015	-0.008	-0.004	-0.002
	(0.005)**	(0.003)**	(0.004)	(0.002)
Only estab*25-99 workers	-0.013	-0.007	-0.005	-0.002
	(0.005)**	(0.003)*	(0.004)	(0.002)
Only estab*100-199 workers	-0.016	-0.009	-0.006	-0.005
	(0.006)**	(0.003)**	(0.005)	(0.002)**
Only estab*200+ workers	-0.009	-0.001	-0.001	-0.001
	(0.009)	(0.007)	(0.007)	(0.003)
Observations	51236	51236	51236	51236

Standard errors in parentheses
* significant at 5%; ** significant at 1%
Equations also control for sector and region.

Table A5 – Whether Establishment is Likely to Offer Apprenticeships in the Next Year: All Establishments

	Likely to have an apprentice in next year	Likely to have a 16-18 y.o. apprentice in next year	Likely to have a 19-24 y.o. apprentice in next year	Likely to have a 25+ y.o. apprentice in next year
Current engagement with apprenticeships				
Has apprentices	0.363			
	(0.009)**			
Has apprentices aged 16-18		0.362		
		(0.012)**		
Has apprentices aged 19-24			0.317	
			(0.012)**	
Has apprentices aged 25+				0.432
				(0.018)**
Number of hard to fill vacancies, by occupation:				
Managers	0.021	0.018	0.018	0.017
	(0.018)	(0.012)	(0.014)	(0.013)
Professional worker	-0.002	-0.001	-0.002	-0.001
	(0.003)	(0.001)	(0.002)	(0.001)
associate profs	0.013	0.011	0.012	0.009
	(0.006)*	(0.004)*	(0.005)*	(0.004)*
administrative staff	0.039	0.022	0.024	0.019
	(0.011)**	(0.008)**	(0.009)**	(0.008)*
skilled trade workers	0.034	0.002	0.020	0.001
	(0.009)**	(0.003)	(0.008)**	(0.004)
personal services	0.033	0.009	0.022	0.025
	(0.008)**	(0.006)	(0.006)**	(0.006)**
sales workers	0.029	0.028	0.018	0.022
	(0.012)*	(0.008)**	(0.010)	(0.009)*
machine operatives	-0.015	-0.000	-0.008	-0.001
	(0.011)	(0.007)	(0.009)	(0.008)
elementary workers	0.023	0.017	0.017	0.011
	(0.010)*	(0.007)*	(0.008)*	(0.007)
Skills gaps – proportion of staff not fully proficient, by occupation				
managers	0.060	0.040	0.044	0.047
	(0.011)**	(0.008)**	(0.009)**	(0.009)**
professionals	0.054	0.031	0.040	-0.007
	(0.025)*	(0.018)	(0.021)	(0.020)
associate professionals	0.064	0.018	0.033	0.017
	(0.021)**	(0.016)	(0.017)	(0.016)
administrative staff	0.087	0.041	0.064	0.046
	(0.011)**	(0.008)**	(0.009)**	(0.009)**
skilled trade workers	0.169	0.101	0.106	0.040
	(0.015)**	(0.011)**	(0.013)**	(0.012)**

personal services	0.165	0.108	0.121	0.074
	(0.023)**	(0.017)**	(0.019)**	(0.017)**
sales workers	0.010	-0.010	0.020	0.004
	(0.014)	(0.011)	(0.012)	(0.011)
machine operatives	0.028	-0.003	0.021	0.017
	(0.025)	(0.018)	(0.021)	(0.019)
elementary workers	0.074	0.033	0.045	0.033
	(0.014)**	(0.010)**	(0.012)**	(0.011)**
Sector Characteristics				
sector turnover rate	0.286	-0.070	0.365	0.490
	(0.075)**	(0.059)	(0.064)**	(0.058)**
Proportion young (sector)	-0.064	0.073	-0.075	-0.114
	(0.040)	(0.031)*	(0.035)*	(0.032)**
Workforce Human Capital				
Proportion training	0.069	0.038	0.057	0.047
	(0.004)**	(0.003)**	(0.004)**	(0.003)**
Proportion level 4+ qualifications	0.013	-0.018	0.022	0.015
	(0.006)*	(0.005)**	(0.005)**	(0.005)**
Proportion level 3 qualifications	0.072	0.060	0.050	0.029
	(0.006)**	(0.005)**	(0.005)**	(0.005)**
Establishment Size (reference category: 2-4 workers)				
Establishment size 5-24	0.029	0.023	0.032	0.012
	(0.007)**	(0.006)**	(0.006)**	(0.006)*
Establishment size 25-99	0.088	0.074	0.089	0.037
	(0.009)**	(0.008)**	(0.008)**	(0.007)**
Establishment size 100-199	0.111	0.113	0.129	0.047
	(0.016)**	(0.015)**	(0.015)**	(0.012)**
Establishment size 200+	0.234	0.224	0.247	0.129
	(0.018)**	(0.018)**	(0.018)**	(0.016)**
Only establishment in firm	0.038	0.031	0.027	0.026
	(0.007)**	(0.006)**	(0.006)**	(0.006)**
Only estab*5-24 workers	-0.011	-0.007	-0.014	-0.017
	(0.009)	(0.007)	(0.007)*	(0.006)*
Only estab*25-99 workers	-0.032	-0.020	-0.028	-0.027
	(0.010)**	(0.007)**	(0.008)**	(0.007)**
Only estab*100-199 workers	-0.020	-0.023	-0.024	-0.009
	(0.024)	(0.015)	(0.018)	(0.018)
Only estab*200+ workers	-0.073	-0.039	-0.062	-0.055
	(0.024)**	(0.015)*	(0.016)**	(0.015)**
Sector Type (reference category: private sector)				
charity / voluntary sector	-0.051	-0.025	-0.042	-0.024
	(0.006)**	(0.005)**	(0.005)**	(0.005)**
local government body	-0.086	-0.033	-0.066	-0.051
	(0.007)**	(0.005)**	(0.005)**	(0.005)**

central government body	-0.080	-0.035	-0.068	-0.039
	(0.011)**	(0.009)**	(0.008)**	(0.008)**
Other firm type	-0.011	-0.029	0.015	0.002
	(0.033)	(0.022)	(0.030)	(0.027)
Observations	65316	65316	65316	65316

Standard errors in parentheses
* significant at 5%; ** significant at 1%
Equations also control for sector and region.

Table A6 – Whether Establishment is Likely to Offer Apprenticeships in the Next Year: Private Sector Only

	Likely to have an apprentice in next year	Likely to have a 16-18 y.o. apprentice in next year	Likely to have a 19-24 y.o. apprentice in next year	Likely to have a 25+ y.o. apprentice in next year
Current engagement with apprenticeships				
Has apprentices	0.349			
	(0.010)**			
Has apprentices aged 16-18		0.342		
		(0.013)**		
Has apprentices aged 19-24			0.302	
			(0.013)**	
Has apprentices aged 25+				0.407
				(0.020)**
Number of hard to fill vacancies, by occupation:				
Managers	0.020	0.029	0.017	0.014
	(0.023)	(0.016)	(0.019)	(0.017)
Professional worker	-0.008	-0.007	-0.007	-0.001
	(0.013)	(0.010)	(0.010)	(0.002)
associate profs	0.015	0.011	0.011	0.006
	(0.008)	(0.006)*	(0.006)	(0.005)
administrative staff	0.037	0.025	0.022	0.019
	(0.012)**	(0.008)**	(0.010)*	(0.009)*
skilled trade workers	0.039	0.029	0.021	0.018
	(0.011)**	(0.008)**	(0.009)*	(0.008)*
personal services	0.036	0.008	0.031	0.026
	(0.011)**	(0.007)	(0.008)**	(0.007)**
sales workers	0.029	0.023	0.020	0.019
	(0.013)*	(0.009)*	(0.010)	(0.009)*
machine operatives	-0.015	-0.008	-0.008	-0.005
	(0.011)	(0.008)	(0.009)	(0.008)
elementary workers	0.020	0.017	0.016	0.008
	(0.011)	(0.007)*	(0.008)	(0.008)
Skills gaps – proportion of staff not fully proficient, by occupation				
managers	0.066	0.039	0.047	0.047
	(0.013)**	(0.009)**	(0.011)**	(0.010)**
professionals	0.050	0.033	0.027	-0.008
	(0.030)	(0.022)	(0.024)	(0.023)
associate professionals	0.073	0.015	0.032	0.020
	(0.024)**	(0.018)	(0.020)	(0.018)
administrative staff	0.088	0.036	0.068	0.045
	(0.013)**	(0.010)**	(0.011)**	(0.010)**
skilled trade workers	0.175	0.102	0.110	0.035
	(0.017)**	(0.012)**	(0.014)**	(0.013)**

personal services	0.178	0.127	0.120	0.070
	(0.031)**	(0.022)**	(0.025)**	(0.023)**
sales workers	0.002	-0.018	0.017	-0.001
	(0.016)	(0.012)	(0.013)	(0.012)
machine operatives	0.037	0.009	0.022	0.020
	(0.027)	(0.020)	(0.022)	(0.021)
elementary workers	0.080	0.043	0.057	0.034
	(0.016)**	(0.012)**	(0.013)**	(0.012)**
Sector Characteristics				
sector turnover rate	0.174	-0.148	0.297	0.462
	(0.086)*	(0.067)*	(0.072)**	(0.065)**
Proportion young (sector)	-0.050	0.076	-0.040	-0.088
	(0.046)	(0.035)*	(0.040)	(0.036)*
Workforce Human Capital				
Proportion training	0.063	0.034	0.051	0.043
	(0.005)**	(0.004)**	(0.004)**	(0.004)**
Proportion level 4+ qualifications	0.010	-0.023	0.019	0.011
	(0.007)	(0.006)**	(0.006)**	(0.005)*
Proportion level 3 qualifications	0.072	0.058	0.047	0.024
	(0.007)**	(0.005)**	(0.006)**	(0.005)**
Business Strategy				
One-off product strategy	-0.017	-0.017	-0.014	-0.013
	(0.005)**	(0.003)**	(0.004)**	(0.004)**
strategy not price dependent	0.015	0.008	0.008	0.010
	(0.004)**	(0.003)**	(0.003)*	(0.003)**
leader in new products/services	0.035	0.024	0.027	0.031
	(0.004)**	(0.003)**	(0.003)**	(0.003)**
premium quality strategy	0.021	0.015	0.014	0.005
	(0.004)**	(0.003)**	(0.004)**	(0.003)
Market Type (reference category: local)				
Market: regional	0.014	0.006	0.015	0.009
	(0.006)*	(0.004)	(0.005)**	(0.005)*
Market: national	-0.007	-0.014	0.004	0.005
	(0.005)	(0.004)**	(0.004)	(0.004)
Market: international	-0.017	-0.016	-0.001	-0.002
	(0.006)**	(0.004)**	(0.005)	(0.005)
Establishment Size (reference category 2-4 workers)				
Establishment size 5-24	0.026	0.021	0.027	0.006
	(0.009)**	(0.007)**	(0.008)**	(0.007)
Establishment size 25-99	0.097	0.095	0.091	0.034
	(0.011)**	(0.010)**	(0.010)**	(0.008)**
Establishment size 100-199	0.132	0.146	0.143	0.053
	(0.019)**	(0.019)**	(0.018)**	(0.015)**

Establishment size 200+	0.189	0.174	0.208	0.101
	(0.022)**	(0.021)**	(0.021)**	(0.018)**
Only establishment in firm	0.050	0.039	0.034	0.033
	(0.008)**	(0.006)**	(0.007)**	(0.006)**
Only estab*5-24 workers	-0.011	-0.007	-0.012	-0.014
	(0.010)	(0.008)	(0.008)	(0.007)
Only estab*25-99 workers	-0.044	-0.033	-0.036	-0.033
	(0.011)**	(0.008)**	(0.009)**	(0.008)**
Only estab*100-199 workers	-0.056	-0.046	-0.053	-0.021
	(0.024)*	(0.015)**	(0.018)**	(0.020)
Only estab*200+ workers	-0.043	-0.012	-0.047	-0.052
	(0.032)	(0.024)	(0.022)*	(0.018)**
Observations	51236	51236	51236	51236

Standard errors in parentheses
* significant at 5%; ** significant at 1%
Equations also control for sector and region.

Table A7 – Whether Establishment Offers Apprenticeships: SMEs Only

	Offer apprenticeships	Offer only or mainly to existing workers	Offer only or mainly to new recruits	offer to 16-18 year olds	offer to 19-24 year olds	offer to 25+ year olds
Number of hard to fill vacancies, by occupation:						
Managers	-0.024		0.010	-0.016	-0.008	-0.048
	(0.033)		(0.015)	(0.028)	(0.026)	(0.037)
Professional worker	0.014	0.002	0.011	-0.003	0.015	0.013
	(0.018)	(0.007)	(0.010)	(0.018)	(0.014)	(0.012)
associate profs	-0.001		0.000	-0.001	-0.001	-0.000
	(0.005)		(0.002)	(0.003)	(0.004)	(0.003)
administrative staff	0.042		0.025	0.037	0.035	0.026
	(0.017)*		(0.009)**	(0.014)**	(0.014)*	(0.012)*
skilled trade workers	0.051	-0.004	0.023	0.036	0.044	0.028
	(0.010)**	(0.006)	(0.005)**	(0.008)**	(0.008)**	(0.007)**
personal services	0.027	0.004	0.010	0.026	0.020	0.014
	(0.009)**	(0.003)	(0.006)	(0.008)**	(0.007)**	(0.006)*
sales workers	0.011	0.002	-0.008	0.014	0.004	0.008
	(0.015)	(0.004)	(0.019)	(0.011)	(0.015)	(0.011)
machine operatives	-0.044		-0.017	-0.057	-0.033	-0.023
	(0.026)		(0.016)	(0.032)	(0.023)	(0.020)
elementary workers	0.019	0.002	0.009	0.013	0.023	0.013
	(0.015)	(0.005)	(0.011)	(0.013)	(0.012)	(0.011)
Skills gaps – proportion of staff not fully proficient, by occupation						
managers	0.006	-0.002	0.006	0.006	0.003	0.013
	(0.010)	(0.004)	(0.006)	(0.009)	(0.009)	(0.007)

professionals	0.048	0.001	0.010	0.038	0.040	0.017
	(0.024)*	(0.011)	(0.016)	(0.020)	(0.020)*	(0.018)
associate professionals	0.033	-0.001	0.015	0.023	0.016	0.025
	(0.019)	(0.009)	(0.011)	(0.016)	(0.016)	(0.013)
administrative staff	-0.001	-0.002	-0.003	0.005	0.005	0.008
	(0.010)	(0.004)	(0.006)	(0.008)	(0.009)	(0.007)
skilled trade workers	0.162	0.014	0.070	0.114	0.120	0.066
	(0.010)**	(0.003)**	(0.006)**	(0.008)**	(0.008)**	(0.007)**
personal services	0.134	0.017	0.038	0.103	0.094	0.062
	(0.021)**	(0.007)*	(0.014)**	(0.017)**	(0.018)**	(0.015)**
sales workers	-0.017	-0.003	-0.007	-0.006	-0.015	-0.007
	(0.016)	(0.006)	(0.010)	(0.013)	(0.014)	(0.012)
machine operatives	0.035	-0.005	0.020	0.011	0.019	0.012
	(0.020)	(0.010)	(0.012)	(0.017)	(0.018)	(0.016)
elementary workers	0.021	0.002	0.003	0.016	0.016	-0.005
	(0.013)	(0.005)	(0.008)	(0.011)	(0.011)	(0.010)
Sector Characteristics						
sector turnover rate	-0.358	-0.084	-0.180	-0.283	-0.239	-0.045
	(0.071)**	(0.029)**	(0.045)**	(0.061)**	(0.061)**	(0.052)
Proportion young (sector)	0.189	0.055	0.060	0.153	0.123	0.071
	(0.037)**	(0.014)**	(0.023)*	(0.031)**	(0.032)**	(0.028)*
Workforce Human Capital						
Proportion training	0.054	0.005	0.022	0.041	0.044	0.033
	(0.004)**	(0.001)**	(0.002)**	(0.003)**	(0.003)**	(0.003)**
Proportion level 4+ qualifications	-0.037	-0.007	-0.016	-0.037	-0.026	-0.014
	(0.005)**	(0.002)**	(0.003)**	(0.005)**	(0.005)**	(0.004)**

Proportion level 3 qualifications	0.044	0.002	0.020	0.032	0.035	0.023
	(0.005)**	(0.002)	(0.003)**	(0.004)**	(0.004)**	(0.004)**
Sector Type (reference category: private sector)						
charity / voluntary sector	-0.036	-0.005	-0.009	-0.026	-0.027	-0.022
	(0.005)**	(0.002)**	(0.004)*	(0.004)**	(0.004)**	(0.003)**
Other firm type	-0.013		-0.021	-0.021	-0.022	-0.005
	(0.029)		(0.011)	(0.021)	(0.021)	(0.022)
Observations	32141	31584	32012	32070	32046	32018

Standard errors in parentheses
* significant at 5%; ** significant at 1%
Equations also control for sector and region.

Table A8 – Whether Establishment Offers Apprenticeships: Non-Traditional Sectors Only

	Offer apprenticeships	Offer only or mainly to existing workers	Offer only or mainly to new recruits	offer to 16-18 year olds	offer to 19-24 year olds	offer to 25+ year olds
Number of hard to fill vacancies, by occupation:						
Managers	0.005	0.001	0.002	0.008	0.006	0.005
	(0.011)	(0.004)	(0.006)	(0.008)	(0.009)	(0.008)
Professional worker	-0.004	-0.001	-0.001	-0.004	-0.002	-0.010
	(0.005)	(0.004)	(0.003)	(0.005)	(0.005)	(0.007)
associate profs	-0.001	-0.002	0.000	0.000	-0.001	0.000
	(0.003)	(0.003)	(0.001)	(0.002)	(0.003)	(0.002)
administrative staff	0.003	-0.001	0.002	0.002	0.002	0.002
	(0.008)	(0.005)	(0.004)	(0.007)	(0.007)	(0.006)
skilled trade workers	0.023	-0.003	0.010	0.001	0.017	-0.000
	(0.006)**	(0.004)	(0.003)**	(0.002)	(0.005)**	(0.002)
personal services	0.005	0.002	-0.001	0.005	0.003	0.004
	(0.004)	(0.001)	(0.003)	(0.003)	(0.004)	(0.003)
sales workers	-0.004	-0.001	-0.001	0.001	-0.007	-0.002
	(0.010)	(0.004)	(0.006)	(0.008)	(0.011)	(0.008)
machine operatives	0.002		0.003	-0.003	0.000	-0.010
	(0.007)		(0.003)	(0.007)	(0.006)	(0.012)
elementary workers	0.001	0.001	0.001	-0.001	-0.000	-0.001
	(0.006)	(0.002)	(0.004)	(0.005)	(0.005)	(0.005)
Skills gaps – proportion of staff not fully proficient, by occupation						
managers	0.012	0.002	0.001	0.008	0.005	0.009
	(0.008)	(0.003)	(0.004)	(0.006)	(0.007)	(0.006)

professionals	0.028	0.005	0.012	0.024	0.029	0.023
	(0.016)	(0.006)	(0.008)	(0.013)	(0.014)*	(0.012)
associate professionals	0.018	-0.003	0.011	0.011	0.008	0.013
	(0.014)	(0.006)	(0.007)	(0.012)	(0.013)	(0.011)
administrative staff	0.007	-0.001	0.001	0.013	0.008	0.010
	(0.008)	(0.003)	(0.004)	(0.007)	(0.007)	(0.006)
skilled trade workers	0.142	0.014	0.055	0.102	0.103	0.058
	(0.010)**	(0.004)**	(0.005)**	(0.008)**	(0.009)**	(0.008)**
personal services	0.107	0.008	0.031	0.073	0.084	0.058
	(0.013)**	(0.005)	(0.007)**	(0.011)**	(0.011)**	(0.010)**
sales workers	-0.028	-0.003	-0.012	-0.012	-0.024	-0.015
	(0.010)**	(0.004)	(0.006)*	(0.008)	(0.009)**	(0.008)
machine operatives	0.011	-0.009	0.012	-0.012	-0.001	0.004
	(0.019)	(0.009)	(0.009)	(0.016)	(0.017)	(0.015)
elementary workers	0.002	0.001	-0.001	-0.006	0.000	-0.002
	(0.010)	(0.003)	(0.006)	(0.008)	(0.009)	(0.008)
Sector Characteristics						
sector turnover rate	-0.262	-0.058	-0.153	-0.264	-0.204	-0.003
	(0.054)**	(0.022)**	(0.030)**	(0.046)**	(0.048)**	(0.042)
Proportion young (sector)	0.068	0.044	-0.010	0.068	0.061	0.037
	(0.027)*	(0.011)**	(0.015)	(0.023)**	(0.024)*	(0.022)
Workforce Human Capital						
Proportion training	0.034	0.002	0.011	0.025	0.028	0.024
	(0.003)**	(0.001)	(0.002)**	(0.003)**	(0.003)**	(0.002)**
Proportion level 4+ qualifications	-0.048	-0.011	-0.013	-0.044	-0.028	-0.020
	(0.004)**	(0.002)**	(0.003)**	(0.004)**	(0.004)**	(0.004)**

Proportion level 3 qualifications	0.041	0.002	0.014	0.033	0.036	0.024
	(0.004)**	(0.002)	(0.002)**	(0.004)**	(0.004)**	(0.003)**
Establishment Size (reference category: 2-4 workers)						
Establishment size 5-24	0.055	0.010	0.021	0.042	0.050	0.033
	(0.006)**	(0.002)**	(0.004)**	(0.005)**	(0.005)**	(0.005)**
Establishment size 25-99	0.116	0.022	0.044	0.083	0.104	0.068
	(0.009)**	(0.005)**	(0.007)**	(0.008)**	(0.009)**	(0.007)**
Establishment size 100-199	0.199	0.034	0.074	0.162	0.175	0.112
	(0.019)**	(0.010)**	(0.014)**	(0.018)**	(0.018)**	(0.015)**
Establishment size 200+	0.333	0.080	0.114	0.269	0.303	0.229
	(0.022)**	(0.016)**	(0.018)**	(0.022)**	(0.023)**	(0.021)**
Only establishment in firm	0.005	0.002	0.007	0.006	0.003	-0.001
	(0.006)	(0.002)	(0.003)*	(0.005)	(0.005)	(0.005)
Only estab*5-24 workers	-0.002	-0.003	0.001	-0.001	-0.003	0.000
	(0.007)	(0.002)	(0.004)	(0.006)	(0.006)	(0.005)
Only estab*25-99 workers	0.001	-0.004	0.000	0.005	-0.003	0.003
	(0.008)	(0.002)	(0.004)	(0.007)	(0.007)	(0.006)
Only estab*100-199 workers	-0.012	0.001	-0.004	-0.014	-0.009	-0.010
	(0.015)	(0.006)	(0.008)	(0.011)	(0.013)	(0.011)
Only estab*200+ workers	-0.025	-0.003	-0.008	-0.011	-0.022	-0.017
	(0.013)	(0.005)	(0.007)	(0.012)	(0.011)	(0.010)
Sector Type (reference category: private sector)						
charity / voluntary sector	-0.039	-0.005	-0.010	-0.028	-0.032	-0.025
	(0.003)**	(0.001)**	(0.002)**	(0.003)**	(0.003)**	(0.002)**
local government body	-0.047	-0.007	-0.009	-0.033	-0.038	-0.033
	(0.003)**	(0.001)**	(0.002)**	(0.003)**	(0.003)**	(0.002)**

central government body	-0.041	-0.005	-0.010	-0.022	-0.035	-0.024
	(0.005)**	(0.002)*	(0.003)**	(0.005)**	(0.004)**	(0.004)**
Other firm type	-0.016	-0.008	-0.013	-0.020	-0.018	0.002
	(0.018)	(0.004)	(0.007)	(0.013)	(0.015)	(0.017)
Observations	53851	53487	53691	53725	53718	53656

Standard errors in parentheses
* significant at 5%; ** significant at 1%
Equations also control for sector and region.

Table A9 – Whether Establishment took any 16-24-year-old Apprentices in the last 12 months - NESS 07 matched to ABI 2007

	(1) Probit	(2) Probit, Quintile specification	(3) Probit Decile specification	(4) Polynomial specification
Business variables from ABI				
Gross Value Added per head	2.27e-05			4.16e-05
	[2.34e-05]			[4.31e-05]
Gross Value Added per head squared				-5.26e-09
				[8.51e-09]
Capital expenditure per head	8.73e-07	-3.84e-06	-4.85e-06	2.27e-07
	[5.98e-06]	[1.19e-05]	[1.22e-05]	[6.38e-06]
Labour cost per head	6.19e-05	0.000119	9.86e-05	9.07e-05
	[7.57e-05]	[4.10e-05]**	[4.16e-05]*	[8.33e-05]
GVA per head quintile 2		-0.00439		
		[0.0126]		
GVA per head quintile 3		-0.0274		
		[0.0115]*		
GVA per head quintile 4		-0.00880		
		[0.0112]		
GVA per head quintile 5		-0.00908		
		[0.0111]		
GVA per head decile 2			-0.0205	
			[0.0146]	
GVA per head decile 3			-0.0293	
			[0.0124]*	
GVA per head decile 4			0.00157	
			[0.0165]	
GVA per head decile 5			-0.0312	
			[0.0126]*	
GVA per head decile 6			-0.0366	
			[0.0123]**	
GVA per head decile 7			-0.00980	
			[0.0148]	
GVA per head decile 8			-0.0245	
			[0.0110]*	
GVA per head decile 9			-0.0278	
			[0.0112]*	
GVA per head decile 10			-0.00871	
			[0.0135]	
Number of skills-shortage hard-to-fill vacancies, by occupation:				
Managers	0.0101	0.00971	0.00935	0.00987
	[0.0122]	[0.0122]	[0.0121]	[0.0122]
Professional worker	-0.000938	-0.00129	-0.00129	-0.000952
	[0.00411]	[0.00407]	[0.00412]	[0.00411]

associate profs	-0.00493	-0.00544	-0.00624	-0.00498
	[0.00846]	[0.00851]	[0.00868]	[0.00846]
administrative staff	-0.0133	-0.0136	-0.0121	-0.0132
	[0.0132]	[0.0133]	[0.0126]	[0.0132]
skilled trade workers	-0.000275	-0.000368	-0.000662	-0.000296
	[0.00314]	[0.00314]	[0.00315]	[0.00314]
personal services	0.0134	0.0126	0.0141	0.0136
	[0.0146]	[0.0143]	[0.0140]	[0.0146]
sales workers	-0.00615	-0.00514	-0.00472	-0.00615
	[0.00530]	[0.00506]	[0.00497]	[0.00529]
machine operatives	0.00812	0.00842	0.00804	0.00821
	[0.00824]	[0.00806]	[0.00781]	[0.00825]
elementary workers	0.00868	0.00791	0.00733	0.00875
	[0.00732]	[0.00718]	[0.00703]	[0.00732]
Skills gaps – proportion of staff not fully proficient, by occupation				
Managers	-0.0211	-0.0200	-0.0191	-0.0213
	[0.0229]	[0.0230]	[0.0227]	[0.0228]
Professional worker	-0.0363	-0.0370	-0.0380	-0.0362
	[0.0460]	[0.0462]	[0.0461]	[0.0460]
associate profs	0.00804	0.00571	0.00944	0.00776
	[0.0451]	[0.0448]	[0.0449]	[0.0452]
administrative staff	-0.0119	-0.0104	-0.0112	-0.0120
	[0.0231]	[0.0229]	[0.0229]	[0.0231]
skilled trade workers	0.140	0.139	0.140	0.140
	[0.0272]**	[0.0271]**	[0.0272]**	[0.0272]**
personal services	0.0865	0.0838	0.0818	0.0868
	[0.0401]*	[0.0396]*	[0.0394]*	[0.0401]*
sales workers	-0.0193	-0.0212	-0.0221	-0.0192
	[0.0259]	[0.0254]	[0.0251]	[0.0259]
machine operatives	0.0194	0.0181	0.0173	0.0195
	[0.0353]	[0.0350]	[0.0351]	[0.0353]
elementary workers	-0.0277	-0.0281	-0.0275	-0.0274
	[0.0247]	[0.0246]	[0.0244]	[0.0247]
Workforce characteristics				
Proportion of staff trained in the last 12 months	0.0153	0.0150	0.0140	0.0152
	[0.00714]*	[0.00706]*	[0.00695]*	[0.00714]*
Whether recruited any 16-year-olds straight from school in the past 12 months	0.0680	0.0670	0.0684	0.0681
	[0.0125]**	[0.0124]**	[0.0119]**	[0.0125]**
Whether recruited any 17-to-18-year-olds straight from school/college in the past 12 months	0.0700	0.0695	0.0691	0.0702
	[0.00960]**	[0.00935]**	[0.00921]**	[0.00958]**

Whether recruited anyone straight from higher education in the past 12 months	-0.000822	-0.000367	-0.00108	-0.000832
	[0.00692]	[0.00690]	[0.00682]	[0.00692]
Establishment Size (reference category: 2-4 workers)				
Establishment size 5-9	0.0979	0.0963	0.0966	0.0979
	[0.0279]**	[0.0278]**	[0.0279]**	[0.0279]**
Establishment size 10-24	0.0921	0.0911	0.0907	0.0922
	[0.0238]**	[0.0239]**	[0.0240]**	[0.0237]**
Establishment size 25-49	0.0671	0.0680	0.0695	0.0673
	[0.0233]**	[0.0236]**	[0.0240]**	[0.0233]**
Establishment size 50-99	0.116	0.115	0.118	0.116
	[0.0301]**	[0.0303]**	[0.0306]**	[0.0300]**
Establishment size 100-199	0.206	0.209	0.208	0.205
	[0.0396]**	[0.0403]**	[0.0407]**	[0.0397]**
Establishment size 200-250	0.174	0.175	0.173	0.173
	[0.0499]**	[0.0506]**	[0.0506]**	[0.0499]**
Establishment size 251-499	0.346	0.350	0.350	0.345
	[0.0568]**	[0.0577]**	[0.0581]**	[0.0569]**
Establishment size 500+	0.306	0.303	0.298	0.306
	[0.0640]**	[0.0638]**	[0.0641]**	[0.0640]**
Only establishment in firm	0.00841	0.00793	0.00608	0.00862
	[0.00876]	[0.00869]	[0.00848]	[0.00877]
Sector Type (reference category: private sector)				
charity / voluntary sector	0.00903	0.00640	0.00268	0.00939
	[0.0147]	[0.0148]	[0.0143]	[0.0147]
local government body	-0.0123	-0.0166	-0.0195	-0.0116
	[0.0182]	[0.0172]	[0.0161]	[0.0184]
central government body	-0.0295	-0.0333	-0.0363	-0.0290
	[0.0200]	[0.0182]	[0.0166]*	[0.0202]
Other firm type	-0.0272	-0.0275	-0.0286	-0.0272
	[0.0173]	[0.0172]	[0.0164]	[0.0173]
Observations	8631	8631	8631	8631

Note: each of the regressions in the above table also controlled for SSC and region.

Robust standard errors in brackets

** p<0.01, *p<0.05

Table A10 – Whether Establishment took any 16-24-year-old Apprentices in the last 12 months - NESS 07 matched to ABI 2007 and ABI 2006

	(1) Probit	(2) GVA per head instrumented by its lagged value	
	Controlling for lagged GVA per head	First stage	Second stage
Business variables from ABI			
Gross Value Added per head	1.29e-05		
	[3.01e-05]		
Lagged Gross Value Added per head (in 2006)	5.61e-06	0.380	
	[2.67e-05]	[0.230]	
Fitted GVA per head			-4.83e-06
			[0.000112]
Capital expenditure per head	1.18e-06	0.00458	2.43e-06
	[4.52e-06]	[0.00279]	[2.44e-06]
Labour cost per head	-4.64e-05	2.572	0.000120
	[0.000264]	[0.905]**	[0.000504]
Number of skills-shortage hard-to-fill vacancies, by occupation:			
Managers	0.0149	-2.549	0.0213
	[0.0124]	[9.575]	[0.0243]
Professional worker	0.00639	-2.745	0.0192
	[0.00564]	[1.922]	[0.0155]
associate profs	-0.00163	-1.605	-0.00915
	[0.00404]	[1.245]	[0.00628]
administrative staff	-0.0196	-1.027	-0.0138
	[0.0173]	[3.044]	[0.0254]
skilled trade workers	0.00350	0.703	0.0154
	[0.00450]	[0.621]	[0.0116]
personal services	0.0133	2.347	0.0235
	[0.0175]	[1.799]	[0.0356]
sales workers	-0.00417	0.307	-0.00703
	[0.00559]	[0.457]	[0.00414]
machine operatives	0.00998	0.562	0.0228
	[0.0103]	[1.818]	[0.0272]
elementary workers	0.00441	-0.614	0.00848
	[0.0100]	[0.998]	[0.0175]
Other/Unspecified occupation		-7.743	-0.0572
		[15.82]	[0.0209]**
Skills gaps – proportion of staff not fully proficient, by occupation			
Managers	-0.0215	4.257	-0.0270
	[0.0281]	[4.224]	[0.0299]

Professional worker	0.0295	1.504	0.00171
	[0.0491]	[5.732]	[0.0752]
associate profs	-0.207	-3.826	-0.163
	[0.0706]**	[13.99]	[0.0503]**
administrative staff	-0.0229	-4.412	-0.0323
	[0.0279]	[3.983]	[0.0324]
skilled trade workers	0.129	-11.81	0.252
	[0.0355]**	[4.853]*	[0.0805]**
personal services	0.0668	9.937	0.115
	[0.0475]	[7.223]	[0.0857]
sales workers	-0.0331	-0.258	-0.0362
	[0.0282]	[3.436]	[0.0268]
machine operatives	0.0277	0.0595	0.0366
	[0.0406]	[7.431]	[0.0740]
elementary workers	-0.0203	4.768	-0.0290
	[0.0280]	[3.402]	[0.0343]
Workforce characteristics			
Proportion of staff trained in the last 12 months	0.0113	1.244	0.0136
	[0.00831]	[2.193]	[0.00904]
Whether recruited any 16-year-olds straight from school in the past 12 months	0.0663	0.397	0.0775
	[0.0142]**	[1.479]	[0.0166]**
Whether recruited any 17-to-18-year-olds straight from school/college in the past 12 months	0.0646	6.682	0.0763
	[0.0103]**	[4.780]	[0.0117]**
Whether recruited anyone straight from higher education in the past 12 months	0.00397	3.452	-0.00413
	0.0663	0.397	0.0775
Establishment Size (reference category: 2-4 workers)			
Establishment size 5-9	0.122	1.638	0.0509
	[0.0389]**	[3.401]	[0.0130]**
Establishment size 10-24	0.0987	-1.639	0.0367
	[0.0310]**	[3.592]	[0.0111]**
Establishment size 25-49	0.0721	0.242	0.0124
	[0.0302]*	[3.757]	[0.0129]
Establishment size 50-99	0.125	-2.794	0.0461
	[0.0397]**	[4.814]	[0.0160]**
Establishment size 100-199	0.217	-6.791	0.110
	[0.0520]**	[7.629]	[0.0204]**
Establishment size 200-250	0.185	-6.029	0.0812
	[0.0611]**	[7.945]	[0.0311]**
Establishment size 251-499	0.367	-9.558	0.216
	[0.0710]**	[8.151]	[0.0364]**

Establishment size 500+	0.328	-11.58	0.196
	[0.0772]**	[7.669]	[0.0433]**
Only establishment in firm	0.0376	11.91	0.0521
	[0.0149]*	[10.06]	[0.0187]**
Sector Type (reference category: private sector)			
charity / voluntary sector	0.0142	-4.534	0.0126
	[0.0176]	[4.652]	[0.0184]
local government body	-0.0190	0.674	-0.0249
	[0.0190]	[8.706]	[0.0327]
central government body	-0.0402	-28.39	-0.0770
	[0.0173]*	[10.86]**	[0.0377]*
Other firm type	-0.0306	-12.21	-0.0372
	[0.0199]	[5.123]*	[0.0313]
Observations	6494	6503	6503

Note: each of the regressions in the above table also controlled for SSC and region.
Robust standard errors in brackets
** p<0.01, *p<0.05

Table A11 – GVA per head - basic OLS regressions

	(1) GVA per head in 2007, NESS07 +ABI07	(2) GVA per head in 2007, NESS07 +ABI07	(3) GVA per head in 2008, NESS07 +ABI08	(4) GVA per head in 2008, NESS07 +ABI08
Apprenticeship engagement				
Whether took any 16-24 apprentices	2.393		3.271	
	[2.575]		[4.115]	
Number of 16-24 apprentices taken		0.0606		0.218
		[0.202]		[0.315]
Unknown Number of 16-24 apprentices taken		-3.659		-11.54
		[3.385]		[5.218]*
Firm type (reference category: private)				
charity / voluntary sector	-13.38	-13.42	-20.00	-20.14
	[3.787]**	[3.784]**	[3.882]**	[3.908]**
local government body	-10.22	-10.16	-23.18	-22.86
	[6.024]	[6.054]	[4.580]**	[4.515]**
central government body	-40.90	-41.03	-47.53	-47.62
	[7.717]**	[7.713]**	[8.623]**	[8.602]**
Other firm type	-12.68	-12.80	-9.332	-9.518
	[3.572]**	[3.571]**	[5.993]	[5.975]
Capital expenditure per head	-0.0380	-0.0379	0.0450	0.0450
	[0.0520]	[0.0520]	[0.153]	[0.153]
Labour cost per head	2.378	2.378	2.013	2.012
	[0.460]**	[0.460]**	[0.522]**	[0.522]**
Only establishment in firm	3.898	4.009	-4.177	-4.044
	[5.182]	[5.187]	[5.786]	[5.822]
Number of skills-shortage hard-to-fill vacancies, by occupation:				
Managers	9.679	9.727	4.955	5.007
	[8.705]	[8.688]	[9.895]	[9.867]
Professional worker	-3.194	-3.165	-0.434	-0.494
	[1.213]**	[1.208]**	[0.276]	[0.301]
associate profs	-1.130	-1.144	-1.687	-1.646
	[0.696]	[0.696]	[1.144]	[1.116]
administrative staff	-3.050	-3.076	3.906	3.912
	[2.261]	[2.260]	[6.882]	[6.875]
skilled trade workers	-0.265	-0.247	0.728	0.626
	[0.518]	[0.519]	[1.589]	[1.577]
personal services	1.362	1.430	0.0247	0.0718
	[1.504]	[1.491]	[0.848]	[0.862]
sales workers	-0.471	-0.446	0.670	0.732
	[0.572]	[0.572]	[0.998]	[0.991]

machine operatives	-1.349	-1.289	-0.200	-0.110
	[1.421]	[1.403]	[1.392]	[1.419]
elementary workers	-0.880	-0.841	-0.362	-0.358
	[0.993]	[0.989]	[1.160]	[1.162]
Other/unidentified occupation	16.50	16.38	1.388	1.228
	[23.70]	[23.66]	[10.52]	[10.56]
Skills gaps – proportion of staff not fully proficient, by occupation				
managers	4.128	4.043	4.506	4.349
	[5.398]	[5.391]	[6.846]	[6.868]
professionals	-0.934	-0.855	-4.025	-2.835
	[8.445]	[8.400]	[9.060]	[8.998]
associate professionals	-4.282	-4.050	-12.50	-12.50
	[8.486]	[8.457]	[13.06]	[12.99]
administrative staff	1.540	1.542	-5.880	-5.694
	[3.440]	[3.450]	[7.390]	[7.399]
skilled trade workers	-15.59	-15.01	-4.754	-4.801
	[4.195]**	[4.037]**	[5.779]	[5.645]
personal services	1.769	1.946	-0.717	-1.066
	[5.446]	[5.581]	[6.012]	[6.007]
sales workers	0.519	0.536	-4.430	-4.474
	[3.675]	[3.669]	[5.008]	[5.007]
machine operatives	-2.354	-2.300	-19.85	-19.42
	[7.346]	[7.402]	[20.65]	[20.43]
elementary workers	1.856	1.848	-3.110	-3.098
	[3.251]	[3.241]	[3.689]	[3.674]
Total proportion of staff trained	3.657	3.703	1.252	1.277
	[2.002]	[2.022]	[6.821]	[6.778]
Observations	8644	8644	8022	8022

Note: each of the regressions in the above table also controlled for SSC, region and the number of employees in the firm or reporting unit by 9 bands.
Robust standard errors in brackets
** p<0.01, *p<0.05

Table A12 – GVA per head – Value Added OLS regressions

	(1) GVA/head in 2008 on GVA/head in 2006 NESS07+ABI08+ABI06	(2) GVA/head in 2008 on GVA/head in 2006 NESS07+ABI08+ABI06	(1) GVA/head in 2007 on GVA/head in 2006 NESS07+ABI07+ABI06	(2) GVA/head in 2007 on GVA/head in 2006 NESS07+ABI07+ABI06
Apprenticeship engagement				
Whether took any 16-24 apprentices	4.366		1.480	
	[3.130]		[2.115]	
Number of 16-24 apprentices taken		0.210		-0.115
		[0.162]		[0.125]
Unknown Number of 16-24 apprentices taken		-2.376		-2.421
		[2.977]		[4.437]
Lagged GVA per head (in 2006)	0.724	0.724	0.380	0.380
	[0.126]**	[0.126]**	[0.231]	[0.231]
Firm type (reference category: private)				
charity / voluntary sector	-4.136	-4.142	-5.148	-5.188
	[4.325]	[4.337]	[4.970]	[4.974]
local government body	-8.951	-8.681	-0.223	-0.171
	[5.280]	[5.260]	[8.368]	[8.380]
central government body	-24.48	-24.55	-30.59	-30.72
	[8.782]**	[8.787]**	[10.99]**	[11.00]**
Other firm type	-8.252	-8.395	-12.51	-12.64
	[4.802]	[4.823]	[5.485]*	[5.506]*
Capital expenditure per head	-0.338	-0.338	0.00374	0.00376
	[0.271]	[0.271]	[0.00288]	[0.00289]
Labour cost per head	1.272	1.273	2.592	2.592
	[0.460]**	[0.460]**	[0.935]**	[0.936]**
Only establishment in firm	-3.371	-3.010	8.189	8.369
	[8.994]	[9.039]	[8.279]	[8.303]
Number of skills-shortage hard-to-fill vacancies, by occupation:				
Managers	-8.126	-8.146	-3.096	-3.054
	[13.34]	[13.34]	[9.884]	[9.866]
Professional worker	0.248	0.356	-2.741	-2.675
	[1.058]	[1.073]	[1.844]	[1.828]
associate profs	-0.110	-0.134	-1.553	-1.581
	[0.945]	[0.952]	[1.251]	[1.254]
administrative staff	1.531	1.532	-0.914	-0.887
	[5.306]	[5.268]	[2.958]	[2.951]
skilled trade workers	1.222	1.279	0.610	0.664
	[1.191]	[1.210]	[0.619]	[0.611]

personal services	0.780	1.074	2.526	2.551
	[0.782]	[0.832]	[1.972]	[1.978]
sales workers	-0.231	-0.197	0.260	0.288
	[0.397]	[0.381]	[0.427]	[0.432]
machine operatives	-0.122	-0.0652	0.445	0.492
	[1.141]	[1.168]	[1.664]	[1.679]
elementary workers	0.212	0.276	-0.409	-0.397
	[1.619]	[1.622]	[1.039]	[1.043]
Other/unidentified occupation	-20.44	-20.58	-7.861	-7.950
	[26.18]	[26.23]	[15.90]	[15.90]
Skills gaps – proportion of staff not fully proficient, by occupation				
managers	10.36	10.18	3.844	3.835
	[5.421]	[5.406]	[4.204]	[4.191]
professionals	-7.156	-6.680	-0.732	-0.520
	[9.331]	[9.252]	[6.030]	[6.017]
associate professionals	0.495	0.257	-1.795	-2.047
	[15.04]	[15.07]	[13.83]	[13.82]
administrative staff	-8.280	-8.183	-4.176	-4.271
	[4.474]	[4.465]	[3.855]	[3.868]
skilled trade workers	-2.080	-1.848	-11.85	-11.37
	[4.717]	[4.352]	[4.470]**	[4.388]**
personal services	4.546	3.832	10.53	11.18
	[4.216]	[4.447]	[7.381]	[7.557]
sales workers	1.030	1.001	2.097	2.052
	[3.535]	[3.535]	[4.064]	[4.051]
machine operatives	0.787	1.307	-2.296	-2.230
	[9.449]	[9.554]	[7.655]	[7.705]
elementary workers	-3.988	-3.992	5.822	5.819
	[2.928]	[2.940]	[3.532]	[3.515]
Total proportion of staff trained	1.594	1.666	2.219	2.240
	[1.976]	[1.983]	[1.783]	[1.788]
Observations	5366	5366	6503	6503

Robust standard errors in brackets

** p<0.01, *p<0.05

Note: each of the regressions in the above table also controlled for SSC, region and the number of employees in the firm or reporting unit by 9 bands.

Table A13a – GVA per head in 2007– apprenticeship engagement instrumented by various measures, NESS07 +ABI07, 2nd stage results

	(1) IV 2nd Stage	(2) IV 2nd stage	(3) IV 2nd stage	(4) IV 2nd stage	(5) IV 2nd stage
Instrumented Variable: whether took any 16-24 apprentices					
Instrumental Variables (in addition to all other exogenous regressors)	Proportion of workplaces in the sector that took any 16-24 apprentices	Proportion of workplaces with skilled-trades skill shortage in the sector	Average number of skilled-trades skill shortage in the sector	Average proportion of skilled trades staff being NFP in the sector	Average number of NFP skilled trades staff among all workplaces in the sector
Whether took any 16-24 apprentices - fitted	-58.50	-37.27	-88.52	-24.30	-42.55
	[26.87]*	[38.33]	[61.00]	[23.26]	[37.99]
Firm type (reference category: private)					
charity / voluntary sector	-19.54	-19.00	-20.31	-18.66	-19.13
	[3.605]**	[3.795]**	[3.901]**	[3.630]**	[3.599]**
local government body	-19.20	-20.02	-18.04	-20.52	-19.82
	[5.000]**	[5.090]**	[5.726]**	[4.829]**	[5.138]**
central government body	-60.10	-59.38	-61.12	-58.94	-59.56
	[9.271]**	[9.315]**	[9.782]**	[9.081]**	[9.243]**
Other firm type	-17.19	-16.56	-18.07	-16.18	-16.72
	[3.872]**	[4.129]**	[4.620]**	[3.850]**	[3.936]**
Capital expenditure per head	-0.0376	-0.0375	-0.0376	-0.0375	-0.0375
	[0.0512]	[0.0511]	[0.0512]	[0.0511]	[0.0511]
Labour cost per head	2.375	2.367	2.386	2.362	2.369
	[0.453]**	[0.456]**	[0.463]**	[0.452]**	[0.456]**
Only establishment in firm	4.788	3.888	6.061	3.338	4.112
	[5.296]	[5.733]	[6.159]	[5.186]	[5.090]
Number of skills-shortage hard-to-fill vacancies, by occupation:					
Managers	10.48	9.980	11.19	9.675	10.10
	[8.348]	[8.464]	[8.403]	[8.490]	[8.469]
Professional worker	-3.103	-3.471	-2.582	-3.696	-3.380
	[1.234]*	[1.253]**	[1.237]*	[1.307]**	[1.245]**
associate profs	-2.500	-2.279	-2.811	-2.145	-2.334
	[0.901]**	[0.997]*	[1.219]*	[0.859]*	[0.962]*
administrative staff	-2.421	-2.470	-2.352	-2.499	-2.458
	[1.971]	[2.055]	[1.968]	[2.047]	[2.010]
skilled trade workers	0.450	0.0700	0.989	-0.163	0.164
	[0.570]	[0.723]	[1.014]	[0.578]	[0.686]
personal services	3.171	2.498	4.124	2.086	2.665
	[2.418]	[2.637]	[3.341]	[2.260]	[2.692]
sales workers	-0.818	-0.813	-0.826	-0.810	-0.814

	[0.630]	[0.643]	[0.644]	[0.638]	[0.640]
machine operatives	0.391	-0.427	1.549	-0.927	-0.224
	[1.538]	[1.759]	[2.488]	[1.469]	[1.895]
elementary workers	0.635	0.248	1.183	0.0107	0.344
	[1.341]	[1.427]	[1.813]	[1.265]	[1.499]
Other/unidentified occupation	14.36	15.21	13.15	15.73	15.00
	[24.14]	[24.12]	[24.18]	[24.15]	[24.45]

Skills gaps – proportion of staff not fully proficient, by occupation

managers	4.291	4.757	3.632	5.043	4.642
	[5.866]	[5.840]	[5.893]	[5.907]	[5.960]
professionals	-4.498	-3.812	-5.469	-3.392	-3.982
	[8.890]	[9.032]	[9.343]	[8.819]	[8.994]
associate professionals	-6.840	-7.731	-5.578	-8.277	-7.510
	[9.881]	[9.584]	[8.789]	[9.810]	[9.815]
administrative staff	-1.726	-1.855	-1.543	-1.934	-1.823
	[3.790]	[3.775]	[3.758]	[3.811]	[3.802]
skilled trade workers	3.739	-3.794	14.39	-8.400	-1.923
	[8.422]	[12.42]	[20.49]	[7.276]	[12.99]
personal services	9.312	5.600	14.56	3.331	6.522
	[9.598]	[10.75]	[14.86]	[8.745]	[11.31]
sales workers	0.702	1.062	0.193	1.282	0.973
	[4.127]	[4.170]	[4.018]	[4.165]	[4.040]
machine operatives	1.512	0.149	3.440	-0.684	0.488
	[7.048]	[7.059]	[7.409]	[7.136]	[7.319]
elementary workers	7.488	7.339	7.698	7.248	7.376
	[4.561]	[4.584]	[4.697]	[4.544]	[4.625]
Total proportion of staff trained	5.423	4.999	6.023	4.740	5.104
	[1.754]**	[1.756]**	[1.808]**	[1.782]**	[1.900]**
Observations	8644	8644	8644	8644	8644

Robust standard errors in brackets

** p<0.01, *p<0.05

Note: each of the IV regressions in the above table also controlled for region and the number of employees in the firm or reporting unit by 9 bands.

Table A13b – Corresponding to Table A13a - 1st stage significance

Instrumental Variables	Proportion of workplaces in the sector that took any 16-24 apprentices	Proportion of workplaces with skilled-trades skill shortage in the sector	Average number of skilled-trades skill shortage in the sector	Average proportion of skilled trades staff being NFP in the sector	Average number of NFP skilled trades staff among all workplaces in the sector
Coefficient on instrument in first stage regression	0.873	2.052	0.385	4.127	0.0715
	[0.0878]**	[0.248]**	[0.0572]**	[0.510]**	[0.00857]**
Observations	8644	8644	8644	8644	8644

Table A14a – Valued added, GVA/ head in 2008 on GVA/head in 2006 – apprenticeship engagement instrumented by various measures, NESS07 +ABI08+ABI06, 2nd stage results

	(1) IV 2nd Stage	(2) IV 2nd stage	(3) IV 2nd stage	(4) IV 2nd stage	(5) IV 2nd stage
Instrumented Variable: whether took any 16-24 apprentices					
Instrumental Variables (in addition to all other exogenous regressors)	Proportion of workplaces in the sector that took any 16-24 apprentices	Proportion of workplaces with skilled-trades skill shortage in the sector	Average number of skilled-trades skill shortage in the sector	Average proportion of skilled trades staff being NFP in the sector	Average number of NFP skilled trades staff among all workplaces in the sector
Whether took any 16-24 apprentices - fitted	-28.13	-79.49	-203.2	-7.995	4.355
	[32.03]	[67.75]	[111.1]	[27.29]	[32.71]
Firm type (reference category: private)					
charity / voluntary sector	-4.747	-5.572	-7.558	-4.424	-4.226
	[3.722]	[4.104]	[4.631]	[3.656]	[3.655]
local government body	-5.924	-2.242	6.630	-7.367	-8.253
	[3.642]	[4.580]	[6.894]	[3.732]*	[4.021]*
central government body	-26.01	-27.39	-30.72	-25.47	-25.14
	[10.67]*	[11.07]*	[11.39]**	[10.58]*	[10.47]*
Other firm type	-8.277	-10.34	-15.33	-7.467	-6.969
	[5.760]	[6.522]	[7.778]*	[5.709]	[5.564]
GVA per head in 2006	0.729	0.729	0.729	0.729	0.729
	[0.125]**	[0.125]**	[0.125]**	[0.125]**	[0.125]**
Capital expenditure per head	-0.333	-0.334	-0.337	-0.333	-0.332
	[0.271]	[0.271]	[0.271]	[0.272]	[0.271]
Labour cost per head	1.095	1.154	1.297	1.072	1.058
	[0.411]**	[0.445]**	[0.486]**	[0.401]**	[0.399]**
Only establishment in firm	-1.866	3.410	16.12	-3.934	-5.202
	[10.22]	[13.26]	[17.23]	[9.545]	[9.464]
Number of skills-shortage hard-to-fill vacancies, by occupation:					
Managers	-7.145	-7.598	-8.690	-6.968	-6.859
	[12.90]	[13.13]	[13.32]	[12.88]	[12.83]
Professional worker	0.854	2.576	6.724	0.179	-0.235
	[1.413]	[2.483]	[3.901]	[1.322]	[1.426]
associate profs	-1.366	-2.136	-3.992	-1.064	-0.879
	[0.960]	[1.453]	[2.082]	[0.875]	[0.858]
administrative staff	-1.380	0.0660	3.550	-1.947	-2.294
	[2.140]	[2.017]	[2.512]	[2.306]	[2.453]
skilled trade workers	1.045	2.541	6.146	0.458	0.0985
	[1.321]	[2.176]	[3.362]	[1.230]	[1.281]
personal services	2.375	5.293	12.32	1.232	0.530

	[2.166]	[4.133]	[6.557]	[1.844]	[2.102]
sales workers	-0.372	-0.360	-0.331	-0.377	-0.379
	[0.378]	[0.418]	[0.439]	[0.391]	[0.395]
machine operatives	0.0305	1.181	3.952	-0.420	-0.697
	[1.046]	[1.295]	[2.094]	[1.109]	[1.277]
elementary workers	1.084	1.795	3.506	0.806	0.635
	[1.936]	[2.371]	[2.915]	[1.822]	[1.771]
Other/unidentified occupation	-17.94	-19.26	-22.45	-17.42	-17.11
	[23.46]	[23.55]	[23.90]	[23.45]	[23.49]
Skills gaps – proportion of staff not fully proficient, by occupation					
managers	10.10	8.360	4.167	10.78	11.20
	[6.079]	[6.090]	[6.463]	[6.165]	[6.320]
professionals	-7.535	-5.493	-0.574	-8.335	-8.826
	[6.028]	[6.052]	[6.890]	[6.088]	[6.126]
associate professionals	-4.274	-7.963	-16.85	-2.829	-1.942
	[18.28]	[19.39]	[21.10]	[18.16]	[18.00]
administrative staff	-9.334	-10.74	-14.14	-8.781	-8.443
	[4.833]	[5.485]	[6.352]*	[4.649]	[4.605]
skilled trade workers	12.50	31.66	77.83	4.988	0.381
	[12.74]	[25.82]	[41.93]	[11.05]	[12.53]
personal services	8.204	12.57	23.09	6.493	5.443
	[5.008]	[7.389]	[10.73]*	[4.739]	[4.918]
sales workers	-0.974	-2.667	-6.745	-0.311	0.0961
	[3.300]	[3.422]	[4.088]	[3.281]	[3.381]
machine operatives	3.659	11.61	30.75	0.544	-1.366
	[10.28]	[13.13]	[18.55]	[9.615]	[10.38]
elementary workers	-0.710	-1.677	-4.006	-0.332	-0.0992
	[2.802]	[2.969]	[3.228]	[2.830]	[2.820]
Total proportion of staff trained	2.463	3.274	5.230	2.145	1.950
	[2.426]	[2.750]	[3.246]	[2.302]	[2.365]
Observations	5366	5366	5366	5366	5366

Robust standard errors in brackets

** p<0.01, *p<0.05

Note: each of the IV regressions in the above table also controlled for region and the number of employees in the firm or reporting unit by 9 bands.

Table A14b – Corresponding to Table A14a - 1ˢᵗ stage significance

Instrumental Variables	Proportion of workplaces in the sector that took any 16-24 apprentices	Proportion of workplaces with skilled-trades skill shortage in the sector	Average number of skilled-trades skill shortage in the sector	Average proportion of skilled trades staff being NFP in the sector	Average number of NFP skilled trades staff among all workplaces in the sector
Coefficient on instrument in first stage regression	0.993	2.208	0.356	4.926	0.0995
	[0.118]**	[0.362]**	[0.0797]**	[0.702]**	[0.0156]**
Observations	5366	5366	5366	5366	5366

Appendix B: National Employer Skills Survey 2009

This note addresses data coding and weighting in the National Employer Skills Survey for England 2009 (NESS09).

NESS09 was an England-wide employer survey carried out on behalf of the UK Commission for Employment and Skills. It was based on a quota sample designed to be representative across sector skills councils (SSC), establishment size bands, and English regions. The sample was drawn from the Experian business database. The original target for interviews was 75,000; the total number completed was 79,152.

Fieldwork was carried out from March to July 2009.

SIC 2003 and SIC 2007

The Office for National Statistics (ONS) implemented a major revision of its Standard Industrial Classification of Economic Activities (SIC) between 2002 to 2008. The classification was revised from SIC 2003 to SIC 2007. SIC 2007 became effective from 1st January 2008.

Coding by industry

For data analysis purposes, establishments in NESS09 are coded by industry.

Establishments were coded prior to interview based on their registration information with Experian. This was verbally queried during interview and, if challenged, a verbatim response was recorded. This was then coded to a four-digit SIC code in post-interview analysis.

Due to the lengthy preparation and planning involved in large-scale survey work of this type, the SIC 2003 coding schedule was used throughout fieldwork and analysis. The published outputs from UKCES (Evidence Report 13, *NESS 2009 Key Findings*, and Evidence Report 23, *NESS 2009 Main Report*) are based on this SIC 2003 data.

Following the introduction of SIC 2007 and associated updating of SSC footprints, UKCES commissioned a recoding exercise to transfer NESS09 data from SIC 2003 to SIC 2007. This allowed analysis to be carried out based on the most up-to-date industrial classifications.

Appendix C: A Technical Note on How Multi-RUs are Matched with NESS Establishments

The following describes the process of matching NESS07 establishments with multi-RUs in ABI 2007. The same process was used to match NESS07 establishments with multi-RUs in ABI 2006 and with those in ABI 2008.

First, we combine all the local-unit-level datasets. There are about 1.88 million unique reporting units out of 2.1mn local units. We record all the postcodes that belong to each RU and keep one observation for each existing combination of RU and postcode. About 1.84mn RUs have unique postcodes, and the others have multiple postcodes.

Second, we identify combinations of IDBR and postcode which are unique to RUs. To do so, we merge in the IDBR number to the RU-Postcode dataset, based on the RU key. At this stage, two observations can have the same combination of IDBR and postcode (such as IDBR 10003 +postcode XXXXX12 in Figure 2), if they refer to different RUs within the same firm. We drop all the 1630 observations of such duplicated combinations. So we are left with combinations of IDBR and postcode that can uniquely identify RUs.

Then, we merge in NESS establishments by IDBR and postcode. That gives a total of 6465 matches, 5664 of which are actually single RUs and have been matched already simply based on IDBR. The other 801 matches are between NESS establishments and multi-RUs.

Table C1 Summary statistics for the matching process

	ABI 2006	ABI 2007	ABI 2008
Number of firms	41099	44908	45357
number of RUs	41909	45755	46005
number of single-RUs	40779	44560	45078
number of local units	2.1million	2.1million	2.1million
	NESS07+ABI06	NESS07+ABI07	NESS07+ABI08
number of RUs in the matched sample	3410	3662	3136
number of NESS07 establishments matched	8011	8644	8023
among which,			
matched to single-RUs	7342	7843	7,193
matched to multi-RUs	669	801	830

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