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The labour market value of STEM qualifications and occupations

An analysis for the Royal Academy of Engineering

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Executive Summary

Science, Technology, Engineering and Mathematics (STEM) are subject areas that are deemed crucial for a modern economy. Having a sufficient supply of skilled workers trained in these subjects is seen as a pressing policy priority.

One indicator of whether employers really do value STEM skills above more general skills is the wage premia that they pay for individuals with STEM qualifications.

This report investigates the labour market value of Science, Technology, Engineering and Mathematics (STEM) qualifications, focusing specifically on vocational qualifications and the value of STEM degrees. The report also investigates the relationship between STEM qualifications held, the STEM occupation that the person may or may not be employed in and their associate wages.

We ask:

1) What is the additional wage premium (or penalty) earned by individuals with STEM qualifications, over and above any return earned for the qualification irrespective of subject;
2) What is the additional wage premium (or penalty) earned by individuals working in STE occupations, irrespective of qualifications held (note that in our data there are no occupations classified as being specifically in mathematics and hence we consider only science, technology and engineering (STE) occupations)?
3) What is the additional wage premium (or penalty) earned by individuals working in STE occupations who also hold STEM qualifications?

This work builds on the *FE and Skills STEM Data report* published in October 2010 (Blue Alumni, 2010) and uses the same classification system for Science, Technology, Engineering and Mathematics qualifications. This previous project involved painstaking work analyzing the Learning Aims Database, the Individual Learner Record and other Further Education data. To identify qualifications as STEM or not, strict criteria were used namely:

- STEM qualifications have learning outcomes rooted in STEM and hence are of a 'technical' or 'technology-application/use' nature;
- STEM qualifications enable progression into further STEM study or a STEM occupation;
- The majority of the assessment for a STEM qualification is in the area of STEM itself;

Where a qualification might be allocated to a number of STEM categories (e.g. mathematics and engineering), the dominant category was identified and multiple categories were minimised.

The data used in this report to analyse differences in wages associated with STEM qualifications and occupations are from the UK Labour Force Survey (LFS), March 2004 to December 2010.

- Many qualifications have higher labour market value if they are in a STEM subject.

- There are additional positive wage premia from holding a range of qualifications at all levels in a STEM subject (e.g. degrees, NVQ2, City and Guilds Foundation, NVQ3, HNC/HND).

- In general there are no wage premia for qualifications held in science bar BTEC National Certificates/Diplomas.

- NVQ5 and City and Guilds Part I/II attract a premium in technology.

- In mathematics, those with first degrees and diplomas in higher education do earn significantly more than those who hold these qualifications in other subject areas.

- In engineering, a larger number of qualifications do attract an additional wage premium if they are held in this subject area.

- Some qualifications in science, engineering or mathematics actually have a slightly lower wage premia than the same qualification in another subject area.

We then considered the wages associated with STE occupations.

- 40% of individuals in higher managerial or professional jobs are in STE occupations.

- Just over one quarter of those in lower supervisory or clerical roles are in STE occupations.

- Those working in STE occupations earn a great deal more than those who are not in STE occupations (19%).

- Those in science occupations earn an additional wage premium of 10% whilst those working in technology, engineering and different combinations of these subjects earn much more than those in non STE occupations (14-34% more).

- The premium from working in a STE occupation is largely for those working at intermediate and lower level occupations (i.e. not at professional or managerial level).

- In many instances, including degrees, STEM qualifications attract a further additional premium if they are used in a STE occupation. Individuals earn a premium from having a STEM qualification and then a further premium from working in a STE occupation.

- At level 3 (intermediate) STEM qualifications tend to have greater value in STE occupations.

- There is a particularly sizeable premium if a STEM qualification is used in a STE occupation in the case of degrees, HNC/HND and City and Guilds Foundation/Part I.

We conclude that:

- Many but not all qualifications have additional value in the labour market if they are in a STEM subject area though less so in science and more so in engineering;

- Most STE intermediate and lower level occupations attract additional wage premia though less so for science and more so for technology and engineering;

- Some but not all STEM qualifications have considerable additional value in the labour market if they are used in a STE occupation.

Methodological caveats

We are unable to allow for the cognitive or other types of ability of individuals and hence where we see wage premia this may reflect the fact that more able people (who would earn more anyway) tend to take STEM qualifications or indeed work in STE occupations. Our analysis is therefore not necessarily causal.

Sample sizes often preclude us looking at the level of detail we would like to.

We only focus on the wage effects from having STEM qualifications: future work could usefully look at whether such qualifications also have an impact on the likelihood of being in employment and the type of employment gained.

Policy Implications

STEM qualifications are not all alike and across the different STEM areas we found very different wage premia associated with different qualifications.

This means the advice given to young people needs to be far more nuanced than it currently is.

It is not enough to urge young people to study STEM subjects: they also need to understand that some STEM qualifications are more valuable than others.

Working in science, engineering or technology occupations (particularly at intermediate level or below) often attracts a sizeable wage premia. Hence students need guidance that earnings in many STE occupations are higher than in non STE occupations.

Some qualifications that attract a premium if they are held in a STEM subject also attract an additional wage premium from being used in a STE occupation. For instance, degrees in STEM are valued by the labour market anyway but particularly so in STE occupations.

Thus for some qualifications their maximum potential value is for use in STE occupations, another message for those making career decisions.

Introduction

There is growing policy consensus that Science, Technology, Engineering and Mathematics (STEM) are subject areas that are crucial for a modern economy (DIUS, 2009; CBI, 2011; Leitch, 2006; UKCES, 2010). Having a sufficient supply of skilled workers trained in these subjects is therefore seen as a pressing policy priority. Yet it is important to determine whether employers really do value STEM skills above more general employability and other skills. Evidence for this would be if employers are prepared to pay a wage premium to individuals who hold qualifications in STEM subject areas or disciplines. This report therefore investigates the labour market value of Science, Technology, Engineering and Mathematics qualifications, focusing specifically on vocational qualifications and the value of STEM degrees. It is increasingly recognized by policy-makers that many individuals who acquire STEM qualifications do not work in STEM occupations (DIUS, 2009) and that in fact employers demand STEM skills even for jobs that are not explicitly STEM jobs (CBI, 2011). It is therefore an open question whether STEM qualifications would have less value if they are not actually used in a STEM occupation. Hence we also investigate the relationship between STEM qualifications held, STEM occupation and wages. Specifically, the research questions addressed here are:

4) What is the additional wage premium (or penalty) earned by individuals with STEM qualifications, over and above any return earned for the qualification irrespective of subject;
5) What is the additional wage premium (or penalty) earned by individuals working in STEM occupations, irrespective of qualifications held?
6) What is the additional wage premium (or penalty) earned by individuals working in STEM occupations who also hold STEM qualifications?

This work builds on the *FE and Skills STEM Data report* published in October 2010 (Blue Alumni, 2010) and uses the same classification system for Science, Technology, Engineering and Mathematics qualifications.

Related Literature

There is a large literature which has consistently shown that most academic qualifications and higher level vocational qualifications have substantial value in the UK labour market (e.g. Dearden *et al.*, 2002; Dickerson 2005). This would suggest that the skills embodied in these qualifications are valued by employers. However, this same literature has also found that many vocational qualifications, particularly at lower levels, have lower labour market value in terms of wages, though many are associated with an increased probability of being in employment (Dearden et al. 2004; McIntosh, 2004; Dickerson 2005; Jenkins, Greenwood and Vignoles, 2007). For example, the wage return to NVQ2 qualifications has been found to be largely nonexistent for males though positive for women (De Coulon and Vignoles, 2008) and when acquired via an employer (Dearden et al, 2004; Jenkins et al. 2007).

The fact that a number of level 2 vocational qualifications do very little to boost wages is obviously cause for concern, suggesting that employers may not value the skills embodied in these qualifications. Further investigations by Jenkins et al. (2007) and others however, confirmed that in fact the value of many qualifications, including NVQ2, varies substantially by sector and the occupation of the individual (McIntosh, 2004, Dearden et al. 2004, Dickenson and Vignoles, 2007; Jenkins et al. 2007). This is presumably because the value of the qualification acquired varies according to the specific skills learned and how they are used in the labour market. Taking NVQ2 qualifications as an exemplar, although on average the wage gain from having these qualifications is virtually zero, this is not true in all sectors. For example, the wage gain from having a NVQ2 is high in the construction and energy and water sectors though the gain varies by gender. BTEC level 2 qualifications are particularly valuable in finance and distribution, hotels and restaurant industries. City and Guilds qualifications at level 2 have high value in manufacturing and the distribution/hotel sectors. RSA level 2 qualifications have particularly high value in manufacturing and construction. These findings suggest that indeed the value of vocational qualifications is likely to vary across subject areas.

Here we investigate how the returns to qualifications vary by subject area, focusing particularly on the wage return to STEM subjects. This is a generally under researched area though it has been shown that literacy and particularly numeracy is highly valued in the UK

labour market (De Coulon et al. 2010; Bynner and Parsons 1997a, 1997b, 2005; Grinyer, 2005), as is A level mathematics (Dolton and Vignoles, 2002). There has also been work suggesting that some STEM degree subjects have greater labour market value than arts and humanities subjects (Sloane and O'Leary, 2004; Walker and Zhu, 2010). The results from this literature are mixed however. Sloane and O'Leary (2004) found very high wage premia for STEM degree subjects such as electrical engineering, mechanical engineering and mathematics and computing. However, Walker and Zhu (2010) found higher wage premia for economics, management and law but not for a number of science subjects, such as biology. Whilst we will not be considering specific STEM subjects in such detail, our analysis provides further guidance about the value of STEM at degree and sub degree levels of qualification.

Data

The data used for this project are from the UK Labour Force Survey (LFS). These data are ideal for our purpose since the LFS data set includes information on the qualifications held by individuals, the subject area of their qualifications (though this is not available for all qualifications as detailed below), their occupation (Standard Occupational Classification) and of course their labour market wages.

The analytical sample consists of wave 1 data from 27 quarters of the UK Labour Force Survey from the period March 2004 to December 2010 (excludes quarter 4 of 2005). This provides records for 163,218 people (79,980 men aged 16-64, and 83,238 women aged 16-59). See Table 1 for descriptive statistics of the sample we use by year of LFS. The sample includes those in employment and with a wage from responding households in a representative sample of private residential addresses in England and Wales.

The dependent variable used in our model is the log of hourly wage, indexed to 2001 values. The sample excludes the top and bottom 0.5% of wage-rates to mitigate coding error and the effect of outliers.

The qualifications modeled are all UK qualifications recorded in the LFS, disaggregated into National Qualification Framework levels. Individuals holding any specifically Scottish academic or vocational qualifications aside from degrees (approximately 1%) were dropped

since the analysis can only focus on qualifications recorded in the Individual Learner Record (Further Education) data for England as this is the data set used to determine whether a qualification is in the STEM subject area or not (see paragraph below for further explanation of this point). We have subject information for all degrees. We also have subject information for all vocational qualifications at level 2 or above. This means we do not have subject information on GCSE/ O levels and GCE A level. In the case of the former, almost everyone who has 5 GCSEs/ O levels will have at least one STEM qualification and hence it would be difficult to determine whether taking a STEM GCSE / O level has additional value in the labour market. In the case of GCE / A level, the absence of subject information is more problematic but the majority of those holding A levels also hold degrees for which we do have subject information and hence this problem is less of an issue than it first appears. The full list of qualifications for which we have subject area information is given in Table 2.[1] The proportion holding each qualification in a STEM subject varies substantially. For example, 30% of higher degrees are in the STEM area whilst only 8% of RSA Higher qualifications are in STEM subjects, unsurprisingly.

Information on whether a qualification is in a STEM subject area or not is derived from a previous project commissioned by the Department of Business Innovation and Skills and The Royal Academy of Engineering to investigate the extent of the STEM offer in the Further Education and Skills sector in England (Blue Alumni, 2010). This project involved painstaking work analyzing the Learning Aims Database, the Individual Learner Record and other Further Education data sets to determine whether each qualification achieved could be classified as science, technology, engineering or mathematics. To identify qualifications as STEM or not, strict criteria were used namely:

- STEM qualifications have learning outcomes rooted in STEM and hence are of a 'technical' or 'technology-application/use' nature;
- STEM qualifications enable progression into further STEM study or a STEM occupation;

[1] Appendix A also provides sample sizes for each qualification observed in the data, the number holding those qualifications in STEM occupations (see below), the number holding each qualification in a STEM subject and finally the number of individuals holding each qualification in a STEM subject who are actually working in a STEM occupation.

- The majority of the assessment for a STEM qualification is in the area of STEM itself;
- Where a qualification might be allocated to a number of STEM categories (e.g. mathematics and engineering), the dominant category was identified and multiple categories were minimised.

Qualifications were deemed to be 'STEM-related' when Science, Technology, Engineering or Mathematics feature in many learning objectives (and / or the qualification provides a degree of learning that will aid progression in STEM) but to a lesser extent than in qualifications deemed to be STEM..

Full details of how qualifications were allocated to a STEM category or otherwise can be found in Blue Alumni (2010) – see Tables 2.1 and 2.2 in that report. Around 2,453 of the qualifications listed in the National Database of Accredited Qualifications and the Learning Aim Database were identified as STEM or STEM related. In this report however, we focus only on qualifications identified as STEM (rather than STEM related). This is a reasonable simplification to make as only the 'T' in STEM has any significant number of STEM-related qualifications, these being predominantly IT user qualifications and qualifications linked to aspects of design and design technologies.

We also investigate the wage premium associated with being in a STEM occupation. More specifically since no occupation was classified as being in the area of mathematics, we investigated the wage differences between occupations classified as S, T or E. The list of occupations identified as being in STE is given at Appendix B. This list was classified by a panel drawn from across the STE subjects and disciplines and convened by The Royal Academy of Engineering. Throughout the report, medicine and medical related occupations and qualifications are considered to be distinct from STE. Hence we identify medicine/medicine related occupations separately in our regressions as per the list of occupations at Appendix C. The distribution of individuals in STE and non STE occupations is given in Table 3. 40% of individuals in higher managerial or professional jobs are in STE occupations, whilst just over one quarter of those in lower supervisory or clerical roles are in STE occupations. It is interesting to note that, according to the classifications adopted here, STE occupations hardly feature in other job categories (lower managerial and associate

professional, intermediate, routine semi routine) and (tautologically) amongst the unemployed.

Table 4 shows the way in which STEM qualifications are used in the labour market. Specifically it indicates the proportion of individuals holding each qualification in a STEM subject who are actually working in a STE occupation[2]. For some qualifications a high proportion of those who hold the qualification in a STEM subject also work in a STE occupation. 48% of those with a higher degree in a STEM subject actually work in a STE occupation (similar trends were found in Engineering UK, 2010). 35% of those with NVQ4 in a STEM subject work in a STE occupation. Only around one quarter of those with NVQ2 in STEM actually work in a STE occupation. In the main analysis we consider the value of these qualifications when used generally and when used in STE occupations.

Methodology

The usual way in which to estimate the labour market value of particular qualifications is to estimate some variant on equation (1) below (e.g. Dearden et al. 2002). This model of (log) wages relates individuals' current wages to the qualifications they hold, as well as their other characteristics. W_i indicates individuals' gross hourly earnings, β_1 is a constant, $\mathbf{Q}_i$ represents a vector of qualification indicator variables which take a value of 1 to indicate whether an individual holds that qualification, $\boldsymbol{X}_i$ is a vector of variables indicating individuals' personal characteristics and ε_i is a normally distributed error term. Specifically in our models we include the individual's age and age-squared (as a proxy for their years of work experience), their gender and a vector of indicator variables signifying the region they live in (to allow for differences in local labour market conditions).

$$lnW_i = \beta_1 + \beta_2 \boldsymbol{Q}_i + \beta_6 \boldsymbol{X}_i + \varepsilon_i \qquad (1)$$

The equation above therefore indicates that an individual's wages are determined by their qualifications and their personal characteristics. If β_2 is positive and statistically significant this implies that having that qualification has a positive association with wages. The coefficients on these qualification indicator variables will indicate the approximate wage premium associated with that particular qualification, as compared to the wages of individuals who do not hold that qualification. Clearly individuals often hold multiple

[2] The full table of descriptive statistics is at Appendix A.

qualifications and to deduce their total wage premium over someone with no qualifications at all one would have to sum the coefficients on all the qualifications that they hold.

However, in our case we are specifically interested in knowing if qualifications classified as S,T,E or M have additional economic value, over and above any wage premium for the qualification held regardless of its subject area. To estimate this we include an additional vector of qualification indicator variables $\boldsymbol{S}_i$ which take a value of 1 to indicate if the particular qualification held is in the STEM subject area. For example, if an individual has a qualification such as NVQ3 in engineering, then we will measure the wage premium from holding a NVQ3 (β_2) as well as the additional premium (if any) from holding a NVQ3 in a STEM subject (in this case engineering). Hence β_3 will measure the additional premium for a NVQ3 in a STEM subject.

$$lnW_i = \beta_1 + \beta_2 \boldsymbol{Q}_i + \beta_3 \boldsymbol{S}_i + \beta_6 \boldsymbol{X}_i + \varepsilon_i \qquad (2)$$

We start by estimating whether any qualification held by the individual in the general area of STEM has additional economic value. Hence we include *one* dummy variable per qualification which takes a value of 1 if the qualification is in the subject areas of science, technology, engineering or mathematics. We are also interested in the differences within the STEM subject area. Our third specification is therefore one in which each qualification variable has an associated set of *four* dummy variables indicating whether the qualification is in science, technology, engineering or mathematics.

We should note that the major methodological problem in this area of work is that it is difficult to separate out the impact of education on individuals' wages from the impact of individuals' inherent ability. Thus if more able and productive individuals tend to acquire more education, it is hard to determine whether their higher wages are really down to the education itself. In our case, we might be concerned that individuals who choose STEM subjects are more able and hence that some of the apparent wage premium associated with holding a STEM qualification is actually attributable to the ability of the individuals who take these subjects. Whilst we cannot deal with this problem directly (e.g. we cannot include independent measures of individuals' abilities as is done in some papers such as Dearden et al. 2002) we are aware of this issue and return to it in the discussion. It means that the evidence we present is associational rather than necessarily causal.

We also investigate the wage premia associated with working in a STE occupation (recall there are no occupations classified as being in the area of mathematics). In this instance we estimate equation (3) below where we control for the highest level of qualification a person has $\boldsymbol{Q}_i$ as above but instead of including information on the subject area of their qualification we instead indicate whether they are working in a STE occupation, where O_i is a dummy variable indicating whether the individual is in a STE occupation or not. 12% of the sample is identified as working in a STE occupation.

$$lnW_i = \beta_1 + \beta_2 \boldsymbol{Q}_i + \beta_4 O_i + \beta_6 \boldsymbol{X}_i + \varepsilon_i \qquad (3)$$

Lastly, we ask whether the wage premia associated with a STEM qualification is greater when the individual is actually working in a STE occupation. For this specification we estimate the model below:

$$lnW_i = \beta_1 + \beta_2 \boldsymbol{Q}_i + \beta_3 \boldsymbol{S}_i + \beta_4 O_i + \beta_5 (O_i * \boldsymbol{S}_i) + \beta_6 \boldsymbol{X}_i + \varepsilon_i \qquad (4)$$

In this equation, the wage premium associated with a particular qualification is measured by β_2, the wage premium associated with holding a particular qualification in a STEM subject is measured by β_3, the wage premium associated with working in a STE occupation is measured by β_4 and finally the additional premium from holding a STEM qualification and working in a STE occupation is measured by β_5.

Results

Wage premia for STEM qualifications

Table 5 shows the results of a wage regression which estimates the wage premium associated with holding a qualification in a STEM subject. The dependent variable is the log of wages expressed in 2001 levels[3] and the regression includes a number of explanatory variables, as shown in Equation 2 above. Specifically, the regression includes age and age squared, to allow for differences in earnings across age (i.e. experience). It also includes gender to allow for known differences in wages by gender and region to allow for differences in earnings

[3] We included year variables and interactions with year but these did not affect our results substantially.

across different labour markets. The equation includes all qualifications held by an individual, enabling us to determine the mean value (in terms of wages) of holding a particular qualification as compared to those who do not hold that qualification. We then include additional variables (vector S above in equation 2) which indicate whether an individual holds the particular qualification in question in a STEM subject. This enables us to determine the additional wage premium from having a STEM subject. In this regression we also include separate controls for medical qualifications since these are not classified here as being in the STEM area and individuals with medical qualifications are often high paid, e.g. Doctors. Hence considering this group separately is important.

When interpreting the results in Table 5 (and subsequent tables) there are a number of pieces of key information.

The **coefficient** on each variable tells the reader about the magnitude of the relationship between having that particular qualification in a STEM subject and the associated gain in wages. We have provided a second "wage premium" column which tells the reader the gain in wages associated with having that qualification.

The coefficients shown are calculated from survey data and we need to determine how accurately they are likely to reflect "real life", taking account of sample sizes etc. Even where coefficients are very large and appear to be suggesting a large wage gain we must determine whether a genuine statistically robust (statistically significant) relationship exists. We do this by emboldening any coefficient that is statistically significant.

Where coefficients are emboldened this suggests that we can be more confident that the true value of the coefficient is NOT zero – in other words we can be more confident that there is a genuine relationship between having that qualification and earning higher wages.
Where a coefficient is statistically significant at the 10% level of significance, this means that there is only a 10% chance that the true value of that coefficient is zero and that there is a high chance that we are observing a genuine statistical relationship between holding that qualification and having higher wages.

Table 5 therefore shows the additional value of holding a qualification in a STEM subject. For example, holding a first degree in a STEM subject is associated with 4.47% higher

wages, as compared to those who hold a first degree in another subject area.[4] In more than half of cases considered the coefficient is statistically insignificant (these are shown as plain text rather than bold text), meaning we cannot be sure that there is a genuine statistical relationship between holding that qualification in a STEM subject and higher wages. We can be sure that there is an additional positive wage premium from having a STEM subject only for the following qualifications:

- First/foundation degree
- HNC or HND
- RSA Higher Diploma
- NVQ 3
- City and Guilds Foundation/Part 1
- NVQ 2
- City and Guilds Craft/Part 2.

In some instances, there appears to be a wage penalty from holding a STEM subject. For instance, those with higher degrees in STEM earn marginally less (2%) than those with higher degrees in non STEM subjects. The only other wage penalty is associated with RSA Advanced Diploma or Certificate but in this instance only very few people have these qualifications in STEM (see Appendix A) and this result is therefore not particularly meaningful.

What one can conclude from Table 5 is that the additional wage premia from having a STEM subject is significant and sizable for a range of vocational qualifications. In a few instances however, one has to be careful to also look at the main effect from holding the qualification which may in a few cases not be positive. Specifically, the main effect from holding an NVQ2 is negative and significant, suggesting that those who hold NVQ2 as their highest qualification earn around 8% less than those who do not have any qualifications. Therefore the additional positive premium from holding an NVQ2 in STEM (5%) would imply that those who have an NVQ2 in STEM earn a similar amount or even a few percent less than those without this qualification. By contrast, those with an HNC or HND earn an additional

[4] To calculate the total wage premium from holding a First degree in a STEM subject as compared to an individual without that qualification, one needs to sum the coefficient on the First degree variable from the first column Table 5 with the coefficient from the second column. In this instance, the premium from holding a First degree is 30% and we calculate an additional wage premium of 4.5% from holding a degree in a STEM subject. This implies a total wage premium of 34.5%.

premium from their STEM subject of around 8% which is on top of the overall value of HNC/HND which is around 11%, providing a total wage premium of 19%.

Table 6 then shows the wage premia associated with holding qualifications in particular subject areas, rather than STEM as a whole. For example, it shows the premium from holding a higher degree in either of the following subject areas: science, technology, engineering or mathematics. This enables us to determine whether employers value some parts of STEM more highly than others for a given type of qualification. The regressions are structured as in Table 5, i.e. they control for age, age squared, gender, region and highest qualification. They include separate controls for medical qualifications.

Table 6 indicates that in science it is rare that individuals earn an additional premium for holding a qualification in this subject area. We know this because many of the coefficients are statistically insignificant (plain text rather than emboldened). Further, some coefficients are both negative and statistically significant. This suggests that holding these qualifications in science may be associated with lower wages than holding that qualification in a non science subject. In fact those with a science NVQ5 or other higher education qualification below degree level actually earn significantly less than individuals with these qualifications in non STEM subject areas, as do those with sub degree higher education qualifications in science subjects. The one exception to this pattern is that individuals who hold a BTEC National Certificate/Diploma in science earn 8% more than those who hold this qualification in a non STEM subject area (this result is statistically significant and hence is emboldened).

In technology, an additional premium is earned by those holding NVQ 5, City and Guilds Part I or City and Guilds Part II (these coefficients are positive and bold). By and large however, most other qualifications do not attract an additional wage premium if they are held in a non STEM subject area. In the case of a first degree, higher education diploma or BTEC National Certificate/Diploma, those with these qualifications in the technology field actually earn less than those with these qualifications in a non STEM subject.

In engineering, a large number of qualifications do attract an additional wage premium if they are held in this subject area (coefficients are positive and bold). Those with first degrees, HNC or HND, NVQ3, City and Guilds Part I, NVQ2, City and Guilds Part II in engineering earn a wage premium over those who have these qualifications in a non STEM subject area.

Only those with higher degrees in engineering earn significantly less than those who have higher degrees in non STEM subjects (by 5%).

In mathematics, those with first degrees and diplomas in higher education do earn significantly more than those who hold these qualifications in non STEM subject areas. However, those with RSA Advanced Diploma or City and Guilds Part I earn significantly less than those who hold these qualifications in non STEM subjects.

In summary, there is no consistent pattern across the different STEM subject areas and this, combined with relatively small sample sizes in some instances, explains why in Table 5 we only identified a limited number of qualifications as attracting a wage premium from being in STEM. Many qualifications simply do not attract an additional wage premium from being in any specific science, technology, engineering or mathematics domain. That said, some qualifications in each subject area do attract quite considerable wage premia: these qualifications are indeed significantly more valuable if they are in a particular STEM subject. Further, we noted that in technology and engineering specifically, a relatively wide range of qualifications do attract an additional wage premium due to being in that subject area.

Wage premia for STE occupations

Table 7 presents the results of wage regressions which estimate the wage premium associated with working in a STE occupation as per equation 3 above (note that no mathematics occupations are identified in the labour market *per se* hence we refer in this section to STE rather than STEM). These regressions include the same controls as the qualification equations i.e. age, age squared, gender and region. In these regressions we also include separate controls for those working in medical occupations. As explained above, this is because for this report both medical qualifications and medical occupations are considered to be outside the main STE area. The classification of occupations used is shown in Appendices B and C. The classification was undertaken by a panel drawn from across the STE subjects and disciplines and convened by The Royal Academy of Engineering.

The first panel of Table 7 shows that on average, and after allowing for differences in individuals' characteristics (e.g. gender) and qualification level, those working in a STE

occupation earn approximately 19% more than those not working in STE occupations. Again any coefficient that is statistically significant is signified in bold. In this particular table, all the coefficients are statistically significant. This large premium from working in a STE occupation does not however distinguish between different STE occupations (i.e. those in science, technology etc.) and represents an average wage premium across all occupations that could be categorised as science, technology or engineering. This wage premium is the also the premium earned by those working *at all levels* of STE occupations, as compared to individuals in non STE occupations. If those in STE occupations tend to be in higher level occupations, this estimate may reflect the level of qualification as much as subject area, an issue we return to below.

The second panel of Table 7 shows the wage premia associated with being in either a science, technology or engineering occupation separately. This allows us to unpack the overall wage premium associated with being in a STE occupation. According to this second specification, those working in science occupations actually earn significantly less than those who do not work in a non science occupation (by around 7%). This is consistent with some lower wage premia associated with science qualifications discussed in the previous section. By contrast, those working in technology occupations earn on average 26% more than those who do not and those in engineering occupations earn 10% more. This specification does not however take account of the fact that many occupations are related to more than one STE domain. For example, some occupations may be classified as being both science and engineering. The final specification in this table allows for these interaction effects.

The bottom panel of Table 7 shows the wage premia associated with being in either a science, technology or engineering occupation or indeed an occupation that is some combination of STE subjects, such as science and engineering. These categories are mutually exclusive. Hence an individual in an occupation classed as a science occupation would appear in the science category, whilst someone in an occupation classed as a science/engineering occupation would appear only in the SE category. According to this third specification, once we allow for these interaction effects, those working in a science-only occupation specifically earn significantly more than those who do not work in a STE occupation (by around 10%). Those working in technology-only occupations earn on average 33% more and those in engineering-only occupations 15% more than individuals working in non-STE occupations. Those working in occupations combining science and engineering actually earn less than

those working in non-STE occupations i.e. they earn a wage penalty of 7%. Those working in occupations combining engineering and technology have premia of 14% and those combining science, engineering and technology of 18% compared with those in non-STE occupations. Hence when we allow for the possible combinations of STE subjects, it is only those in occupations classified as both science and engineering-based that actually earn less than those in non-STE occupations.

It is clear from these results that there are sizable wage premia associated with being in a STE occupation. The sole exception is the group (n=651) that are in occupations classed as being in both science and engineering. This category includes occupations such as research and development managers and electrical / electronic technicians (Appendix B).

These average benefits from working in a STE occupation may however vary by level of occupation and as discussed earlier we may be confounding level of occupation with subject area. We therefore estimate separate models for those in professional occupations (NS-SEC Group 1), managerial occupations (NS-SEC Group 2) and those in occupations below managerial (all other NS-SEC Groups). In other words we determine the value of working in a STE occupation for professional, managerial and other occupations separately. These results are presented in Table 8. A very interesting pattern emerges. Those in professional or indeed in managerial STE occupations earn less than those in non STE occupations at the same level (the coefficients are negative and statistically significant). However, below managerial level there is a very large benefit from working in a STE occupation: those in STE occupations below managerial level earn 17% more than those not in STE occupations. When we break this overall STE effect out to consider science, technology and engineering separately (and combinations of these groups) we find these patterns still hold. Generally those in STE occupations below managerial level earn more than those in non STEM occupations at a similar level.

For those in professional jobs, only those in technology occupations or occupations combining science, engineering and technology earn a wage premium over non STE occupations at that level (of 2% and 5% respectively). For those in managerial groups generally we see no significant wage premia from working in STE occupations and those in engineering management actually earn significantly less than those in non-STE management occupations.

For occupations below managerial level, those in science, technology or engineering (or combinations of) earn more than those in other occupations - though in the case of occupations combining science and engineering the coefficient is not statistically significant. For example, those in science occupations earn 14% more than those in non STE occupations; those in technology occupations earn 24% more and those in engineering earn 16% more than those in STE occupation at this level. Those in engineering/technology occupations earn 30% more than those in non STE occupations and those in occupations combining science, engineering and technology earn 22% more.

These findings perhaps reflect the fact that many senior professional and managerial level jobs are not identified as being specifically STE occupations, though many people in these jobs have STEM qualifications and may be working in STEM-related sectors. It does however, raise the question as to whether those who want to remain in STEM to the highest levels of occupation end up earning no more (and in some cases less) than their non STEM colleagues. This would clearly provide limited incentive for career progression within STEM.

Wage premia for STEM qualifications used in STE occupations

In this last section, we consider the value of STEM qualifications when used in STE occupations. Table 9 presents the results of wage regressions which estimate the wage premium associated with a STEM qualification when used in a STE occupation as per equation 4 above. These regressions include the same controls as the previous equations i.e. age, age squared, gender and region. In these regressions we include a) a main effect from having a particular qualification b) an additional effect from having a qualification in a STEM subject and c) an additional effect from having a STEM-subject qualification in a STE occupation[5].

Ignoring the main effect of qualifications, Table 9 presents the specific premia from holding a qualification in a STEM subject and any additional premia from having that STEM qualification if it is used in a STE occupation. The first set of columns provides an estimate of the wage premia from having a qualification in a STEM subject area. These are the premia that would apply if someone has obtained the qualification in a STEM subject but does not

[5] We do not include a separate main effect for STE occupation, since we know this varies considerably across the occupational-hierarchy thus confounding the qualification-specific interactions.

work in a STE occupation. The second set of columns then provides an estimate of the additional wage premia from using the STEM-subject qualification in a STE occupation. The total additional effect from having a STEM qualification and using it in a STE occupation is therefore obtained by summing the first two effects as indicated in the final column.

Table 9 shows that a number of STEM qualifications attract sizable premia if they are used in a STE occupation. For example, first degrees in STEM subjects attract a sizable additional premia if they are used in a STEM occupation (13%). However, not all higher level qualifications in STEM subjects attract an additional premium if they are used in a STE occupation, consistent with the previous evidence that STE occupations at the professional and managerial level do not always yield an additional premium. Thus those who progress to higher degree level in a STEM subject and who actually use it in a STE occupation earn significantly less than those who have a higher degree in a STEM subject and use it in a non STE occupation (by 6%). Those with STEM-subject vocational degrees, NVQ 4 or NVQ5 qualifications who also work in STE occupations do not earn significantly more (or less) than their peers in other occupations (the coefficients are statistically insignificant). However, those who have a STEM-subject diploma do earn significantly more (3.4%) if they use it in a STE occupation. Individuals with STEM HNC or HND qualifications earn significantly more than those with other HNC or HNDs (4%) but they earn a lot more (11%) if they actually use these qualifications in a STE occupation. A number of STEM qualifications at level 3 in particular attract an additional wage premia if used in a STE occupation. The following qualifications earn an additional wage premium if they are used in a STE occupation: RSA Higher Diplomas (5%), NVQ3 (6%), BTEC National Certificate/Diploma (6%), ONC or OND (<1%), City and Guilds Foundation (10%).

In summary, many but by no means all STEM-subject qualifications have additional value of they are also used in a STE occupation. It is of note that STEM-subject first degrees do have additional value if they are used in a STE occupation. Ideally one would like to know the value of a qualification in a particular STEM subject (e.g. science) when it is used in a particular STE occupation (e.g. science). However, sample sizes preclude us from identifying these complex interaction effects at that level of detail. However, given the patterns observed earlier in the wage premia associated with different STEM subject areas, one might expect a similar pattern here with higher value for most technology and engineering subjects rather than science though this is likely to vary by occupation level too.

Conclusions

In the analysis above we considered the following:

- the value of any qualifications held in STEM subjects,
- the additional wage premia earned by working in a STE occupation, and
- the total wage premia earned by those with STEM qualifications working STE occupations.

The results indicated that on average many qualifications have higher labour market value if they are in a STEM subject. Indeed there are additional positive wage premia from holding a range of qualifications at all levels in a STEM subject (e.g. degrees, NVQ2, City and Guilds Foundation, NVQ3, HNC/HND). When we looked in more detail however, at particular STEM subject areas, we found a mixed pattern. In general there are no wage premia for qualifications held in science bar BTEC National Certificates/Diplomas. More qualifications attract an additional premium in technology, namely NVQ5 and City and Guilds Part I/II. In mathematics, those with first degrees and diplomas in higher education do earn significantly more than those who hold these qualifications in other subject areas. In engineering, a larger number of qualifications do attract an additional wage premium if they are held in this subject area. In many instances however, qualifications in science, engineering or mathematics actually have a slightly lower wage premia than the same qualification in another subject area.

In terms of occupations, those working in STE earn a great deal more than those who are not in STE occupations (19%). Again however, the premium is less for science. Those in science generally earn an additional wage premium of 10% whilst those working in technology, engineering and different combinations of these subjects earn much more than those in non STE occupations (14-34% more). When we investigated these results further, we found that the premium from working in a STE occupation is largely for those working at intermediate and lower level occupations (i.e. not at professional or managerial level). We argued that these findings reflect the fact that many senior level jobs are not identified as being specifically STEM though many people in those jobs do have STEM qualifications.

Lastly we considered the value of STEM qualifications in STE occupations. In many instances, including degrees, STEM qualifications attract a further additional premium if they are used in a STE occupation. In other words, individuals earn a premium from having a STEM qualification and then a further premium from working in a STE occupation. This was particularly true at level 3 (intermediate) qualifications. In some cases there is a particularly sizeable premium if a STEM qualification is used in a STE occupation (e.g. degrees, HNC/HND, City and Guilds Foundation/Part I).

We conclude that:

- Many but not all qualifications have additional value in the labour market if they are in a STEM subject area though less so in science and more so in engineering;
- Most STE intermediate and lower level occupations attract additional wage premia though less so for science and more so for technology and engineering;
- Some but not all STEM qualifications have considerable additional value in the labour market if they are used in a STE occupation.

There are a number of policy implications of this work but first some caveats. We are unable to allow for the cognitive or other types of ability of individuals and hence where we see wage premia this may reflect the fact that more able people (who would earn more anyway) tend to take STEM qualifications or indeed work in STE occupations. Our analysis is therefore not necessarily causal. The second issue is that sample sizes often preclude us looking at the level of detail we would like to. For instance, we do not find significant wage premia by and large for those working in STE at managerial level but this may reflect the relatively small numbers of people working in these occupations. We also focus our attention only on the wage effects from having STEM qualifications: future work could usefully look at whether such qualifications also have an impact on the likelihood of being in employment and the type of employment gained.

Despite these issues, the work does reveal interesting, and in some instances surprising, patterns. STEM qualifications are not all alike and across the different STEM areas we found very different results. In particular, qualifications in science and indeed science occupations often do not attract high wage premia, whereas those in engineering and technology often do. It does vary by qualification level and type though. This means the advice given to young

people needs to be far more nuanced than it currently is. It is not enough to urge young people to study STEM subjects: they also need to understand that some STEM qualifications are more valuable than others. Our evidence also indicates that STE occupations (particularly at intermediate level or below) often attract a sizeable wage premia. Hence students need guidance that earnings in many STE occupations are higher than in non STE occupations. However, again the picture is mixed across the different STE areas. As we found in the case of qualifications, those working in science occupations earn a smaller (though still positive) premium as compared to those working in technology or engineering for example. Most interestingly some qualifications that attract a premium if they are held in a STEM subject also attract an additional wage premium from being used in a STE occupation. For instance, degrees in STEM are valued by the labour market anyway but particularly so in STE occupations. Thus for some qualifications their maximum potential value is for use in STE occupations, another message for those making career decisions.

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Table 1: Number of Observations from each year of Labour Force Survey

2004	25,090
2005	18,766
2006	24,371
2007	25,540
2008	24,725
2009	22,860
2010	21,866

Table 2: Qualifications for which subject information is available

Description	Number with qualification in sample		Number with qualification in STEM subject	
NQF level 4+				
Higher degree (masters, doctorate, other postgraduate degree)	**9,260**	*6%*	**2,770**	*30%*
Vocational degree (pgce, graduate member of professional institute)	**4,762**	*3%*	**658**	*14%*
NVQ or SVQ Level 5	**438**	*0%*	**59**	*13%*
BTEC Higher Level	**778**	*0%*	**202**	*26%*
HNC or HND	**8,145**	*5%*	**3,956**	*49%*
RSA Higher	**155**	*0%*	**13**	*8%*
First / foundation degree	**33,226**	*20%*	**8,944**	*27%*
Diploma in higher education	**4,502**	*3%*	**688**	*15%*
NVQ or SVQ level 4	**1,827**	*1%*	**192**	*11%*
Other higher education qual below deg level	**2,038**	*1%*	**371**	*18%*
NQF level 3				
BTEC National Cert / Diploma level	**4,316**	*3%*	**851**	*20%*
City and Guilds Foundation / Part 1	**5,873**	*4%*	**3,991**	*68%*
GNVQ, GSVQ advanced level	**1,895**	*1%*	**228**	*12%*
ONC or OND	**3,694**	*2%*	**2,100**	*57%*
RSA Advanced diploma or certificate	**289**	*0%*	**13**	*4%*
NVQ or SVQ level 3	**9,033**	*6%*	**1,593**	*18%*
NQF level 2				
BTEC 1st / General Diploma level	**931**	*1%*	**153**	*16%*
City and Guilds Craft / Part 2	**4,167**	*3%*	**2,214**	*53%*

GNVQ, GSVQ intermediate level	**1,445**	*1%*	**186**	*13%*
RSA Diploma	**493**	*0%*	**34**	*7%*
NVQ or SVQ level 2	**10,277**	*6%*	**1,473**	*14%*

Table 3: NS - SEC class main occupation

	Not STEM	STEM	Total
Higher managerial and professional	14,235	9,129	23,364
	60.93	39.07	100
Lower managerial and assoc professional	44,708	4,232	48,940
	91.35	8.65	100
Intermediate occupations	21,304	852	22,156
	96.15	3.85	100
Lower supervisory and clerical	13,272	4,893	18,165
	73.06	26.94	100
Semi-routine occupations	26,133	376	26,509
	98.58	1.42	100
Routine occupations	17,433	377	17,810
	97.88	2.12	100
Never worked, unemployed	6,060	214	6,274
	96.59	3.41	100
Total	**143,145**	**20,073**	**163,218**
	87.70	**12.30**	**100**

Table 4: Proportion of those holding qualifications in STEM who are in STEM occupations

Description	Number with this qualification in a STEM subject	Number with STEM subject and in STEM occupation	
	N	N	
NQF level 4+			
Higher degree (masters, doctorate, other postgraduate degree)	**2,770**	**1,327**	*48%*
Vocational degree (pgce, graduate member of professional institute)	**658**	**157**	*24%*
NVQ or SVQ Level 5	**59**	**21**	*36%*
BTEC Higher Level	**202**	**111**	*55%*
HNC or HND	**3,956**	**2,014**	*51%*
RSA Higher	**13**	**1**	*8%*
First / foundation degree	**8,944**	**3,986**	*45%*
Diploma in higher education	**688**	**138**	*20%*
NVQ or SVQ level 4	**192**	**68**	*35%*
Other higher education qual below deg level	**371**	**83**	*22%*
NQF level 3			
BTEC National Cert / Diploma level	**851**	**394**	*46%*
City and Guilds Foundation / Part 1	**3,991**	**1,847**	*46%*
GNVQ, GSVQ advanced level	**228**	**89**	*39%*
ONC or OND	**2,100**	**1,085**	*52%*
RSA Advanced diploma or certificate	**13**	**0**	*0%*
NVQ or SVQ level 3	**1,593**	**671**	*42%*
NQF level 2			
BTEC 1st / General Diploma level	**153**	**61**	*40%*
City and Guilds Craft / Part 2	**2,214**	**856**	*39%*
GNVQ, GSVQ intermediate level	**186**	**39**	*21%*
RSA Diploma	**34**	**3**	*9%*

NVQ or SVQ level 2	**1,473**	**380**	*26%*

Table 5: Wage premia from holding a STEM qualification by qualification type

Qualification	Coeff on qual	Wage premium from qual compared to no qual %	Coeff on interaction between qual and STEM	Additional wage premium for STEM %
NQF level 4+				
First / foundation degree	**0.26**	**29.34**	**0.04**	**4.47**
Higher degree (masters, doctorate, other postgrad)	**0.14**	**15.07**	**-0.02**	**-2.32**
Vocational degree (pgce, grad member of prof institute)	**0.36**	**43.20**	-0.01	-1.21
NVQ or SVQ 5	**0.12**	**13.22**	-0.09	-8.24
NVQ or SVQ 4	**0.12**	**12.88**	-0.04	-4.06
Diploma in higher education	**0.09**	**9.60**	-0.02	-1.78
HNC or HND	**0.11**	**11.32**	**0.08**	**7.83**
BTEC Higher level	**0.07**	**6.74**	-0.04	-3.83
RSA Higher Diploma	0.02	2.25	**0.23**	**25.24**
Other higher education qual below degree level	**0.07**	**7.53**	-0.03	-3.32
NQF Level 3				
NVQ or SVQ 3	**-0.01**	**-1.38**	**0.06**	**6.60**
GNVQ, GSVQ Advanced level	**0.06**	**6.13**	-0.03	-3.11
RSA Advanced Diploma or Cert	0.01	1.16	**-0.23**	**-20.44**
BTEC National Cert/Diploma	**0.05**	**5.49**	0.02	2.25
ONC or OND	**0.08**	**8.02**	0.00	0.05
City and Guilds Foundation/Part 1	**-0.02**	**-2.37**	**0.09**	**9.19**
NQF Level 2				
NVQ or SVQ 2	**-0.08**	**-8.06**	**0.05**	**5.01**
GNVQ, GSVQ Intermediate level	0.00	0.26	-0.01	-0.71
RSA Diploma	-0.02	-2.35	-0.02	-1.62
City and Guilds Craft/Part 2	**-0.06**	**-5.88**	**0.08**	**8.84**
BTEC 1st / General Diploma	-0.01	-1.15	0.02	2.45

Notes: All regressions control for highest qualification, age, age squared and region. Coefficients are transformed into % wage premium using the formula (exp(coeff)-1)*100 to allow for the fact that wages are logged.

Emboldened coefficients are significant at the 10%.
Separate controls for medical occupations are included.

Table 6: Wage premia from holding particular qualifications in each STEM subject

Qualification	Coeff on science	Wage premium from science qual %	Coeff on tech	Wage premium from tech qual %	Coeff on eng	Wage premium from eng qual %	Coeff on maths	Wage premium from maths qual %
NQF level 4+								
First / foundation degree	-0.01	-0.82	**-0.08**	**-7.55**	**0.07**	**7.27**	**0.09**	**9.06**
Higher degree (masters, doctorate, other postgrad)	0.01	1.07	0.04	4.07	**-0.05**	**-4.53**	-0.03	-3.24
Vocational degree (pgce, grad member of prof institute)	0.00	0.21	0.01	1.35	-0.03	-3.32	0.00	-0.45
NVQ or SVQ 5	**-0.29**	**-25.22**	**0.39**	**48.10**	-0.06	-6.24	-0.20	-17.81
NVQ or SVQ 4	-0.06	-5.41	-0.01	-0.75	-0.01	-1.11	0.01	0.60
Diploma in higher education	0.00	0.10	**-0.12**	**-11.30**	0.02	2.10	**0.07**	**6.97**
HNC or HND	-0.02	-1.64	-0.03	-2.75	**0.11**	**11.69**	0.04	3.71
BTEC Higher level	-0.02	-1.78	0.01	1.21	-0.03	-3.26	-0.05	-5.21
RSA Higher Diploma	0.43	53.77	-0.28	-24.43	0.17	18.91	-0.03	-3.24
Other higher education qual below degree level	**-0.07**	**-6.56**	0.04	3.74	-0.03	-2.86	0.03	2.85
NQF level 3								
NVQ or SVQ 3	-0.01	-1.25	0.00	0.28	**0.10**	**10.21**	-0.06	-5.51
GNVQ, GSVQ Advanced level	0.00	-0.16	-0.04	-4.19	0.02	1.63	-0.07	-6.88
RSA Advanced Diploma or Cert	-0.19	-17.34	-0.02	-2.43	0.32	37.39	**-0.27**	**-23.59**
BTEC National Cert/Diploma	**0.08**	**8.32**	**-0.09**	**-8.61**	0.03	3.06	0.05	5.60
ONC or OND	-0.02	-1.77	0.04	3.58	0.00	0.27	-0.03	-2.49
City and Guilds Foundation/Part 1	-0.02	-1.65	**0.07**	**6.88**	**0.10**	**10.27**	**-0.11**	**-10.24**
NQF level 2								
NVQ or SVQ 2	0.01	0.92	-0.02	-1.81	**0.06**	**6.24**	0.01	0.57
GNVQ, GSVQ Intermediate level	-0.05	-4.50	-0.08	-8.06	0.06	5.91	0.01	0.72
RSA Diploma	-0.18	-16.65	-0.09	-8.72	0.17	19.02	0.03	3.54
City and Guilds Craft/Part 2	-0.06	-5.88	**0.12**	**12.31**	**0.10**	**10.23**	-0.04	-4.40
BTEC 1st / General Diploma	0.09	9.42	0.00	-0.12	0.00	0.16	0.01	0.83

Notes: All regressions control for highest qualification, age, age squared and region.

Coefficients are transformed into % wage premium using the formula (exp(coeff)-1)*100 to allow for the fact that wages are logged.

Emboldened coefficients are significant at the 10% level.

Separate controls for medical occupations are included.

Table 7: Wage premia from working in a STEM occupation

		Sample size	Coeff	Wage premium %
Specification 1	**STEM**	20,295	**0.17**	**18.79**
Specification 2	**S**	2,945	**-0.080**	**-7.40**
	T	7,624	**0.230**	**25.52**
	E	13,541	**0.100**	**10.03**
Specification 3	**S**	1,204	**0.098**	**10.33**
	T	5,550	**0.288**	**33.39**
	E	10,816	**0.136**	**14.59**
	S and E	651	**-0.073**	**-7.01**
	E and T	984	**0.130**	**13.86**
	S, E and T	1,090	**0.162**	**17.60**

Notes: All regressions control for highest qualification, age, age squared and region. Coefficients are transformed into % wage premium
Using the formula (exp(coeff)-1)*100 to allow for the fact that wages are logged.
All coefficients reported are significant at the 10% level.
Separate controls for medical occupations are included.

Table 8: Wage premia from working in a STEM occupation by level of occupation

		All occupations		Professional		Managerial		Below Managerial	
		Coeff	Wage premium %	Coeff	Wage premium %	Coeff	Wage premium %	Coeff	Wage premium %
Specification 1	**STEM**	**0.17**	**18.53**	**-0.034**	**-3.33**	**-0.038**	**-3.73**	**0.158**	**17.12**
Specification 2	**S**	**-0.080**	**-7.69**	**-0.098**	**-9.34**	**-0.145**	**-13.50**	**-0.054**	**-5.26**
	T	**0.230**	**25.86**	**0.030**	**3.07**	**0.029**	**2.94**	**0.117**	**12.41**
	E	**0.100**	**10.52**	**-0.047**	**-4.58**	-0.012	-1.19	**0.143**	**15.37**
Specification 3	**S**	**0.098**	**10.30**	**-0.163**	**-15.02**	**n/a**		**0.134**	**14.32**
	T	**0.288**	**33.38**	**0.019**	**1.92**	0.001	0.15	**0.213**	**23.76**
	E	**0.136**	**14.57**	**-0.060**	**-5.87**	-0.01	-1.06	**0.144**	**15.54**
	S and E	**-0.073**	**-7.04**	**n/a**		**-0.22**	**-19.99**	0.073	7.62
	E and T	**0.130**	**13.85**	**-0.130**	**-12.23**	-0.010	-1.00	**0.261**	**29.88**
	S, E and T	**0.162**	**17.59**	**0.052**	**5.31**	0.010	1.00	**0.195**	**21.52**

Notes: All regressions control for highest qualification, age, age squared and region. Coefficients are transformed into % wage premium

using the formula (exp(coeff)-1)*100 to allow for the fact that wages are logged.

Bold coefficients significant at 10% level.

Separate controls for medical occupations are included.

Note professional is NS-SEC Group 1, managerial NS-SEC Group 2 and below managerial is NS-SEC everything else

Table 9: Wage premia from having STEM qualification in a STEM occupation

	Premia on STEM qualification		Additional benefit from STEM qualification used in STEM occupation		Approx total premia
Qualification	Coeff on qual	Wage premium	Coeff on qual	Wage premium	
NQF level 4+					
First / foundation degree	**-0.01**	**-1.42**	**0.13**	**14.14**	12.72
Higher degree (masters, doctorate, other postgrad)	0.00	0.14	**-0.06**	**-6.20**	-6.06
Vocational degree (pgce, grad member of prof institute)	-0.03	-2.66	0.06	6.05	3.39
NVQ or SVQ 5	-0.06	-6.22	-0.07	-6.42	-12.64
NVQ or SVQ 4	-0.03	-3.00	-0.02	-2.31	-5.31
Diploma in higher education	-0.02	-2.30	**0.03**	**3.37**	1.07
HNC or HND	**0.04**	**3.73**	**0.07**	**7.40**	11.13
BTEC Higher level	**-0.09**	**-8.76**	0.08	8.18	-0.59
RSA Higher Diploma	**0.22**	**24.94**	0.05	5.01	29.95
Other higher education qual below degree level	**-0.06**	**-5.92**	0.13	13.52	7.60
NQF level 3					
NVQ or SVQ 3	**0.04**	**3.76**	**0.06**	**5.81**	9.57
GNVQ, GSVQ Advanced level	-0.06	-5.44	0.05	5.48	0.04
RSA Advanced Diploma or Cert	**-0.22**	**-19.84**	Omitted		
BTEC National Cert/Diploma	-0.01	-1.08	**0.06**	**5.87**	4.79
ONC or OND	-0.01	-0.78	**0.01**	**0.64**	-0.14
City and Guilds Foundation/Part 1	**0.04**	**4.58**	**0.10**	**9.98**	14.55
NQF level 2					
NVQ or SVQ 2	**0.03**	**3.55**	0.06	6.22	9.77
GNVQ, GSVQ Intermediate level	0.00	0.21	-0.03	-2.77	-2.56
RSA Diploma	-0.02	-2.33	0.16	16.95	14.63
City and Guilds Craft/Part 2	**0.05**	**5.26**	0.09		5.26
BTEC 1st / General Diploma	-0.03	-3.26	0.14	14.74	11.48

Notes: All regressions control for highest qualification, age, age squared and region. Coefficients are transformed into % wage premium
Using the formula (exp(coeff)-1)*100 to allow for the fact that wages are logged.
Bold coefficients significant at 10% level.
Separate controls for medical occupations are included.

Appendix A – Qualifications with subject information available and coded as STEM

	(A) Number with qualification		(B) Number with qualification in STEM occupation		Subject of qual availabl e	C) Number with STEM subject		D) Number with STEM subject and in STEM occupation	
	N	*% (sample)*	**N**	*% (of A)*		**N**	*% (of A)*	**N**	*% (of C)*
Higher degree (masters, doctorate, other postgraduate degree)	**9,260**	*6%*	**1,949**	*21%*	Y	**2,770**	*30%*	**1,327**	*48%*
Vocational degree (pgce, graduate member of professional institute)	**4,762**	*3%*	**299**	*6%*	Y	**658**	*14%*	**157**	*24%*
NVQ or SVQ Level 5	**438**	*0%*	**60**	*14%*	Y	**59**	*13%*	**21**	*36%*
BTEC Higher Level	**778**	*0%*	**177**	*23%*	Y	**202**	*26%*	**111**	*55%*
HNC or HND	**8,145**	*5%*	**2,778**	*34%*	Y	**3,956**	*49%*	**2,014**	*51%*
Nursing or other medical qual n.e.c.	**5,059**	*3%*	**66**	*1%*					
RSA Higher	**155**	*0%*	**3**	*2%*	Y	**13**	*8%*	**1**	*8%*
Teaching qual, excl PGCE (all levels except foundation)	**3,671**	*2%*	**77**	*2%*					
First / foundation degree	**33,226**	*20%*	**6,029**	*18%*	Y	**8,944**	*27%*	**3,986**	*45%*
Diploma in higher education	**4,502**	*3%*	**392**	*9%*	Y	**688**	*15%*	**138**	*20%*
NVQ or SVQ level 4	**1,827**	*1%*	**194**	*11%*	Y	**192**	*11%*	**68**	*35%*
Other higher education qual below deg level	**2,038**	*1%*	**171**	*8%*	Y	**371**	*18%*	**83**	*22%*
Apprenticeship	**13,376**	*8%*	**4,926**	*37%*					
Modern Apprenticeship (any type except foundation level)	**731**	*0%*	**327**	*45%*					
BTEC National Cert / Diploma level	**4,316**	*3%*	**695**	*16%*	Y	**851**	*20%*	**394**	*46%*
City and Guilds Foundation / Part 1	**5,873**	*4%*	**2,199**	*37%*	Y	**3,991**	*68%*	**1,847**	*46%*
GNVQ, GSVQ advanced level	**1,895**	*1%*	**220**	*12%*	Y	**228**	*12%*	**89**	*39%*
ONC or OND	**3,694**	*2%*	**1,417**	*38%*	Y	**2,100**	*57%*	**1,085**	*52%*

RSA Advanced diploma or certificate	**289**	*0%*	**11**	*4%*	Y	**13**	*4%*	**0**	*0%*
Access to HE qual	**440**	*0%*	**24**	*5%*					
A-level, voc A-level, equiv	**39,398**	*24%*	**5,628**	*14%*					
A/S-level, voc A/S-level, equiv	**758**	*0%*	**34**	*4%*					
NVQ or SVQ level 3	**9,033**	*6%*	**1,098**	*12%*	Y	**1,593**	*18%*	**671**	*42%*
BTEC 1st / General Diploma level	**931**	*1%*	**124**	*13%*	Y	**153**	*16%*	**61**	*40%*
City and Guilds Craft / Part 2	**4,167**	*3%*	**1,070**	*26%*	Y	**2,214**	*53%*	**856**	*39%*
GNVQ, GSVQ intermediate level	**1,445**	*1%*	**123**	*9%*	Y	**186**	*13%*	**39**	*21%*
RSA Diploma	**493**	*0%*	**13**	*3%*	Y	**34**	*7%*	**3**	*9%*
A-level, voc A-level, equiv (just one)	**7,296**	*4%*	**898**	*12%*					
A/S-level, voc A/S-level, equiv (just 2-3)	**2,543**	*2%*	**262**	*10%*					
CSE grade 1	**6,657**	*4%*	**896**	*13%*					
GCSE, vocat GCSE 5 or above	**35,841**	*22%*	**4,439**	*12%*					
NVQ or SVQ level 2	**10,277**	*6%*	**708**	*7%*	Y	**1,473**	*14%*	**380**	*26%*
O-level or equivalent 5 or above	**37,612**	*23%*	**5,441**	*14%*					
Modern Apprenticeship Foundation level	**1,554**	*1%*	**567**	*36%*					
Basic Skills qual	**1,192**	*1%*	**78**	*7%*					
BTEC 1st / General Certificate level	**1,820**	*1%*	**340**	*19%*					
City and Guilds Advanced craft / Part 3	**8,294**	*5%*	**1,782**	*21%*					
GNVQ, GSVQ Foundation level	**1,284**	*1%*	**144**	*11%*					
Key Skills qual	**979**	*1%*	**113**	*12%*					
Other prof, voc, foreign quals	**54,590**	*33%*	**6,903**	*13%*					
RSA Other	**8,210**	*5%*	**259**	*3%*					
Youth Training Certificate	**611**	*0%*	**84**	*14%*					
CSE grade 2-5	**15,860**	*10%*	**2,011**	*13%*					
GCSE, vocat GCSE <5	**20,147**	*12%*	**2,221**	*11%*					
NVQ or SVQ level 1	**5,131**	*3%*	**532**	*10%*					
O-level or equivalent <5	**15,516**	*10%*	**2,209**	*14%*					
Entry Level qual	**197**	*0%*	**24**	*12%*					

Appendix B – Occupations coded as STEM

OCCUPATIONS				STEM CODING		
SOC2000 CODE	soc2km			S	T	E
CODE	Description	N				
2111	Chemists	200		1		
2112	Biological scientists and biochemists	578		1		
2113	Physicists, geologists and meteorologists	117		1		
2212	Psychologists	146		1		
2216	Veterinarians	76		1		
2321	Scientific researchers	87		1		
1136	Information and communication technology managers	1882			1	
2131	IT strategy and planning professionals	696			1	
2132	Software professionals	1838			1	
3131	IT operations technicians	718			1	
3132	IT user support technicians	416			1	
1121	Production, works and maintenance managers	2222				1
2121	Civil engineers	386				1
2122	Mechanical engineers	408				1
2123	Electrical engineers	288				1
2124	Electronics engineers	217				1
2125	Chemical engineers	47				1
2127	Production and process engineers	226				1
2128	Planning and quality control engineers	191				1
2129	Engineering professionals n.e.c.	453				1

2431	Architects	191			1
3113	Engineering technicians	418			1
3114	Building and civil engineering technicians	153			1
5215	Welding trades	450			1
5221	Metal machining setters and setter-operators	452			1
5222	Tool makers, tool fitters and markers-out	128			1
5223	Metal working production and maintenance fitters	1373			1
5224	Precision instrument makers and repairers	109			1
5231	Motor mechanics, auto engineers	1072			1
5232	Vehicle body builders and repairers	148			1
5233	Auto electricians	40			1
5241	Electricians, electrical fitters	1097			1
5314	Plumbers, heating and ventilating engineers	679			1
8143	Rail construction and maintenance operatives	68			1
3119	Science and engineering technicians n.e.c.	246	1		1
3111	Laboratory technicians	405	1		1
2126	Design and development engineers	393		1	1
5212	Moulders, core makers, die casters	24		1	1
5242	Telecommunications engineers	289		1	1
5244	TV, video and audio engineers	55		1	1
5245	Computer engineers, installation and maintenance	223		1	1
1137	Research and development managers	387	1	1	1
3112	Electrical/electronics technicians	178	1	1	1
5249	Electrical/electronics engineers n.e.c.	525	1	1	1

Appendix C – Occupations coded as medical

For the equations investigating the wage premium associated with different occupations, medical occupations are coded separately as follows

medical dummy 1

221 Health Professionals

221

1 Medical practitioners

221

2 Psychologists

221

3 Pharmacists/pharmacologists

221

4 Ophthalmic opticians

221

5 Dental practitioners

medical dummy 2

321 Health Associate Professionals

321

1 Nurses

321

2 Midwives

321

3 Paramedics

321

4 Medical radiographers

321

5 Chiropodists

321

6 Dispensing opticians

321

7 Pharmaceutical dispensers

3218 Medical and dental technicians
322 Therapists
3221 Physiotherapists
3222 Occupational therapists
3223 Speech and language therapists
3229 Therapists n.e.c.