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Business, Innovation and Skills and Education Committees

Education, skills and productivity: commissioned research

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Contacts

All correspondence should be addressed to the Clerk of the Business, Innovation and Skills Committee, House of Commons, London SW1A 0AA. The telephone number for general enquiries is 020 7219 5777; the Committee's email address is biscom@parliament.uk

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Contacts

All correspondence should be addressed to the Clerk of the Education Committee, House of Commons, London, SW1A 0AA. The telephone number for general enquiries is 020 7219 1376; the Committee's email address is educom@parliament.uk

Education, skills and productivity

1. The Education Committee and the Business, Innovation and Skills Committee have agreed to carry out joint work on the contribution that education and skills make to productivity. In preparation for this work, the Committees jointly commissioned research from the National Institute of Economic and Social Research, which undertook a review of the literature on the main channels of influence by which education and skills appear to affect economic performance. The research compared the role played by education and training institutions, including schools, and the vocational systems in the following countries: United Kingdom; United States of America; France; and Germany.

2. The research is published as an appendix to this Report.

Appendix

Skills and Productivity in the UK, US, France and Germany: a Literature Review

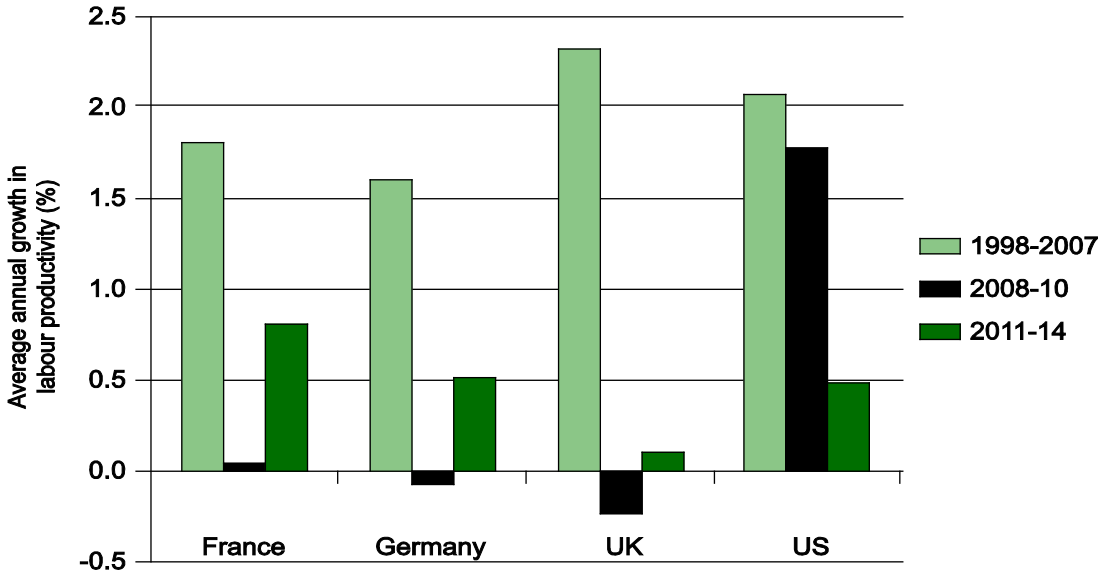
Geoff Mason and Ana Rincon-Aznar, National Institute of Economic and Social Research, London

Report to the Business, Innovation and Skills and Education Select Committees, House of Commons, 26 October 2015

1. Introduction

In the decade leading up to the 2008–09 recession, average labour productivity (ALP) grew faster in the UK than in the US, France and Germany, thus helping to narrow the longstanding gaps in ALP levels between the UK and those three countries. However, in the wake of the UK's relatively poor productivity growth performance during and after the recession (Figure 1.1), ALP levels–measured by Gross Domestic Product (GDP) per hour worked–were estimated to be about a third lower in the UK in 2014 than in all three of the US, France and Germany (ONS, 2015).

Figure 1.1: Average annual rates of growth in constant-price GDP per hour worked in France, Germany, UK and US, 1998–2014



Source: ONS Statistical Bulletin, International Comparisons of Productivity — First Estimates, 2014 (released 18 September 2015)

In this report we examine the extent to which these inter-country differences in productivity performance can be attributed to skill deficiencies in the UK relative to the other three countries, paying particular attention to national-institutional differences in the ways that skills are produced and developed in each country.

Researchers have identified numerous examples of mechanisms by which skills can contribute positively to economic performance, in particular, the role of skills in supporting the introduction of new technologies and in facilitating knowledge transfer (between regions, countries and industries) and in fostering innovation of different kinds (Lundvall, 1992; Bresnahan et al, 2002; Chun, 2003). However, skills can only make such positive contributions when they are applied in combination with other production inputs, for example, machinery, equipment, buildings, land and raw materials as well as intangible assets such as those deriving from investments in innovation.

Thus skills tend to feature only partially or indirectly in most attempts to explain the recent weakening of UK productivity performance. For example, Pessoa and van Reenen (2014) argue that the decline in UK labour productivity during and after the recession owed much to labour–both skilled and unskilled–having less physical capital to work with as firms substituted capital for labour in response to falling real wages and higher costs of capital. They estimate that average capital stocks per worker declined by 5% between the second quarter of 2008 and the second quarter of 2012, and that this accounted for around two thirds of the productivity decline during this period.

This 'capital shallowing' hypothesis has been disputed by several other researchers. For example, Oulton (2013) argues that the estimate of capital per worker used by Pessoa and van Reenen overstates the pre-crisis level of capital stock and therefore overestimates the post-crisis decline in the capital-labour ratio. In addition, recent growth accounting studies have found that weak labour productivity growth in the UK owes little to capital shallowing but instead is much more attributable to relatively poor performance in 'total factor productivity' (TFP, a measure of changes in value added per hour worked that cannot be attributed to increases in the quantity and quality of either capital or labour) (Goodridge et al, 2015; Murphy and Franklin, 2015). To a large extent the TFP measure captures the efficiency with which existing capital and labour resources (both skilled and unskilled) are utilised but it can also reflect unmeasured (or poorly measured) production inputs in growth accounting calculations. [1]

Potential insights into the links between skills and productivity trends emerge when a sectoral perspective is adopted. Dolphin and Hatfield (2015) report evidence of a structural shift from high-productivity to low-productivity work, especially over the last three years. They use shift-share analysis to decompose the UK productivity gap in relation to four other European economies (Germany, France, Netherlands, Belgium) and estimate that around half of the weakness in UK productivity growth since 2012 derives from structural shifts in the economy, with strong job growth in relatively low value-added, low-paid sectors of the economy. They argue that the proportion of over-qualified and/or over-experienced workers has increased and that many firms are making less use of the skills available to them than they were before the financial crisis.

1 Growth accounting is a method of estimating the separate contributions of production inputs to growth in labour productivity. It does not take account of complementarities between production inputs. Total factor productivity is estimated as the residual growth in labour productivity which is not accounted for by growth in measured production inputs.

However, in contrast to this assessment, other researchers report evidence of a reallocation of work-hours away from low-productivity industries and towards high productivity industries, consistent with growing employment of high-skilled workers in the creation of intangible assets related to research and innovation (Goodridge et al, 2013, 2014).

Indeed, recent growth accounting-based estimates suggest that labour productivity growth could have been even weaker in the UK in recent years had it not been for significant up-skilling of the workforce. Using skill measures based on formal qualifications, Rincon-Aznar et al (2015) estimate that, in the run-up to the 2008–09 financial crisis, growth in skills accounted for around 20% of total labour productivity growth in the UK. Between 2008–13 (that is, during and after the financial crisis), overall growth in labour productivity was negative on average—largely because of declining total factor productivity—but skills continued to make a positive contribution.

Thus, even if limited use of skills contributes to low productivity in some sectors of the UK economy, it cannot be argued that weak productivity growth in the UK is primarily due to skill deficiencies, nor that skill improvements on their own will ensure more rapid growth in productivity in the future. Nonetheless, investment in skills development—in conjunction with many other kinds of investment (in both tangible and intangible assets)—has an important part to play in fostering productivity growth. Hence it is instructive to look at how the UK compares with other countries in terms of, for example, the mix of high-level and intermediate skills that are produced and the different institutions underlying both general and vocational education and training, and to assess what policy implications (if any) these comparisons yield for the UK.

The report is ordered as follows. In Section 2 we describe the main differences between the UK, US, France and Germany in the composition of workforce skills. Section 3 then explores high-level skills issues with emphasis on university graduates' contributions to innovation and productivity growth and on graduate employability skills issues. Section 4 focuses on intermediate skills development, in particular, the roles played by technician-level training, apprenticeship training and full-time vocational schooling in the four countries. Section 5 assesses the extent of skills upgrading through continuing training of adult workers in each country. Section 6 summarises our main findings and considers what implications (if any) they have for UK policy-makers.

2. Cross-country differences in workforce skills

Because of their intangible nature, skills are hard to measure. Over the years researchers have used several different proxy measures of skill, for example, years of completed schooling which is a measure of attendance rather than attainment. Here we make use of formal qualifications measures which have the advantage of capturing something of what has actually been learned while undergoing education rather than just signifying attendance. However, like the years of schooling measure, they have the disadvantage of neglecting skills acquired in the workplace without formal certification. We examine available evidence on training of this kind in Section 5 below.

Table 2.1 compares the mix of workforce qualifications in the UK, US, France and Germany in 2012 with that found ten years earlier. In 2002 the 21% graduate share in the UK had started to reflect the transition to mass higher education which began in the late 1980s but it was still 8 percentage points below the graduate share in the US where mass higher education was already well established. After ten more years of new graduate entrants to the UK workforce, as well as non-graduate departures from it, the UK graduate share rose to a third in 2012, much the same as in the US and well above the 19% and 23% graduate shares in, respectively, France and Germany.

It should be noted that graduate-level courses vary across countries in the extent to which they have a predominantly theoretical or applied focus, and in the extent to which classroom studies are combined with practical experience. In the case of Germany, long-established graduate-level courses of a practical or occupation-specific nature in *Fachhochschulen* ('universities of applied sciences') operate in parallel with traditional, more 'academic' university courses. *Fachhochschulen* account for roughly a third of higher education students in Germany.[2] Their graduates are traditionally well regarded by German employers for their 'employability' skills and have few counterparts in the UK, US and France; we return to issues of graduate employability in Section 3.

Table 2.1: Employment analysed by qualification group share, France, Germany, UK and US, 2002 and 2012

	France	Germany	UK	US
	% of all persons in employment aged 18–64			
2002				
Graduates	12	18	21	29
Above NVQ Level 3, below Bachelor degree level	11	11	9	9
NVQ Levels 2–3 or equivalent — vocational	39	58	23	-
NVQ Levels 2–3 or equivalent — general	10	6	29	-
Some college, no degree (US)	-	-	-	20
High school graduate (US)	-	-	-	31
Low or no qualifications	28	7	18	10
Total	**100**	**100**	**100**	**100**
2012				
Graduates	19	23	33	34

2 Estimate of Fachhochschulen student numbers taken from Powell et al (2012).

Above NVQ Level 3, below Bachelor degree level	15	11	11	11
NVQ Levels 2–3 or equivalent – vocational	35	55	22	-
NVQ Levels 2–3 or equivalent — general	9	6	26	-
Some college, no degree (US)	-	-	-	20
High school graduate (US)	-	-	-	27
Low or no qualifications	22	5	9	8
Total	**100**	**100**	**101**	**100**

Sources: Enquête-Emploi (France), Socio-Economic Panel (Germany), Labour Force Survey (UK), Current Population Survey (US)

Note re classification of qualifications:

1. Graduates:

France: Bac + 3 or more years of study, eg, License, Maitrise, Doctorat.

Germany: Fachhochschulabschluss, Hochschulabschluss and higher qualifications.

UK: First degrees and higher degrees.

US: Bachelor degrees and higher degrees.

2. Above Level 3, below Bachelor degree level:

France: BTS, DUT; Paramédical ou social avec baccalauréat general; Paramédical ou social sans baccalauréat general.

Germany: Meister-/Techniker oder gleichwertiger Fachschulabschluss; Abschluss einer 2- oder 3jährigen Schule des Gesundheitswesens; Abschluss an einer Fach- oder einer Berufsakademie; Abschluss der Fachschule in der ehemaligen DDR; Beamtenausbildung.

UK: Foundation degrees, Higher National awards, sub-degree qualifications in teaching and nursing and equivalent awards; Diplomas in Higher Education and other higher education qualifications below Bachelor degree level.

US: Associates degrees.

3. NVQ Levels 2–3 or equivalent — vocational:

France: Baccalauréat technologique, BAC pro. et brevet professionnel; BEI, BEC, BEA; CAP, BEP, et BEPC; CAP, BEP seul.

Germany: Anlernausbildung oder berufliches Praktikum; Berufsvorbereitungsjahr; Abschluss einer Lehrausbildung; Vorbereitungsdienst für den mittleren Dienst in der öffentlichen Verwaltung; Berufsqualifizierender Abschluss an einer Berufsfachschule/Kollegschule; Abschluss einer 1jährigen Schule des Gesundheitswesens.

UK: BTEC National awards, City & Guilds advanced craft and craft awards, completed trade apprenticeships and equivalent awards; BTEC General and First awards; City & Guilds awards below craft level; SCOTVEC National Certificate modules; YT, YTP certificates and equivalent awards.

Notes to Table 2.1 (continued):

4. NVQ Levels 2–3 or equivalent — general:

France: Baccalauréat général et diplôme technique secondaire; Baccalauréat général seul.

Germany: Realschulabschluss, Abitur.

UK: A level, A-S level, Scottish CSYS, Scottish Higher and equivalent awards; GNVQ Advanced awards, GCSE grade A-C, O level, CSE grade one and equivalent Scottish awards; GNVQ Intermediate and Foundation awards; and equivalent awards.

At intermediate qualification levels—between university graduates and workers with low or no formal qualifications—several inter-country contrasts stand out:

(1) the relatively large share of French employees with technician-level qualifications (below Bachelor degrees, above NVQ3 level) which reflects the prevalence in France of short-cycle higher education courses leading to qualifications such as the BTS (*Brevet de technicien supérieur*, Advanced Technician Certificate) and the DUT (*Diplôme universitaire de technologie*, University Technical Diploma).

(2) the relatively large and stable share (58% in 2002, 55% in 2012) of the German workforce holding intermediate vocational qualifications (mostly at the equivalent of NVQ Level 3) which largely reflects the strong German tradition of apprenticeship training.

(3) the UK's relatively large share of general education qualifications at NVQ Levels 2–3 which contrasts with the much greater emphasis on vocational education and training at these intermediate levels in both Germany and France.

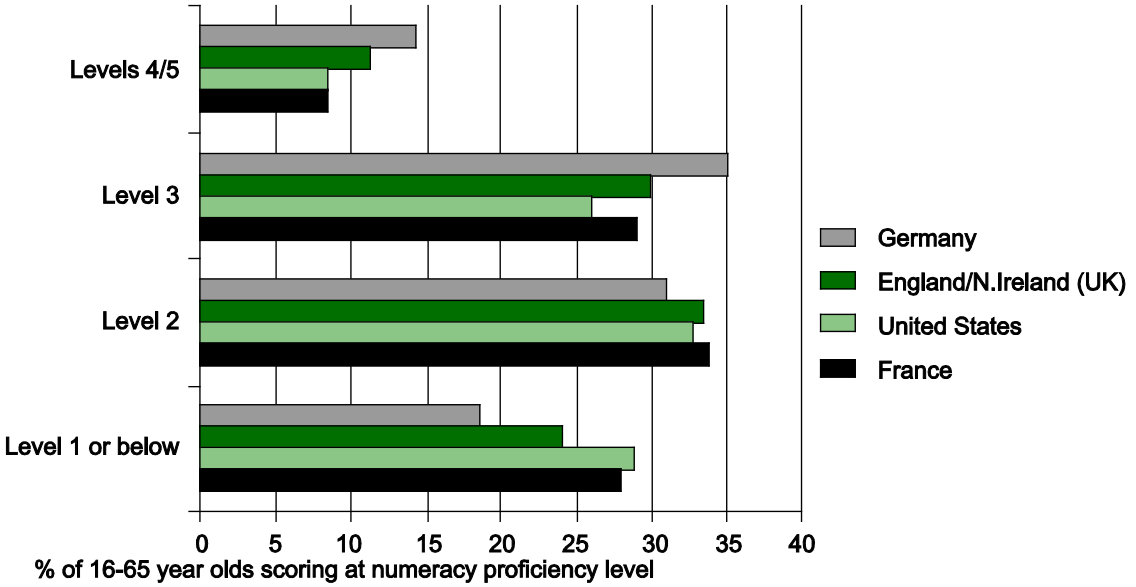
At the equivalent of NVQ Levels 2–3, the US cannot be compared directly with the other three countries because of differences in education and certification systems. A fifth of US workers are classed as having attended college after high school without obtaining a formal diploma but a large share of these people may still have acquired useful vocational skills in the process (Marcotte, 2006). In 2012 another 27% of the US adult population held high school graduation diplomas but had not participated in formal education above that level. The majority of these people will have acquired general skills but not vocational skills during their high school education since vocational education programmes (traditionally followed by a minority of high school students) have been in sharp decline since the early 1990s (Cappelli, 2015).

As in the UK, the American emphasis on general skills development is not necessarily a disadvantage in terms of economic performance since general (or 'generic') skills such as communication and mathematical skills are sought after by employers for many purposes. Indeed, Krueger and Kumar (2004) develop a model of technology adoption and economic growth which suggests that general or academic education may be better suited to developing the skills needed to adapt to fast-changing technologies than is specialised vocational education.

However, in both the US and UK, any advantages deriving from general education may only apply towards the upper end of the skills spectrum. International comparisons of mathematics proficiency levels based on the OECD's 2012 Survey of Adult Skills (SAS) suggest that in both countries proficiency in numeracy was significantly below average among 23 participating countries (OECD, 2013, Figure 2.5). The SAS assesses proficiency in numeracy at six different levels (described in the notes to Figure 2.1) which range from the use of basic arithmetic skills (at 'Below Level 1' and Level 1 itself) to the interpretation and use of basic statistics at Level 3 and the use of progressively more complex mathematical procedures at Levels 4 and 5.

Figure 2.1 shows that an estimated 11% of 16–65 year olds in England/Northern Ireland (representing the UK) and 8% in the US attained Levels 4 or 5 which placed England/NI at 14th and the US 16th among the 23 countries. France also compared poorly on this measure (ranking 18th) while, of the four countries considered here, Germany fared best, ranking 8th with 14% of 16–65 year olds attaining Levels 4 or 5 in mathematical proficiency. [3] At the lower end of the scale it is notable that as many as 29% of 16–65 year olds in the US, 28% in France and 24% in England were graded as Level 1 or Below Level 1.

Figure 2.1: Numeracy proficiency among 16–65 year olds, 2012, France, Germany, UK and US



Source: Survey of Adult Skills, 2012 (OECD, 2013, data underlying Figure 2.5)

Notes: Description of proficiency levels in numeracy Source: OECD (2013), Table 2.3:

Below Level 1: Tasks at this level require the respondents to carry out simple processes such as counting, sorting, performing basic arithmetic operations with whole numbers or money, or recognising common spatial representations in concrete, familiar contexts where the mathematical content is explicit with little or no text or distractors.

Level 1: Tasks at this level require the respondent to carry out basic mathematical processes in common, concrete contexts where the mathematical content is explicit with little text and minimal distractors. Tasks usually require one-step or simple processes involving counting, sorting, performing basic arithmetic operations, understanding simple percents such as 50%, and locating and identifying elements of simple or common graphical or spatial representations.

Level 2: Tasks at this level require the respondent to identify and act on mathematical information and ideas embedded in a range of common contexts where the mathematical content is fairly explicit or visual with relatively few distractors. Tasks tend to require the application of two or more steps or processes involving calculation with whole numbers and common decimals, percents and fractions; simple measurement and spatial representation; estimation; and interpretation of relatively simple data and statistics in texts, tables and graphs.

Level 3: Tasks at this level require the respondent to understand mathematical information that may be less explicit, embedded in contexts that are not always familiar and represented in more complex ways. Tasks require several steps and may involve the choice of problem-solving strategies and relevant processes. Tasks tend to require the application of number sense and spatial sense; recognising and working with mathematical relationships, patterns, and proportions expressed in verbal or numerical form; and interpretation and basic analysis of data and statistics in texts, tables and graphs.

Level 4: Tasks at this level require the respondent to understand a broad range of mathematical information that may be complex, abstract or embedded in unfamiliar contexts. These tasks involve undertaking multiple steps and choosing relevant problemsolving strategies and processes. Tasks tend to require analysis and more complex

3 The leading seven countries above Germany on this measure were Finland, Japan, Sweden, Norway, Flanders (Belgium), Netherlands and Denmark.

reasoning about quantities and data; statistics and chance; spatial relationships; and change, proportions and formulas. Tasks at this level may also require understanding arguments or communicating well-reasoned explanations for answers or choices.

Level 5: Tasks at this level require the respondent to understand complex representations and abstract and formal mathematical and statistical ideas, possibly embedded in complex texts. Respondents may have to integrate multiple types of mathematical information where considerable translation or interpretation is required; draw inferences; develop or work with mathematical arguments or models; and justify, evaluate and critically reflect upon solutions or choices.

3. High-level skills issues

3.1 High-level skills and productivity

University graduates in relevant disciplines are well-placed to generate new ideas and knowledge relevant to innovation and help firms take advantage of new technologies. For example, US evidence suggests that high-level skills played a key role in facilitating the effective take-up of Information and Communication Technologies (ICTs) and that there has been a complementarity over several decades between ICTs and the educated labour required to perform non-routine tasks (Bresnahan et al, 2002; Autor et al, 2003). A number of studies in European countries have also found evidence of a positive relationship between workforce skills and the adoption of ICTs (for example, Hollenstein, 2004 and Bayo-Moriones and Lera-López, 2007). In general, high skilled workers are well-placed to contribute to the selection and installation of ICTs and also to the adaptation of ICTs to firm-specific requirements.

Other important mechanisms by which high-level skills may affect innovative performance include knowledge transfer processes, for example, the transfer of knowledge between firms, sectors and countries through collaboration on R&D and technical problem-solving among skilled workers involved in supply-chains (Lundvall, 1992), the mobility of highly-qualified engineers and scientists between firms (Saxenian, 1994) and the impact of foreign direct investment (FDI). Research evidence suggests that FDI is attracted to economies with a high skills base while simultaneously bringing with it new technologies and knowledge which augment the skills base of host countries (Barrell and Pain, 1997; Blomstrom and Kokko, 2003). However, the impact of multinational enterprises on host-country innovation may be reduced if host-country firms lack the absorptive capacity to take full advantage of new knowledge and technologies or are unable to withstand the increase in competition.

'Absorptive capacity' here refers to the ability to identify and make effective use of knowledge, ideas and technologies that are generated outside each firm (Cohen and Levinthal, 1989). As suggested by Zahra and George (2002), it is useful to distinguish between potential absorptive capacity (the ability to acquire and assimilate external knowledge) and realised absorptive capacity (the ability to transform and apply acquired knowledge within organisations). At each stage of this process — recognising useful external knowledge, seeing how it might be applied and then successfully making use of it within firms—high-skilled workers have a key role to play. Furthermore, supply-chains involving foreign investors have greater prospects of becoming 'developmental' in nature (with close collaborative relationships between supply-chain partners) rather than 'dependent' (with suppliers being used primarily to cut costs) if prospective host-country suppliers are well endowed with high-level skills. [4]

The potential economic advantages of a large supply of graduates show up in a number of ways. In the US, the ready availability of university graduates over several decades

4 For more discussion of this distinction between developmental and dependent supply-chains, see Turok (1993) and Brown (2000).

contributed to relatively high levels of innovation and helped the US in the late 1990s and early 2000s to outperform most European countries in terms of both productive applications of ICT and in the estimated contribution of ICTs to growth in labour productivity (O'Mahony and van Ark, 2003; Van Ark, O'Mahony and Timmer, 2008). Similarly, high-level skills featured prominently in the sizeable skills contribution to UK productivity growth in the decade prior to the 2008–09 recession (Rincon-Aznar et al, 2015). Econometric analysis for 15 countries (including France and Germany as well as the UK and US) suggests that a 1% increase in the graduate share of the workforce is associated with 0.2–0.5% growth in long run productivity levels (Holland et al, 2013).

In spite of the apparent advantages of mass higher education, there are similar concerns in both the UK and US about a number of issues relating to graduate supply, in particular:

- Reported shortages of graduates in STEM (science, technology, engineering and mathematics) disciplines
- Reported deficiencies in the 'employability' skills and 'work-readiness' of many new graduates
- Sizeable proportions of graduates who (at least at the start of their careers) experience difficulties in finding jobs requiring graduate-level skills

3.2 STEM graduate supplies

In the UK periodic reports of apparent or predicted shortages of STEM graduates over the years (for example, Roberts, 2002; RAE, 2012) might be thought to reflect relatively low salaries for graduates in STEM subjects. However, recent evidence points to relatively high average salary returns to degrees in STEM subjects, albeit more so in engineering and technology than in science subjects (Greenwood et al, 2011). In addition, average salary returns to Bachelor degrees in STEM subjects such as mathematics/computing and engineering/technology have been found to compare favourably with returns to traditionally well-rewarded subjects such as accountancy and medicine (O'Leary and Sloane, 2005). However, there is a wide dispersion of salary returns around the average levels. Where difficulties in recruiting STEM graduates do occur, they tend to be experienced by relatively low-paying employers in STEM-related industries (especially in manufacturing). Many such STEM employers are frustrated by the large and apparently growing proportion of STEM graduates who work in non-STEM jobs and industries (Bosworth et al, 2013).

From the perspective of skill requirements across the UK economy, this can be seen in a positive light as diffusing graduates who, by dint of their studies in STEM subjects, are widely seen as possessing desirable skills in mathematics and in 'logical approach[es] to solving problems' (BIS, 2011: 7). To the extent that such skills are in short supply among the wider pool of graduates, this must partly reflect the fact that STEM subjects absorb a high proportion of those entrants to UK universities who have studied maths beyond the age of 16. Indeed, England in particular is conspicuous by international standards for the

relatively large proportion of school pupils who abandon maths study at that age (Hodgen et al, 2013).

In a review of the many reports focussing on apparent shortages of STEM graduates in the US, Cappelli (2015) cites counter-evidence of many recent US engineering graduates not finding jobs as engineers or not choosing to take such jobs because of their relatively low pay rates. One implication is that, as in the UK, if there is a problem in relation to STEM skills, it is that some employers in STEM-related industries find it hard to compete on salaries with employers in other industries. Again as in the UK, the relatively high demand for STEM graduates in non-STEM industries in the US could reflect the relatively low proportion of workers with adequate mathematical skills (discussed in Section 2 above) which helps to enhance employer demand, and thus job and salary prospects, for highly numerate STEM graduates across the whole economy.

3.3 Graduate employability and underemployment issues

Another common issue in both the UK and US concerns a perceived lack of employability skills among many graduates. From the perspective of employers, 'employability' tends to refer to 'work-readiness', that is, possession of the skills, knowledge, attitudes and commercial understanding that will enable new graduates to make productive contributions to organisational objectives soon after commencing employment. In the UK a number of employers' associations and higher education organisations in the UK have, over many years, urged universities to make more explicit efforts to develop the 'key', 'core', 'transferable' and/or 'generic' skills needed in many types of high-level employment (AGR, 1995; Universities UK, 2002; CBI 2009; CBI/Universities UK, 2010).

In response to such urgings, considerable resources have been devoted to various employability skills initiatives in UK higher education. Empirical evidence on the effectiveness of these initiatives suggests that structured work experience is more likely to have positive effects on graduates' employment prospects than is the case for university departments' efforts to develop employability skills in classroom settings (Mason et al, 2009). This finding serves as a reminder that many relevant employability skills are probably best learned in workplaces rather than through full-time education courses.

In past decades many UK employers used to offer substantial work-based training programmes for new graduate recruits. However, the implication of the current pressure for employability skills to be developed prior to taking up employment is that many employers are now less willing to undertake responsibility for graduates' initial training. This trend is entirely consistent with US evidence, reviewed by Cappelli (2015), of employers' unwillingness to recruit graduates without prior work experience, with the same implication that many employers now seek to avoid responsibility for training inexperienced new recruits.

Once graduates do find employment, many benefit from high positive average salary premia attached to Bachelor degree-level qualifications in both the UK and the US (Goldin

and Katz, 2007; Walker and Zhu, 2008). [5] However, in both countries there has been some widening in the dispersion of returns to university education and there are concerns about under-utilisation of some graduates' skills, particularly when they first enter the labour market (Green and Zhu, 2010; Abel et al, 2014).

How do France and Germany compare with the UK and US in relation to STEM, graduate employability and graduate underemployment issues? International comparisons suggest that the STEM shares of university students in both France and Germany are higher than in the UK and US and there are fewer concerns about possible shortages of STEM graduates in the two Continental European countries (Marginson et al, 2013). France and Germany also differ greatly from the US and UK in respect of graduate employability skills in that structured work experience and training is provided for large proportions of higher education students in France and Germany as part of their study programmes (discussed further below), including the sizeable proportion of graduates from German *Fachhochschulen*. In addition about one in six German students who gain the *Abitur* necessary to study at university choose first to undertake apprentice training (Pilz, 2009). These features of the French and German HE systems do not, however, prevent issues of graduate underemployment from arising in both countries.

One comparable measure of underemployment of graduate skills across countries derives from the 2010 European Working Conditions Survey which asks if respondents possess the skills to carry out more demanding duties than they are given in their jobs. The proportion of graduates replying yes to this question only fell below 25% in four of the 27 countries participating in the survey. In Germany the proportion so responding was just above 30%; in France and the UK it was just above 40% (CIPD, 2015). Possible explanations for the wide extent of apparent underemployment of graduate skills include post-recession labour market weakness in some countries and technological factors which affect all countries such as high-level skills not being needed for ICT utilisation as much as they were for ICT adoption (Chun, 2003). In addition, many developments in ICTs make them both easier to use and capable of de-skilling or displacing previously demanding graduate jobs (Beaudry et al, 2013).

As described in Section 2, the graduate shares of employment in France and Germany are markedly smaller than in the UK or US. Until recently the most common initial degrees in both France (*Maitrise*) and Germany (*Hochschulabschluss*) took five years or more to complete (often including structured work placements) and were more equivalent to UK or US Masters degrees than to Bachelor degrees. In Germany, as described above, this form of higher education has long been complemented by four-year degree courses of a practical or occupation-specific nature in *Fachhochschulen*. However, in the last 15 years, substantial changes to HE qualification structures have taken place in both France and Germany in response to the 1999 'Bologna Declaration' in which several European countries agreed to make HE study programmes more comparable and internationally competitive. One prominent feature of this process has been the introduction of three-year Bachelor degree

5 A long-running debate continues about the extent to which graduate salary premia reflect value added during degree-level education as compared to employers' assumptions that possession of a university degree is a positive signal of individual ability (CIPD, 2015).

courses in both France and Germany, some of whose graduates immediately enter the labour market while others stay on to complete additional study for Masters-equivalent qualifications (MER, 2010; Ertl, 2013).

This has required considerable adjustment from French and German employers who were accustomed to all graduates having skills and knowledge commensurate with longer study programmes. But a striking feature of many new Bachelor degree courses in both countries is the extent to which they have been designed to be practical and work-related. In France new 'vocational Bachelor' courses (*Licenses professionnelles*)—which include work placements in firms for three months or more—now attract growing numbers of students (Powell et al, 2012). In Germany the new Bachelor degree courses are offered by both universities and *Fachhochschulen,* with the latter institutions also prominent in the development of 'dual study programmes' which combine HE study with vocational training for state-recognised occupations. It is notable that, so far, employment prospects for graduates with Bachelor degrees from *Fachhochschulen* are superior to prospects for Bachelor degree graduates from universities (Ertl, 2013). This apparently reflects the greater emphasis in the *Fachhochschulen* courses on practical applications of knowledge and on work practice (ibid).

4. Intermediate skills development

4.1 Intermediate skills and productivity

'Intermediate' here refers to technicians, craft workers and other employees with qualifications and skills below university graduate level but who are above the low-skilled category. As with high-skilled workers, the principal mechanisms by which intermediate-skilled workers can contribute to productivity centre on innovation and efficiency. For example, incremental innovations in products, services, processes and modes of work organisation rely heavily on workers in direct production, marketing, finance and human resources departments who have developed new ideas through learning-by-doing in the course of their work (Toner, 2010).

Intermediate-level skills also make key contributions to absorptive capacity at firm level. Even if high-skilled employees such as professional engineers and scientists contribute disproportionately to firms' ability to identify and acquire useful external knowledge, the successful application of this knowledge will depend in many ways on intermediate-skilled employees as well as on high-skilled employees. For example, there are many key support roles for technicians in product design and development areas and for craft-skilled workers in improving production processes.

In countries like Germany with well-established apprenticeship training systems, intermediate-skilled workers are particularly well equipped to suggest ways in which efficiency (and hence productivity) can be improved. These contributions emerged with clarity in a series of comparisons of German and British sample of establishments in manufacturing and service industries in the 1980s and 90s (Prais, 1995). This qualitative research—largely based on site visits and semi-structured interviews with managers and supervisors—also highlighted the extent to which senior managers and professional staff in British establishments were caught up in dealing with daily problems ('fire-fighting') because of the relative absence of intermediate-skilled workers to deal with those problems, or prevent them happening in the first place (ibid).

> What types of intermediate skills are most useful in enhancing efficiency and productivity? When employers in England were surveyed in 2013 about the skills that most needed improving among their intermediate-level employees, their responses pointed to a wide range of technical, practical and job-specific skills and also a number of generic skills such as communication skills, problem solving skills, team-working skills and customer handling skills (Winterbotham et al, 2014). Technical/practical skills and generic skills are often required in combination with each other (Dickerson and Green, 2004). Indeed, generic skills learned in classrooms only become economically productive to the extent that they can be applied in workplaces. For example, research on the use of quantitative skills in UK firms and organisations has shown that many jobs require only a 'simple' level of mathematics (in principle no higher than GCSE standard) but additional skills, knowledge and experience are usually required to apply this level of mathematics in the 'complex settings' of workplaces (Hodgen and Marks, 2013:7).

For this reason most assessments of different forms of vocational education and training suggest that, if classroom-based learning is to become useful, it needs to be reinforced by employment-based training in some way. Indeed, international evidence reviewed by Eichhorst et al (2015) suggests that apprenticeship training—centred on employment-based training but combining it with part-time attendance in vocational education classes or workshops related to the field of training—is superior to purely school-based vocational education in terms of trainees' employment and salary prospects. Labour market outcomes of this kind are useful indicators of how well different types of skill correspond with employer skill requirements.

We now go on to compare the provision of technician-level education and training, craft-level apprenticeship training and full-time vocational schooling in France, Germany, the UK and US.

4.2 Technician-level education and training

In the last ten years skill assessments in the UK have identified a number of sectors where employer demand for associate or 'para' professional and technician-level skills is strong, for example, health services, financial services and some branches of advanced manufacturing such as aerospace and innovative areas of electronics and chemicals (FSSC, 2007; SEMTA 2009; Skills for Health, SEMTA and Cogent, 2010; Lewis, 2014). What is at issue is whether the relatively high level of graduate supply in the UK best meets the skill needs of employers (and the career aspirations of the individuals concerned) or whether there is a need for the mix of skills to include more technician-level skills, including practical skills developed through employment-based training.

Of the four countries under consideration in this report, the one which devotes proportionately most resources to technician-level education and training is France where (as noted in Section 2) a relatively large proportion of the workforce have acquired BTS or DUT qualifications from two-year technician-level courses. After completing these courses, students can choose between entering employment or going on to study for Bachelor or higher degrees. About half of students who complete DUT courses and 20 percent of those who complete BTS courses go on to further studies (CEREQ, 2010). For those who depart higher education at this stage, there are favourable prospects of finding technician-level employment at a salary appropriate to their qualifications (Nauze-Fichet and Tomasini, 2005).

The development of employment-related skills and knowledge on BTS and DUT courses is facilitated by work placements for those students undertaking full-time courses and the recent growth of apprenticeships for students on technician-level courses as well as students attending longer-cycle HE courses (Méhaut, 2008).

The position of BTS and DUT qualifications in the French education system bears some resemblance to Foundation degrees and Higher National qualifications in the UK which also usually require two years of study in the case of full-time students. In addition, the proportion of Foundation degree and Higher National students who go on to study for Bachelor degrees after completing their studies (about a third) is similar to the staying-on

rate of BTS and DUT completers in French higher education (Mason, 2010). However, the numbers of UK students enrolled on courses at this level are proportionately much smaller than in France. Although Foundation degree student numbers rose steadily from their introduction in 2001 until 2010, they still only accounted for about 3 percent of all higher education enrolments in the UK in 2010. Higher National Certificate or Diploma enrolments represented only 2 percent of total higher education enrolments (ibid). Since 2010, enrolments on Foundation degree courses have declined quite sharply (HEFCE, 2014).

About half of all UK-domiciled students on Foundation degree and Higher National courses in 2008 were studying part-time, and a proportion of these students were also engaged in apprentice training. As yet, the numbers of UK apprentices being supported by their employers to progress to higher education are relatively small [6] but recent case studies of employers who do provide such support found that the perceived benefits—such as development of youthful expertise and improved staff retention—outweighed the costs so far as these employers were concerned (Kewin et al, 2011).

The US also provides many examples of short-cycle (two-year) tertiary qualifications serving as potential stepping-stones to either intermediate-skilled employment or to further study to Bachelor degree level. By 2000 an estimated one in five people holding Bachelor degrees had started as students in community colleges and other 'two-year institutions' (Bailey et al, 2004). In 2012 about 40 percent of all students enrolled in post-high school education in the US were at colleges of this kind. [7]

The main qualification offered by community and other two-year colleges is Associate degrees. Several studies have found that the average returns to these two-year qualifications are positive even though, as expected, they fall short of returns attached to Bachelor degrees (Kane and Rouse, 1995; Bailey et al, 2004). But a distinctive feature of the US higher education system is the relatively high proportion of community college students who depart their studies without gaining formal qualifications of any kind. While this may appear to represent a high level of wastage, it has long been argued in the US that community college students often succeed in upgrading their skills by attending courses even though they do not have certification to attest to this. Support for this proposition has now come from analysis of the National Education Longitudinal Study in the US which finds evidence of positive salary returns to uncertified community college study as well as to courses leading to Associate degrees (Marcotte, 2006).

> Thus, in the US as in France, upper intermediate qualifications serve a dual purpose: helping to meet employer demand for technician-level skills applicable in workplaces while also serving as stepping-stones towards Bachelor degree study. In the UK context where certification is more established than in the US, Foundation degree and Higher National courses together with Higher Apprenticeships are already in place and could

6 In 2014-15 there were 19,300 Higher Apprenticeship starts in England—more than double the number in the previous year—but still representing only 4% of total Apprenticeship starts in 2014-15 (Source: https://www.gov.uk/government/statistical-data-sets/fe-data-library-apprenticeships; provisional data).

7 Source: Table 303.70, Digest of Education Statistics, National Center for Education (https://nces.ed.gov/programs/digest/d13/tables/dt13_303.70.asp)

serve as a basis for expanded provision of technician-level skills while also recognising the strong incentives confronting UK students to aim (in the medium term) for Bachelor degree qualifications.

4.3 Apprenticeship training and full-time vocational schooling

As shown in Table 2.1, holders of NVQ Levels 2–3 or equivalent qualifications in the UK are much less likely than their counterparts in France and Germany to have undertaken vocational education and training. Although skills acquired through general education are keenly sought after by employers, a strong case can be made (as discussed above) for employment-based training—especially through apprenticeships—as the best means of learning how to actually apply generic skills in work settings while also developing practical occupation-specific skills and experience.

Apprenticeship training remains strong in Germany, covering a wide range of occupations. In large part this reflects the deployment of skill-intensive business strategies which have co-evolved with labour market institutions that support apprentice training, for example, partnerships between strong employer associations and unions, statutory regulation of apprenticeship training standards and concerted efforts to modernise apprentice training in line with changing technologies and market requirements, (Thelen, 2004; Steedman, 2010).

However, it is notable that the number of young Germans engaged in 'pre-vocational' training outside the apprenticeship system is now almost as large as the number of apprentice trainees: 'the demand for training has grown far beyond what firms provide' (Powell et al, 2012:13). The bulk of this pre-vocational training is school-based and the trainees concerned experience difficulties in finding employment due to their lack of work experience which most German employers expect (ibid).

In France apprentice trainee numbers have grown substantially since the 1980s, financed in part by the proceeds of an apprenticeship tax on most employers (who are exempted from paying the tax if they train specified numbers of apprentices). This tax dates back to 1925 and has been modified and strengthened at intervals over the years, as well as being supplemented by tax credits for firms employing apprentices (OECD, 2009; Steedman, 2010; Dif, 2011). However, as many as three-quarters of young French people engaged in vocational training still attend vocational schools with limited exposure to workplaces (Eichhorst et al, 2015). Indeed, a sizeable proportion (roughly a third) of young French people gain vocational qualifications such as the CAP (*Certificat d'aptitude professionnelle*) or the *Baccalauréat professionnel* during their secondary schooling and only then start seeking employment. Following the 2008–09 financial crisis, unemployment rates have risen sharply for holders of both these qualifications (CEREQ, 2014).

Both the UK and US had a common heritage of apprenticeship training for manual workers dating back to the nineteenth century. In the UK this form of training remained strong until the 1970s and the early 1980s recession. In the US apprentice training declined much earlier and more steeply than in Britain, partly due to the earlier growth of mass production in the US and hence lower demand for craft skills (Gospel, 1994). In recent

years apprentice training numbers have expanded rapidly in the UK but from a relatively low base by comparison with Germany (Steedman, 2010). In the US apprenticeship training now survives on a very small scale, for example, in some construction occupations (Eichhorst et al, 2015).

In consequence, large proportions of young British and American people engaging in vocational education do so through school-based courses at, respectively, further education colleges and community colleges. In both types of institution, the quality of training provision is restricted by markedly lower funding per student than that available to higher education (Kahlenburg, 2015; Wolf, 2015a).

In 2014–15 some 493,000 people started apprentice training in England, about 2.6 times higher than ten years previously and covering a much wider range of occupations and industries than was the case in the 1970s and 80s. Two distinctive features of the expansion that has occurred are the large proportion of adult trainees (43% aged 25-plus in 2014–15) and the 60% of trainees who were aiming for NVQ Level 2 qualifications rather than the Level 3 or higher qualifications which are typically associated with apprenticeship training in Continental Europe. [8]

In addition to concerns about the relatively low qualification aims of a majority of apprentice trainees, there are a number of criticisms of the quality of apprentice training received by many trainees. For example, there are still clear variations between different sectors in the amount of on- and off-the-job training and related vocational education that apprentices receive. Some training under the 'apprenticeship' heading for older workers in their existing jobs seems to amount to little more than short-duration skills updating or accreditation of existing skills (Richard, 2012; OFSTED, 2015; Wolf, 2015b).

Although some firms in England and other parts of the UK do provide high-quality apprentice training, overall employer commitment to apprentice training in the UK continues to be limited by comparison with Germany and some other Continental European nations. In large part this reflects the business strategies deployed by many British firms which do not seek to specialise in high skill, high value added product areas or to organise their workplaces in skill-intensive ways.

The UK retail industry provides a striking example of the different patterns of employer demand for skills in the UK and Germany. Although there has been recent rapid growth in apprenticeships in British retailing, these employees still represent only a very small proportion of the retail workforce and a large majority of retail apprentices are aiming only for Level 2 qualifications. [9] By contrast, the German retail industry has one of the highest shares (73%) of apprentice-trained workers in the whole German economy, something which may appear surprising to British retailers who tend to rely on relatively short company-specific training programmes (Mason and Osborne, 2008; Lewis et al, 2008).

8 Source: https://www.gov.uk/government/statistical-data-sets/fe-data-library-apprenticeships; provisional data for 2014-15.

9 Source as in Footnote 8.

The main reasons for this disparity emerge from comparisons of work organisation and skills utilisation in the two industries. In Germany sales assistants are typically responsible for the whole distributive process, including ordering, merchandising and advising customers and they do not receive daily instructions from superiors (Voss-Dahm et al, 2008). By contrast, in UK retail firms, work for sales assistants is typically divided up into bounded tasks which are relatively easy to carry out. Sales staff have limited autonomy and tend to follow day-to-day instructions by managers (Mason and Osborne, 2008). Thus, the predominant mode of work organisation in the British retail industry is entirely consistent with limited demand for Level 3 apprentice skills and also illustrates why the government is likely to encounter resistance from some employers to its recent proposal to introduce a levy on large firms to help fund apprentice training (HM Treasury, 2015).

5. Continuing training for adult employees

Although a majority of British employers display relatively low demand for the types of skills that are developed through long-duration apprenticeship training, there are good reasons for many of them to finance short periods of continuing training for existing employees.

In the 2013 UK Commission's Employer Skills Survey (UKCESS), as many as 71% of UK establishments reported that some of their employees needed to acquire new skills or knowledge, with many of these new skill requirements deriving from factors such as the introduction of new goods or services or new work practices or new technologies (Winterbotham et al, 2014).

These skill updating needs were reported across a wide range of occupations but applied particularly to professionals, personal service workers, managers and skilled trades workers. Across all occupations the main types of skill in need of improvement included technical and practical skills, planning and organising skills and problem-solving skills. Other priority skill updating needs included advanced IT/software skills for managers, professionals, associate professionals and administrative and clerical workers and customer handling skills for workers in sales and elementary occupations (ibid). This reported incidence of skill updating and improvement needs among existing staff was much higher than the 4% of firms reporting skills-related recruitment difficulties, defined as vacancies that were hard to fill for skills reasons at a given point in time (ibid).

According to evidence from the Continuing Vocational Training in Europe Survey in 2010, about 80% of UK firms supported continuing training for at least some existing employees in order to meet skill improvement needs of the kind described above (Eurostat, 2013, Table 1). This measure refers to continuing vocational training courses designed either by the company itself or by external providers, plus other forms of training such as planned learning through job rotation, exchanges or secondments, participation in learning or quality improvement groups, or self-directed learning. By this yardstick the UK ranked third highest of 25 countries, with France ranked 6th (76% of firms) and Germany 9th (73%).

However, the UK ranked much lower in terms of the proportion of employees participating in planned continuing training courses which took place away from their usual workplace: by this measure the UK ranked 18th (31% of employees participating) compared to France ranked 6th (45%) and Germany ranked 11th (39%).

Cross-country evidence on continuing training is hard to gather and to interpret, and some other measures of the incidence of continuing training show the UK comparing more strongly against both France and Germany (O'Mahony, 2012). However, even if we treat the comparative evidence with caution, there is evidence internal to the UK which points to growing weakness in continuing training provision. Recent analysis based on the Labour Force Survey suggests that the average volume of job-related adult training—in terms of days per employee—fell by about a half between the mid 1990s and 2012, with the

strongest effects on those in younger age groups and those with lower levels of prior education (Green et al., 2013).

This is paralleled in the US by similar evidence of employers reducing their commitment to training for existing employees: evidence derived from the US Survey of Income and Program Participation suggests that employer-financed training for adult workers fell by roughly 28% between 2001–09 (Waddoups, 2015). This provides a degree of support for the proposition that 'responsibility for developing the skills that [US] employers want has been transferred from the employer to the job seekers and schools' (Cappelli, 2015:281).

Reductions in continuing training for adult workers could potentially harm productivity performance, not just because of possible failure to meet recognised skill updating needs (of the kind revealed by the UK employers' survey described above) but also because, in cross-country comparisons at industry level, positive links between vocational skills and labour productivity have been found to strengthen when the measures of vocational skill take account of employer-provided job-related training as well as certified vocational skills (Mason et al, 2014).

One well-known institution designed to stimulate continuing training by firms is the French training levy scheme, introduced in 1971, under which firms are obliged to spend specified proportions of their wage bills (varying by firm size) on continuing vocational training. For several years after 1971, French firms' spending on continuing training rose steadily and, for all but the smallest firms, reached levels well above the minimum required share of wage costs (CEREQ, 2006). Although the impact of the training levy is hard to disentangle from other influences on training expenditure, successive Continuing Vocational Training in Europe Surveys have shown higher levels of continuing training per employee in France than in the UK or Germany and some researchers have attributed this in part to the effects of the French levy (Greenhalgh, 2002; Behringer and Descamps, 2009). However, as in many countries which do not have training levies, continuing training in France continues to be offered disproportionately to more highly-educated employees than to lower-skilled workers (Muller and Behringer, 2012).

6. Summary and assessment

Investment in skills development—in conjunction with many other kinds of investment (in machinery, equipment, innovation and other assets)—has an important part to play in fostering productivity growth. Hence in this report we compare the UK with three high-productivity industrialised countries—the US, France and Germany—in terms of the mix of high-level and intermediate skills that is produced and the different ways that general and vocational education and training is provided in each country.

Overview of qualifications

The graduate share of the workforce in the UK has now caught up with the US and is well above the graduate shares in France and Germany.

At higher education level, Germany stands out from the other three countries for its long-established graduate-level courses of a practical or occupation-specific nature in *Fachhochschulen* ('universities of applied sciences') which operate in parallel with traditional, more 'academic' university courses.

At intermediate qualification levels—between university graduates and workers with low or no formal qualifications—several inter-country contrasts stand out:

- the relatively large share of French employees with technician-level qualifications (below Bachelor degrees, above NVQ3 level)
- the relatively large and stable share of the German workforce holding intermediate vocational qualifications (mostly at the equivalent of NVQ Level 3) which reflects the strong German tradition of apprenticeship training
- the UK's relatively large share of general education qualifications at NVQ Levels 2–3 which contrasts with the much greater emphasis on vocational education and training at these intermediate levels in both Germany and France. The US is more similar to the UK in emphasising the development of general skills at intermediate level

Many generic skills such as communication and mathematical skills are keenly sought after by employers. However, in both the US and UK, any advantages deriving from general education may only apply towards the upper end of the skills spectrum. International comparisons suggest that average levels of numeracy proficiency in both countries are relatively low.

High-level skills

Both the UK and US have benefited from the ready supply of university graduates in terms of innovation and productivity growth in recent decades. Indeed, the UK's weak productivity performance since the 2008–09 recession might have been weaker still were it not for the contribution made by growth in high-level skills.

In spite of the apparent advantages of mass higher education, there are similar concerns in both the UK and US about a number of issues relating to graduate supply, in particular:

- Reported shortages of graduates in STEM (science, technology, engineering and mathematics) disciplines
- Reported deficiencies in the 'employability' skills and 'work-readiness' of many new graduates
- Sizeable proportions of graduates who (at least at the start of their careers) experience difficulties in finding jobs requiring graduate-level skills

In both countries difficulties in recruiting STEM graduates tend to be experienced by relatively low-paying employers in STEM-related industries (especially in manufacturing). High demand for numerate STEM graduates in non-STEM jobs and industries may partly reflect deficiencies in mathematical skills in other sections of the workforce in each country.

Another feature common to both the UK and US is pressure for graduate employability skills to be developed prior to their taking up employment. This appears to reflect growing unwillingness by employers in each country to recruit and train graduates who lack prior work experience.

In France and Germany the STEM shares of university students in both France and Germany are higher than in the UK and US and the two Continental European countries also benefit from the extent to which structured work experience and training is integrated with higher education and the prevalence of courses that are practical and work-related. Such courses depend heavily on co-operation between employers and universities.

Average salary premia attached to Bachelor degree-level qualifications in both the UK and the US remain high and positive. However, in both countries there has been some widening in the dispersion of returns to university education reflecting under-utilisation of some graduates' skills, particularly when they first enter the labour market. Underemployment is also a problem for sizeable minorities of graduates in France and Germany, partly due to post-recession labour market weakness and to ongoing technological changes which may be reducing demand for high-level skills in all industrialised countries.

Intermediate skills

As with high-skilled workers, the principal mechanisms by which intermediate-skilled workers can contribute to productivity centre on innovation and improvements to efficiency.

Research evidence suggests that intermediate-level education and training contributes most to economic performance when:

(1) it produces a mix of technical, practical and occupation-specific skills combined with generic skills such as communication skills, problem solving skills, team-working skills and customer handling skills

(2) classroom-based learning is reinforced by employment-based training in some way (preferably through apprenticeship training) so that trainees learn a range of skills which are best acquired—or can only be acquired—in workplaces

In this context, as is well known, Germany benefits greatly from its well-established apprentice training system (although a growing proportion of young people do not have access to that system).

France benefits in particular from the considerable resources that it devotes to two-year technician-level courses, including work placements for full-time students and growing numbers of higher apprenticeship places. After completing these courses, students can choose between entering employment or going on to study for Bachelor or higher degrees.

Craft-level apprentice numbers have also grown in France in recent decades. However, a large majority of French students in vocational education still attend full-time vocational schools with limited exposure to workplaces. In addition, unemployment rates are high for holders of low-level vocational qualifications in France.

Apprenticeship training in the US has long been very limited in scale. Where the US does have unsung strengths is in community colleges which—in spite of being poorly funded compared to universities—provide an opportunity for large numbers of students to gain or upgrade work-related skills, including students who are already in employment of some kind. US community colleges also offer two-year Associate degree qualifications which are typically less expensive for students than the first two years of study in four-year colleges. In some ways akin to French technician-level qualifications, Associate degrees serve as potential stepping-stones to either intermediate-skilled employment or to further study to Bachelor degree level.

These comparisons have important implications for intermediate skills policy in the UK, in particular, policy relating to the balance between higher education and intermediate-level education and training.

Many UK employers clearly value employability skills and occupation-specific skills that are best learned through employment-based training and experience. However, that is not the same as being willing to pay for large quantities of employment-based training. As mass higher education has developed in the UK, it has been tempting for many employers to recruit more and more graduates from full-time HE courses (educated largely at state and individual expense) and then to complain about their lack of employability skills.

French technician-level education and training exemplifies a very different pathway which, after two years study in higher education, enables students to choose between entering employment or going on to study for Bachelor or higher degrees. The majority of these students will have participated in structured work placements or higher

apprenticeships before reaching the point of choice between job-seeking or further academic study. (A similar choice is offered to US students gaining Associate degrees in community colleges but these courses are much less likely to have involved employment-based training or experience).

Expanded provision of pathways offering a choice between skilled employment and further study after two years of higher education could help the UK to shift the balance between higher education and intermediate skills development in the direction of intermediate skills. If that is a chosen objective, the UK would not need to imitate foreign examples. Two-year higher education qualifications such as Foundation degrees and Higher National Certificates/Diplomas are already in place and—if linked to Higher Apprenticeships on a larger scale than currently exists—could serve as a basis for expanded provision of technician-level skills.

A key advantage of this kind of education and training pathway offering a potential stepping stone towards further study for Bachelor degree qualifications is that it would recognise the strong incentives confronting UK students to aim for such qualifications. This continued study need not follow directly after completion of two-year qualifications and associated training. Indeed, given current high levels of HE tuition fees, many students might be interested in Higher Apprenticeship arrangements with employers whereby, following completion of their training, they work at technician level for an agreed number of years in return for future employer support with HE tuition fees.

However, to achieve this, steps would need to be taken to arrest the present decline in Foundation degree enrolments and to greatly increase the number of Higher Apprenticeship places offered by employers. Newspaper reports suggest that employers currently offering high-quality apprentice training places (including support for HE studies) typically receive a large number of applications which far exceeds the number of trainee places on offer. [10]

Below Higher Apprenticeship level, the UK's apprenticeship system has expanded to reach a high number of trainees and looks on the surface to be very promising in terms of skill development. However, a large proportion of employers of apprentices do not appear to offer high-quality training. Many trainees are aiming only for NVQ Level 2 qualifications rather than the Level 3 or higher qualifications which are typically associated with apprenticeship training in Continental Europe. Furthermore, some training under the 'apprenticeship' heading for older workers in their existing jobs seems to amount to little more than short-duration skills updating or accreditation of existing skills.

In short, employer commitment to apprentice training in the UK continues to be limited by comparison with Germany and some other Continental European nations. In large part this reflects the business strategies deployed by many British firms which do not seek to

10 For information on highly regarded apprenticeship schemes having to turn away large numbers of applicants for training places, see for example: http://www.telegraph.co.uk/finance/jobs/8710305/School-leavers-scramble-for-apprenticeships.html

specialise in high skill, high value added product areas or to organise their workplaces in skill-intensive ways.

In this context there is only limited demand for Level 3 apprentice skills among British employers and the government may encounter resistance from some employers to its recent proposal to introduce a levy on large firms to help fund apprentice training. Considerable challenges lie ahead to design such a levy in ways that will both achieve its objectives—to expand high-quality apprentice training—and secure buy-in from a significant proportion of employers.

Continuing training for adult workers

Although a majority of British employers display relatively low demand for the types of skills that are developed through long-duration apprenticeship training, there are good reasons for many of them to finance short periods of continuing training for existing employees. In 2013 just over 70% of UK establishments reported that some of their employees needed to acquire new skills or knowledge, with many of these new skill requirements deriving from factors such as the introduction of new goods or services or new work practices or new technologies.

These skill updating needs were reported across a wide range of occupations but applied particularly to professionals, personal service workers, managers and skilled trades workers. The main types of skill in need of improvement included technical and practical skills, planning and organising skills, problem-solving skills, advanced IT/software skills and customer handling skills.

Cross-country evidence on continuing training does not show clearly how well the UK compares in terms of continuing training and needs to be treated with caution. However, it is of concern that evidence internal to the UK points to growing weakness in the average volume of job-related adult training—in terms of days per employee—which fell by about a half between the mid 1990s and 2012, with the strongest effects on those in younger age groups and those with lower levels of prior education. This is paralleled in the US by similar evidence of employers reducing their commitment to training for existing employees.

Renewed thought needs to be given to policies and initiatives which could help reinvigorate employer provision of job-related training in the UK. However, the challenge of avoiding deadweight will always remain. One option might be to follow the example of the well-known French training levy scheme, introduced in 1971, under which firms are obliged to spend specified proportions of their wage bills (varying by firm size) on continuing vocational training. However, the impact of this levy is hard to disentangle from other influences on continuing training expenditure. On balance, given the alarming issues that have been raised about the quality of much apprenticeship training in the UK, it seems wisest for any new initiatives regarding training levies to focus solely on apprentice training for the time being.

REFERENCES

Abel, J., Deitz,R. and Su, Y. (2014), Are Recent College Graduates Finding Good Jobs?, *Current Issues in Finance, 20(1),* Federal Reserve Bank of New York.

AGR (1995) *Skills for Graduates in the 21st. Century*, Cambridge: Association of Graduate Recruiters.

Autor, D., Levy, F. and Murnane, R. (2003), The skill content of recent technological change: an empirical explanation, *Quarterly Journal of Economics*, 118(4): p. 1279–1333.

Bailey, T., Kienzl, G. and Marcotte, D. (2004), The return to a sub-baccalaureate education: the effects of schooling, credentials and program of study on economic outcomes, Report to National Assessment of Vocational Education, US Department of Education.

Barrell, R., and Pain, N. (1997), Foreign Direct Investment, Technological Change, and Economic Growth within Europe, *Economic Journal*, 107, p. 1770–1776.

Bayo-Moriones, A., and Lera-López, F. (2007), A firm-level analysis of determinants of ICT adoption in Spain, *Technovation*, 27: p.352–366

Beaudry, P., Green, D. and Sand, B. (2013), The great reversal in the demand for skill and cognitive tasks, Working Paper 18901, Cambridge, MA: National Bureau of Economic Research.

Behringer, F. and R. Descamps (2009), Determinants of employer-provided training: A comparative analysis of Germany and France, in F. Behringer, et al. (eds.), *Betriebliche Weiterbildung — der Continuing Vocational Training Survey (CVTS) im Spiegel nationaler und europäischer Perspektiven. Zeitschrift für Berufs- und Wirtschaftspädagogik*, Stuttgart: Franz Steiner Verlag.

BIS (2011), *STEM Graduates in Non-STEM Jobs: Executive Summary*, Research Paper No. 31, London: Department for Business, Innovation and Skills.

Blomstrom, M. and Kokko, A. (2003), Human Capital and Inward FDI, Discussion Paper No. 3762, Centre of Economic Policy Research, London.

Bosworth, D., Lyonette, C., Wilson, R., Bayliss, M. and Fathers, S. (2013), *The Supply of and Demand for High-Level STEM Skills*, Evidence Report 77, London: UK Commission for Employment and Skills.

Bresnahan, T., Brynjolfsson, E. and Hitt, L. (2002), Information Technology, Workplace Organization, and the Demand for Skilled Labor: Firm-Level Evidence, *Quarterly Journal of Economics*, 117(1), p.339 – 376.

Brown, R. (2000), Clusters, supply chains and local embeddedness in Frystad, *European Urban and Regional Studies*, 7(4): p. 291–305.

Cappelli, P. (2015), Skill gaps, skill shortages, and skill mismatches: evidence and arguments for the United States, *Industrial and Labor Relations Review,* 68(2): 251–290.

CBI (2010), Ready to grow: business priorities for education and skills: Education and skills survey 2010*,* London: Confederation of British Industry.

CBI/Universities UK (2009), Future fit: Preparing graduates for the world of work, London: Confederation of British Industry and Universities UK.

CEREQ (2010), Entrer en STS ou IUT, et après?, CEREQ Bref No. 210, Marseilles: Centre d'Etudes et de Recherche sur les Qualifications.

CEREQ (2014), The gap between levels of qualification widens as the crisis deepens, *Training & Employment* No. 109/110, Marseilles: Centre d'Etudes et de Recherche sur les Qualifications.

Chun, H. (2003), 'Information technology and the demand for educated workers: disentangling the impacts of adoption versus use', *The Review of Economics and Statistics*, 85 (1): 1–8.

CIPD (2015), *Over-Qualification and Skills Mismatch in the Graduate Labour Market*, London: Chartered Institute of Personnel and Development.

Cohen, W. and Levinthal, D. (1989), Innovation and learning: two faces of R&D, *Economic Journal*, 107: p. 139–149.

Dickerson, A. and Green, F. (2004), The growth and valuation of computing and other generic skills, *Oxford Economic Papers,* 56 (3): 371–406.

Dif, M. (2011), Comparative Analysis of the Development of Apprenticeship in Germany, France, the Netherlands and the UK, Work Package 3a, Leonardo Da Vinci Transfer Of Innovations Project (Devapprent)

Dolphin, T., and Hatfield, I. (2015), The missing pieces: Solving Britain's productivity puzzle, Institute of Public Policy Research Report.

Eichhorst, W., Rodríguez-Planas, N., Schmidl, R. and Zimmermann, K. (2015), A road map to vocational education and training in industrialized countries, *Industrial and Labor Relations Review,* 68(2): 314–337.

Ertl, H. (2013), The impact of the post-Bologna reforms on German higher education and the transition of graduates into the labour market, Research Paper No. 116, Centre on Skills , Knowledge and Organisational Performance (SKOPE), Oxford.

Eurostat (2013), Continuing vocational training statistics, Brussels: European Commission (http://ec.europa.eu/eurostat/statistics-explained/)

FSSC (2007), Skills review: UK wholesale financial services, Financial Services Skills Council.

Goldin, C. and Katz, L. (2007), Long-run changes in the wage structure: narrowing, widening, polarizing, *Brookings Papers on Economic Activity*, 2:2007: 135–165.

Goodridge, P., Haskel, J. and Wallis, G. (2013). Can intangible investment explain the UK productivity puzzle?National Institute Economic Review 224(1): R48R58

Goodridge, P., Haskel, J. and Wallis, G. (2014), The UK productivity puzzle is a TFP puzzle: current data and future predictions, Discussion Paper 2014/9, Imperial College Business School.

Goodridge, P., Haskel, J. and Wallis, G. (2015), Accounting for the UK productivity puzzle: current data and future predictions, Discussion Paper 2015/02, Imperial College Business School.

Gospel, H. (1994), Whatever happened to apprenticeship training? A British, American, Australian comparison, Discussion Paper No. 190, Centre for Economic Performance, London School of Economics and Political Science,

Green, F., Felstead, A., Gallie, D., Inanc, H. & Jewson, N. (2013). *What Has Been Happening to the Training of Workers in Britain?* : Institute of Education, Centre for Learning and Life Chances in Knowledge Economies and Societies (LLAKES), Research Paper 43.

Green, F. and Zhu, Y. (2010), Overqualification, job dissatisfaction, and increasing dispersion in the returns to graduate education, *Oxford Economic Papers*, first published online: February 10, 2010

Greenhalgh, C. (2002), Does an employer training levy work? — the incidence of and returns to adult vocational training in France and Britain, *Fiscal Studies*, 23(2): 223–263.

Greenwood, C., Harrison, M. and Vignoles, A. (2011), The labour market value of STEM qualifications and occupations, London: Department of Quantitative Social Science, Institute of Education.

HEFCE (2014). *Higher Education in England 2014. Analysis of Latest Shifts and Trends.* Downloaded from www.hefce.ac.uk/pubs, read 14/4/2014.

HM Treasury (2015), *Fixing the foundations: Creating a more prosperous nation*, London: HM Treasury.

Hodgen, J. and Marks, R. (2013), *The Employment Equation: Why our young people need more maths for today's jobs*, London: The Sutton Trust.

Hodgen, J., Marks, M. and Pepper, D. (2013), Towards Universal Participation in Post-16 Mathematics: Lessons from High-Performing Countries, London: Nuffield Foundation.

Holland, D., Liadze, I., Rienzo, C. and Wilkinson, D. (2013), The relationship between graduates and economic growth across countries, Research Paper No. 110, London: Department for Business, Innovation and Skills.

Hollenstein, H. (2004), Determinants of the adoption of ICT, An empirical analysis based on firm-level data for the Swiss business sector, *Structural Change and Economic Dynamics*, 15: 315–342

Kahlenburg, R. (2015), How higher education funding shortchanges community colleges, New York: Century Foundation.

Kane, T. and Rouse, C. (1995), Labor market returns to two- and four-year colleges, *American Economic Review*, 85: 600–614.

Kewin, J., Hughes, Fletcher, T. and Sheen, J. (2011), *The Road Less Travelled: Experiences of employers that support the progression of Advanced Apprentices to higher education,* Leicester: CFE.

Krueger, D. and Kumar, K. (2004) Skill-Specific rather than General Education: A Reason for US-Europe Growth Differences?, *Journal of Economic Growth*, 9: 167–208.

Lewis, P. (2014), Flying high?: a study of technician duties, skills, and training in the UK aerospace industry, London: Gatsby Foundation.

Lewis, P., Ryan, P. and Gospel, H. (2008), A hard sell? The prospects for apprenticeship in British retailing, *Human Resource Management Journal*, 18 (1): 3–19.

Lundvall, B-A. (1992), *National Systems of Innovation: Towards a Theory of Innovation and Interactive* Learning, London: Pinter Publishers.

Marcotte, D. (2006), The earnings effect of education at community colleges, IZA Discussion Paper No. 2334, Bonn: Institute for the Study of Labor (IZA).

Marginson, S., Tytler, R., Freeman, B. and Roberts, K. (2013), *STEM: country comparisons: international comparisons of science, technology, engineering and mathematics (STEM) education. Final report,* Melbourne: Australian Council of Learned Academies.

Mason, G. (2010), *Part-time Foundation Degree Students and their Employers*, Research Report, London: Foundation Degree Forward.

Mason, G., Holland, D., Liadze, I., O'Mahony, M., Riley, R. and Rincon-Aznar, A. (2014). *Macroeconomic Benefits of Vocational Education and Training,* Research Paper No. 40, Thessaloniki: CEDEFOP (European Centre for the Development of Vocational Training).

Mason, G. and Osborne, M. (2008). Business strategies, work organisation and low pay in UK retailing, in C. Lloyd, G. Mason, K. Mayhew (eds), *Low-Wage Work in the UK,* New York: Russell Sage Foundation.

Mason, G., Williams, G. and Cranmer, S. (2009), Employability skills initiatives in higher education: what effects do they have on graduate labour market outcomes, *Education Economics*, 17(1): 1–30.

Mehaut, P. (2008) *Higher apprenticeship: French and Italian experiences*, paper presented to Turin conference for the EU's Peer Review of Italian Higher Apprenticeship, (available at www.mutual-learning-employment.net/index.)

MER (2010), *The State of Higher Education and Research in France*, Paris: Ministère de l'Enseignement supérieur et de la Recherche.

Müller, N. and Behringer, F. (2012), Subsidies and levies as policy instruments to encourage employer-provided training, OECD Education Working Paper No. 80, Paris: Organisation for Economic Cooperation and Development.

Murphy J and Franklin M (2015) *Volume Index of Capital Services (Experimental), Estimates to 2013*, London: Office for National Statistics.

Nauze-Fichet, E. and Tomasini, M. (2005), Parcours des jeunes a la sortie du systeme educatif et declassement salarial, *Economie et Statistique*, No. 388–389: 57–83.

OECD (2009), *Jobs for Youth: France*, Paris: Organisation for Economic Cooperation and Development.

OECD (2013). *OECD Skills Outlook 2013: First Results from the Survey of Adult Skills, OECD Publishing.*

OFSTED (2015), *Apprenticeships: developing skills for future prosperity*, London: Office for Standards in Education, Children's Services and Skills.

O'Leary, N. and Sloane, P. (2005), The return to a university education in Great Britain, *National Institute Economic Review,* 193: 75–80

O'Mahony, M. (2012), 'Human capital formation and continuous training: evidence for EU countries', *Review of Income and Wealth*, doi: 10.1111/j.1475–4991.2011.00476.x (available on-line)

O'Mahony, M., and van Ark, B. (2003), EU Productivity and Competitiveness: A Sectoral Perspective. Can Europe Resume the Catching-up Process? The European Commission, Luxembourg.

ONS (2015), *International Comparisons of Productivity — First Estimates 2014*, London: Office for National Statistics.

Oulton, N. (2013), Medium and Long Run Prospects for UK Growth in the Aftermath of the Financial Crisis, Occasional Paper 37, Centre for Economic Performance, LSE.

Pessoa, J. and van Reenen, J. (2014), The UK productivity and jobs puzzle: Does the answer lie in labour market flexibility?, *Economic* Journal, 124(576):433–452.

Pilz, M. (2009), Why *Abiturienten* do an apprenticeship before going to university: the role of 'double qualifications' in Germany, *Oxford Review of Education*, 35(2): 187–204.

Powell, J., Graf, L., Bernhard, N., Coutrot, L. and Kieffer, A. (2012), The shifting relationship between vocational and higher education in France and Germany: towards convergence?, *European Journal of Education*, 47(3): 405–423.ejed

Prais, S. (1995), *Productivity, Education and Training*, Cambridge: Cambridge University Press.

Richard, D. (2012), The Richard Review of Apprenticeships, London: Department for Business, Innovation and Skills.

Rincon-Aznar, A., Forth, J., Mason, G., O'Mahony, M. and Bernini, M. (2015), *UK Skills and Productivity in an International Context*, Research Paper (forthcoming), London: Department for Business, Innovation and Skills.

Roberts, G. (2002), *SET for Success: The Supply of People with Science, Technology, Engineering and Mathematics Skills*, London: HM Treasury.

RAE (2012), *Jobs and Growth: The Importance of Engineering Skills to the UK Economy*. London: Royal Academy of Engineering.

Saxenian, A. (1994), *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*, Cambridge, MA: Harvard University Press.

SEMTA (2009), Skills and the Future of Advanced Manufacturing, A Summary Skills Assessment for the SSC Advanced Manufacturing Cluster, Watford: Sector Skills Council for Science, Engineering and Manufacturing Technologies.

Skills for Health, SEMTA and Cogent (2010) Life Sciences and Pharmaceuticals: A Future Skills Review with Recommendations to Sustain Growth in Emerging Technologies, 2010.

Steedman, H. (2010), *The State of Apprenticeship in 2010*, London: Centre for Economic Performance, London School of Economics

Thelen, K. (2004), *How Institutions Evolve: The Political Economy of Skills in Germany, Britain, the United States and Japan*, New York: Cambridge University Press.

Toner, P. (2011). *Workforce Skills and Innovation: An Overview of Major Themes in the Literature*, Paris: Organisation for Economic Cooperation and Development.

Turok, I. (1993), Inward Investment and Local Linkages: How Deeply Embedded is Silicon Glen?, *Regional Studies,* Taylor and Francis Journals, 27(5): p. 401–417

Universities UK (2002), *Enhancing Employability, Recognising Diversity*, London: Universities UK.

van Ark, B., O'Mahony, M., and Timmer, M., The productivity gap between Europe and the United States, *Journal of Economic Perspectives*, 2008, 22(1): p. 25–44

Voss-Dahm, D. (2008), Low-paid but committed to the industry: salespeople in the retail sector, in G. Bosch and C. Weinkopf (eds), *Low-Wage Work in Germany,* New York: Russell Sage Foundation.

Walker, I. and Zhu, Y. (2008) The college wage premium and the expansion of higher education in the UK, *Scandinavian Journal of Economics*, 110, 695–709.

Waddoups, J. (2015), Did employers in the U.S. back away from skills training during the 2000s? *Industrial & Labor Relations Review, (*forthcoming).

Winterbotham, M., Vivian, D., Shury, J. and Davies B. (2014), UK Commission's Employer Skills Survey 2013: UK Results, London: UK Commission for Employment and Skills.

Wolf, A. (2015a), Heading for the Precipice: Can Further and Higher Education Funding Policies be Sustained?, London: Gatsby Foundation and The Policy Institute at King's.
Wolf, A. (2015b), Fixing a Broken Training System: The Case for an Apprenticeship Levy, London: Social Market Foundation.

Zahra, S., A., and George, G. (2002), Absorptive capacity: A review, reconceptualisation, and extension, The Academy of Management Review, 27(2): p. 185–203