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# Skills Demand, Training and Skills Mismatch: A Review of Key Concepts, Theory and Evidence

Future of Skills & Lifelong Learning  
Evidence Review

Foresight, Government Office for Science

# **Skills Demand, Training and Skills Mismatch: A Review of Key Concepts, Theory and Evidence**

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## Executive Summary

“Skill” is broadly defined as any personal characteristic that is productive of value and can be augmented through some form of investment.

In recent decades, the demand for skilled labour has been increasing in Britain. Four types of evidence support this claim. Tasks requiring high skills have become more important; jobs increasingly require high levels of education and training; high-skilled occupations have expanded most rapidly, while mid-skilled occupations have declined; and the median returns to higher education have been maintained or even increased.

However, the rise in the demand for skills may be slowing down, and there is increased dispersion in the wage premium associated with tertiary education. Graduate jobs have been growing this last decade, as fast as the supply of graduates, but not among the younger half of the workforce.

The drivers of skills demand are new technologies, managers’ strategies as to how these new technologies are used and associated ways of organising work, changing industrial and consumer demand, and rising inequality. The future demand for skills is especially uncertain because of the unknown implications of highly automated new technologies (robots). This uncertainty contrasts with the much greater confidence we can have in the growing supply of tertiary educated workers for the foreseeable future.

Skills can be acquired at work, but training volumes and expenditures have decreased since the 1990s. Some interpretations of this decline are relatively benign: training courses may have become more efficient in achieving company objectives. Nevertheless, the decline is of concern, given the contribution of training to new skills at all ages.

Skills mismatch takes many forms, which this report describes. The “skills deficit”, “skill shortages” and graduate underemployment are all important, with detrimental effects on both workers and employers.

It is recommended that monitoring be improved in relation to training volume and quality. Monitoring of the “skills deficit” points to the importance of international benchmarking of skills and training.

# I. Concepts of Skill

## Introduction: the general notion of skill

To consider the future of skills in Britain, it is first important to have a definition of this concept. The word “skill” is used both in everyday language in a variety of ways, but also by several separate social scientific disciplines – especially economics, psychology and sociology. Its use has palpably changed in the last half century, broadening out from a narrow focus on technical or physical abilities. There is no full consensus among perspectives.

To ensure consistency, it is best to define skill in a broad sense to refer to any personal characteristic which is productive of value and which can be augmented through some form of investment. What constitutes “value” will differ according to readers’ perspectives. In a market economy the value of something is often reduced to, and expressed in, monetary terms even when it is not exchanged. The value generated by skills need not be given in monetary units, though it frequently is. This broad sense of skill captures the vision of policy-makers who conceive skills as the channel to raise prosperity and improve well-being.

This breadth of meaning should be helpful when considering future scenarios. When defined in this encompassing manner skill is close, in meaning, to the term “competence” as used by occupational psychology. It incorporates the possession of knowledge, “skills” (as used in the narrower sense of whether able to do specific sets of tasks) and attitudes. But the term “competence” also has disputed nuances, including when translated into other languages. Economics writers in the last two decades have also, in practice, arrived at a broad notion of skill.

Nevertheless, the definition given above is not so open as to lose any distinctive meaning for the term. For example, it excludes personal characteristics that one cannot reasonably expect to change – such as height – even if such characteristics might have value in the labour market.

## Typologies

Skills can be classified according to several typologies, which are useful for theorising about education and training, and about who should fund these.

One typology is the psychologists’ distinction between knowledge, abilities and attitudes. This categorisation overlaps partly with the economists’ distinction between “cognitive” and “non-cognitive” skills. The latter term is meant to encompass attitudes, norms, behaviours and traits, and should be accepted as skills (as long as they conform to the general definition). Often, there is no clear break between these types of skills. For example, many interactive social skills, such as those associated with professional communication, entail both cognitive and non-cognitive facilities.

Another typology, important for the economic theory of the funding of training, is the distinction between firm-specific and transferable skills. While the former can only have value in the firm where a person works, the latter can be applied to other firms. Where the skills are transferable to all (or very many) other firms they are termed “general” (Stevens, 1994).

At the bottom end of the spectrum of general skills are “basic skills”, which are taken to be the minimum required for being employable in any job across the economy. In the modern economy, this typically includes basic literacy and numeracy as well as appropriate work behaviours. At the top end of the spectrum the phrase “talent” is often used for the skills needed for global corporate management. However, it is an unfortunate term, since it is widely used without detailing exactly what facilities the term refers to; sometimes it covers skills at any level and “talent management” simply means human resource management.

“Generic” skills are an example of general skills. They refer to skills that can be applied in a whole range of occupations, such as the ability to use a spreadsheet. It is commonly held that generic skills have become more important in modern economies, and the possession of many generic skills is proposed as part of the key to personal employability and employment security.

Distinct from generic skills, occupation-specific skills are an important intermediate category, referring to fields of knowledge and/or manual dexterity necessary to operate in a particular occupation. Often occupation-specific skills are extensive and require long periods of educational preparation or training.

Finally, attitudes and interactive skills, including communication skills and “emotional labour” – all valid and sometimes very productive skill types – are occasionally referred to as “soft” skills (in contrast to “hard” skills). However, this distinction is to be discouraged and will not be repeated in this review, because it implicitly denigrates soft skills, has no substantive utility, and can reflect a discriminatory orientation.

These typologies of skill are frequently used, but sometimes hidden, in public debate about skills. Because skill is interpreted nowadays in such a broad way, it is often necessary to state what type is being discussed, not least because the implications can differ enormously. One example will suffice: the discourse on skill shortage. Complaints about skill shortage are of long standing and will no doubt re-surface repeatedly in the coming decades. However, the response to them should depend on what kinds of skill are being complained about. In the 1980s, a remarkable and insightful study by Oliver and Turton (1982) illustrated this point. They found, through in-depth interviews with managers who reported skill shortages, that the skills in question (at that time) were not technical skills of the sort that suggested grave problems with the college and further education system, but what would now be referred to by economists as “non-cognitive” skills. The employers did not appreciate the behaviours of job applicants, in terms of reliability, work record, and ability or orientation to work at speed without supervision; they were looking for “good blokes”. Thus they reported a skill shortage, but the implications are rather different from what they would have been if they were unable to recruit staff with the requisite occupation-specific skills.

The concept of “skill shortage” and other categories of skills mismatch will be described in section 4 below. Before that, in section 2, we next address the question posed in the review specification concerning the demand for the skill mix in the UK.

## 2. The Demand for Skilled and Educated Labour

### Introduction

This section summarises information about long-term trends in employers' demand for skilled and educated labour in Britain. It is first important to state that the "demand" under consideration refers to the labour market, in particular to the demand for one category of labour. This must be distinguished from the "demand" that employers and individuals also have for more education, formal training or work-based forms of skills acquisition: this type of "demand" refers to education and training markets. The labour market is, naturally, articulated with the education and training market. Unfortunately, this relationship has often led to confusion in discussions of the role of demand in the overall skill system. In recent years governments have sometimes sought to put "employer demand" in the driving seat in the skill system; however, this has mainly referred to the demand for training. This is quite distinct from what is sometimes called for by critics, namely a greater emphasis on policies for the demand for skilled labour.

After a historical introduction to place the discussion in context, the following sections look at the evidence, direct and indirect, about changing demand for skills, the factors behind the trends, and future considerations.

### Historic Arguments about the Demand for Skilled Labour

A generation ago there were two broad schools of thought in economic sociology about the trend in the demand for skilled labour. On the one hand, there were writers who, during the 1960s, argued that it was an inherent tendency of modern economic life to bring incremental additions to and improvements in technology, and that these generally liberated workers from being tied to machines, decentralised control, and required more knowledge and skill. On the other hand, modern Marxist writers such as Braverman argued the opposite, namely that a managers' aim was to gain ever greater control over work processes, and that this progressively deskilled jobs. Stepping away from this opposition, others argued that the trend in skills demand should be regarded as contingent on the way that technology is used.

Two conclusions from these historical debates emerged. First, that there have been periods in history when skills have been lost as jobs became deskilled with the introduction of machinery, as well as eras when progressively more educated and more skilled workers were required. In other words, both trends are possible and nothing is inherent. The second conclusion is consequent on the first: it is essential to bring evidence to bear, not just rely on 'grand theory', in order to understand the evolution of skilled labour markets. Positive changes in skills demand in one particular period do not mean that the changes will always be positive.

## Evidence about the long-term trend in the demand for skill since the 1980s

The demand for skilled labour is not something that can be directly measured. It has to be inferred, using assumptions, from data on the amount of skilled labour or skills used, about the supply of skilled labour in the population, and/or about the pay they receive. We build a picture using four alternative methods: task-based analysis, broad skill requirement analysis, employment composition analysis, and wage-return analysis.

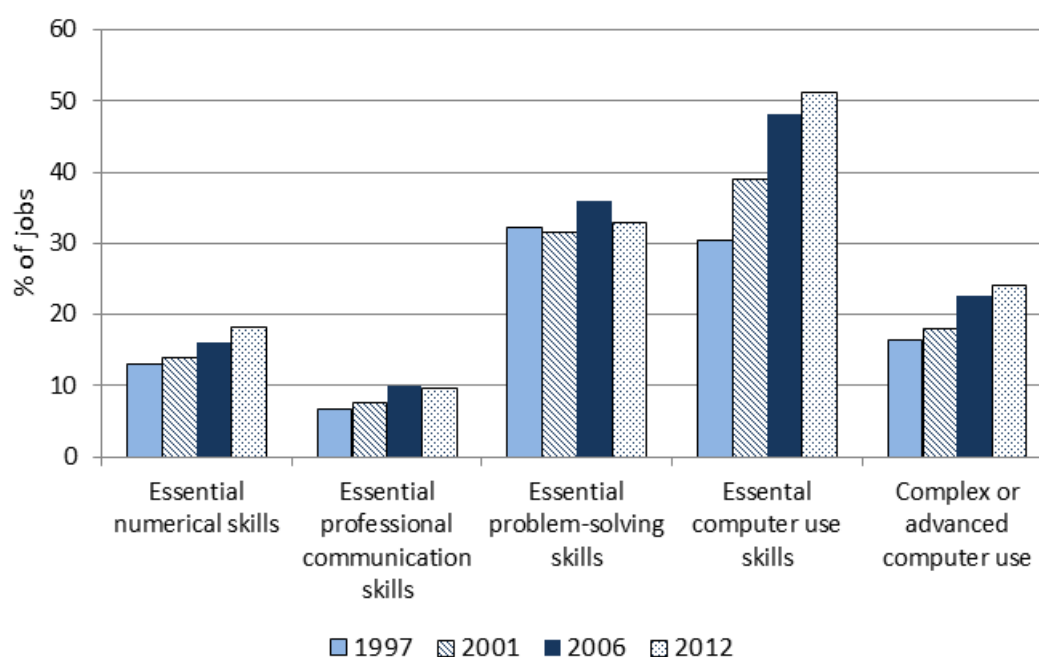
### a) Task-based analysis

Under the assumption that to carry out tasks one is using associated skills, data on tasks carried out in workplaces are now widely used to infer skills utilisation. The data give the lower bound of employers' generic skills demand, and trends in the task data are then taken to indicate trends in skills demand. (Note that these are quite distinct from indicators of skills supply, which would typically be obtained from qualifications or test data).

While much of the debate has revolved around differential trends in "routine" and "non-routine" tasks and skills, it is often difficult or impossible to categorise tasks in this convenient way (Green, 2012). Rather, in Britain we have more detailed task data over a period of 15 years. In some of these, such as the tasks involving physical activity and strength, it is presumed that these do not require high levels of skill. Others may involve greater manual dexterity, or more generally the use of conceptual thinking, knowledge and high-level interaction skills. Singling out five key tasks which require high skills and for which we have data, it can be seen in figure 1 that there has been an increase in the importance of all five over the fifteen year period, though with problem-solving skills the change is minimal. Most notably, there have been striking increases in the demand for computer skills over the period. The period 1997 to 2006 was the period in which very many workplaces were being transformed by the need for computer skills, and the level of sophistication of computer use also was increasing. Also rising were professional communication skills (such as making speeches and presentations, influencing people, and so on), and numerical skills.

The next period from 2006 to 2012 saw less of an increase in computing and professional skills and, while numerical skills requirements continued to grow apace, there is the impression of a slowing down in the overall pace of increase in the use of generic skills. Only further surveys will reveal if this slowing down denotes a reversal of the longer-term trend or perhaps a response to the Great Recession of 2008-9 and subsequent macroeconomic stagnation.



**Figure 1: Trends in Generic Skills Utilisation, 1997-2012**

Source: Skills and Employment Survey. See Felstead et al (2007).

## b) Education, training and learning requirements

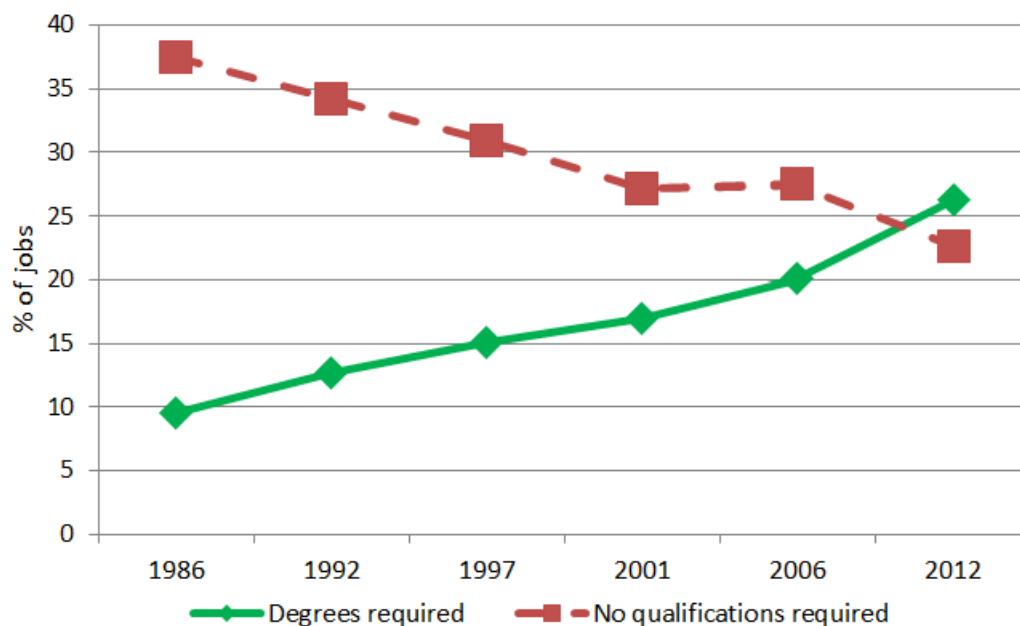
Generic skills only cover a portion of the range of skills needed in modern economies. Also essential are occupation-specific and industry-specific skills. These are less easy to capture in general-purpose surveys that can give an aggregate picture, and often have to be analysed with detailed sector-specific studies. However, three broad measures of skills go a long way to capturing the level of knowledge required for jobs: the level of education required, the extent of prior training undertaken for the line of work, and finally the amount of time needed on the job before you can be expected to be fully competent.

The education level required of a job is naturally related to the generic tasks just discussed, but can be seen as a measure of the general level of knowledge required. Figure 2 summarises long-term trends in the highest qualification required to both get the job and do the job competently, as reported by workers themselves. As can be seen, the trend is unambiguously towards increased requirements. In 1986, more than a third of jobs could be gained by applicants with no qualifications at all, but this had come down to below a quarter by 2012. Meanwhile, the numbers of jobs requiring degrees or above was increasing steadily, and for the first time exceeded the number of no-qualifications jobs in 2012. Of course, some of this rise in education requirements might have been caused by the rising supply of educated workers if education merely signals some generalised ability. However, the evidence for a purely-signalling interpretation of education is slim.

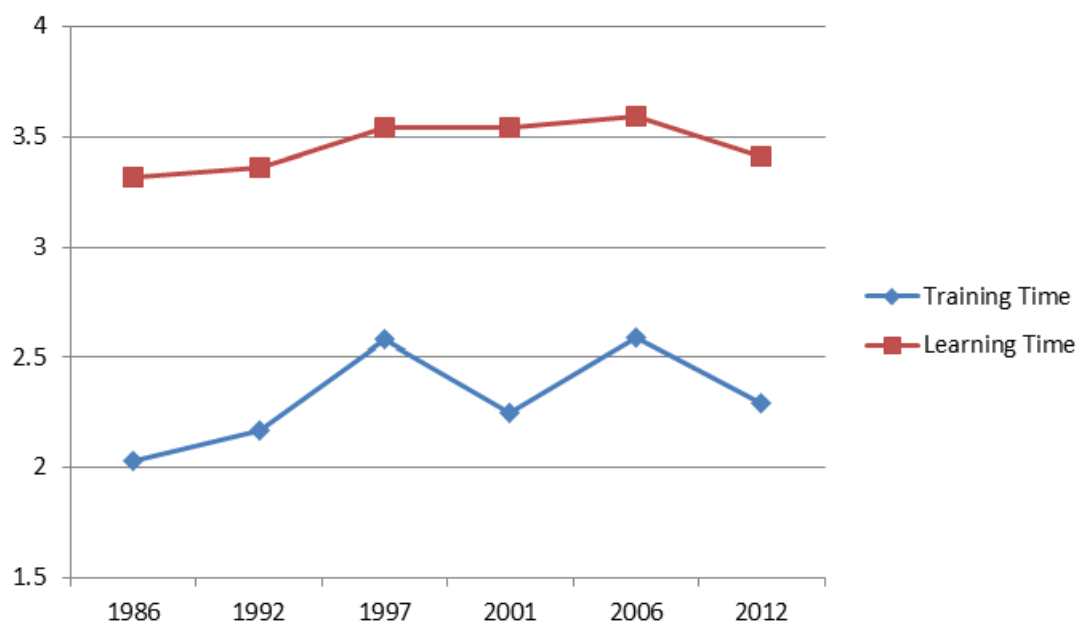
Figure 3 looks at the other two broad skills demand measures. Both the amount of formal training time prior to undertaking jobs, and the required learning time, increased overall since 1986. Nevertheless, the picture since the end of the 1990s is far less clear: there is no obvious rise in either of these indicators since then.

It is possible that, by requiring and obtaining better qualified employees over time, employers came to have less need to send employees for long periods of prior training, and that they would expect them to get more quickly up to speed. Taken together, since the rise in educational requirements is substantial, this is usually taken as consistent with an overall picture of rising skills demand.

**Figure 2: Trends in Required Qualification, 1986-2012**



Source: Skills and Employment Survey.

**Figure 3: Trends in Training Time and Learning Time, 1986-2012**

Source: Skills and Employment Survey. Learning Time is an index capturing the time taken to learn to do the type of job well. The scale ranges from “less than one month” (scoring 1) to “over two years” (scoring 6). Training Time is an index of the amount of formal training undertaken prior to beginning the type of work done. The scale ranges from “no training or less than a week” (scoring 0), to “two years or more” (scoring 6).

### c) Employment Composition

Another way of capturing the demands for workers with specific bodies of knowledge is by studying the changing occupational composition. Sometimes jobs are ranked by skill level according to their “major occupational group”. Thus, groups such as managers, professional and associate professional workers are typically ranked by experts as requiring higher skills, and these jobs have gained in importance. An alternative often followed in economic analyses is to rank jobs, in any chosen start-year, by their median wage, the presumption being that more skilled jobs receive higher pay. One then plots the growth of jobs in subsequent years. The complication in this method is that, from time to time, the coding of occupations is updated, in order to incorporate changes within occupations and the emergence of new types of occupations.

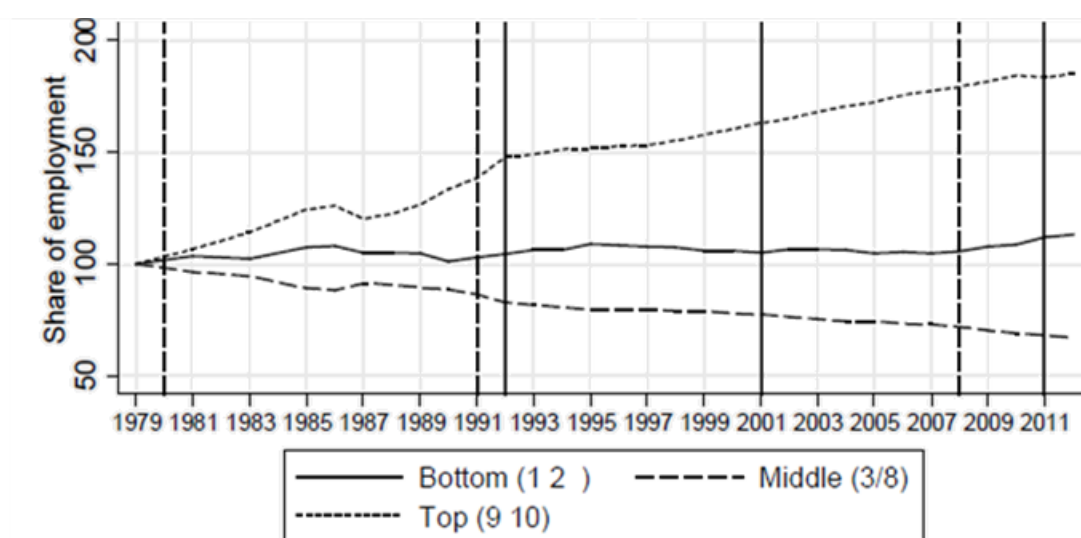
The results of a long-term analysis that recognises such changes are shown in figure 4. It shows that, despite the complication of the codification changes, there is a clear long-term trend for the fastest growing jobs to be those that were highest paid (top two deciles) in 1979. The share of the low-skilled (lowest two pay deciles) also increased though by much less. Meanwhile, the share of the middle deciles declined steadily except for a brief period at the end of the 1980s. This process has been termed “asymmetric polarisation”. (It is not sufficient to use the word “polarisation” on its own, since the overall movement is towards an upgrading of skills demand, with the growth of high-skilled jobs being dominant.)

Analyses from the European Foundation for Living and Working Conditions (Eurofound, 2015) have shown that this pattern of asymmetric polarisation is far from universal across countries.

However, with regard to the United Kingdom, the European Foundation's analysis is in agreement that the UK has for most of the time over the four decades from the mid-1970s exhibited a similar pattern of asymmetric polarisation. In this, the UK is quite similar to Germany, whereas in Spain and Sweden, by contrast, there has been a consistent pattern of occupational upgrading whereby jobs have grown faster, the further up they are in the skills hierarchy.

The main lessons to draw from such multi-country studies are twofold. First, they provide yet more evidence of the long-term rise in skills demand till now. Second, because the asymmetric polarisation is not general, the patterns observed in the UK do not necessarily simply reflect the effects of an exogenous technology (which would be similar for all developed countries) but rather reflects the different economies, institutional structures and choices of each country with respect to how new technologies are used.

**Figure 4: Occupational Shares by Group of 1979 Deciles**



Source: Salvatori (2015). Occupations ranked by median wage, all employees. Solid vertical lines indicate SOC changes, dashed vertical lines indicate recession years. Deciles based on NESPD 1979 shares from LFS data. Occupational classification: soc90.

#### d) Wage-Return Analysis

Last but not least, a standard method of inferring the demand for skills is by studying the relative wage of high-educated workers as compared with low-educated workers, along with the relative supplies. Underpinning this method is a model of supply and demand. For example, if over time there is an increase in the relative stock of highly-educated workers, while at the same time the relative pay of highly-educated workers remains constant or increases, then one infers that the demand for highly-educated workers (and the skills that they have) must have increased at least as fast as their supply. Exactly how much would depend on the extent to which more and less skilled workers are substitutes in production. By making assumptions about this “elasticity of substitution”, economists are able to infer the demand for skilled labour.

The evidence over recent decades is consistent with the direct evidence on skills noted above: over the long term, the pay of tertiary-educated workers has remained steady, or even

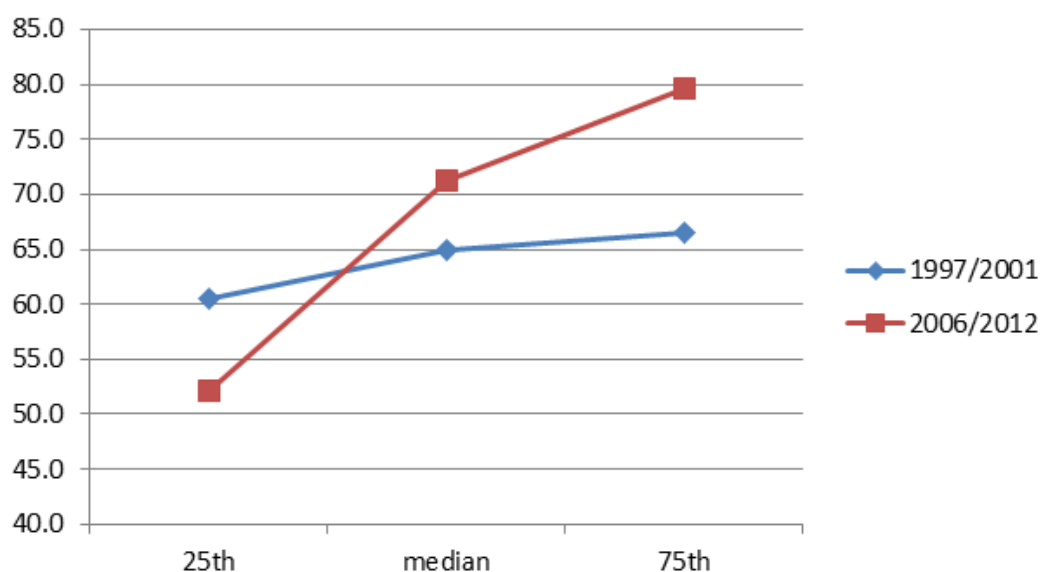
increased, in most countries, including the UK. This has occurred despite a massive rise in the relative supply of tertiary-educated workers, following the leap in university and college attendance – a transformation that began in earnest in Britain at the end of the 1980s. This combined evidence is further confirmation of the rising demand for higher skills.

Yet it remains possible that the pace of increase in the demand for college-educated labour could in future be slower than the rise in supply, stemming from the mass participation in higher education, as has happened in some other countries.

Another complication to the evidence on wage returns is that studying just the average return is increasingly misleading, during this era of rising wage inequality. Figure 5 illustrates this point with recent evidence for Britain taken from an analysis of Labour Force Survey data. It shows the wage premium at different positions in the wage distribution. As can be seen, over the period 1997 to 2001, the premium was a little higher for those at the 75th percentile (i.e. high end) of the pay distribution, than for those at the 25th percentile (low end). In effect, it says that the benefit of a tertiary education is slightly higher for those who are already above-average in their wage-earning ability.

By a decade later, covering the period 2006 to 2012, the proportion of tertiary graduates in the labour force had increased by as much as 12 percentage points, to 42 percent. The spread in the benefits of tertiary education had also become much greater. At the median and at the 75th percentile, the premium had increased, but at the 25th percentile it had dropped.

One possible reason for this increasing dispersion in the wage premium for tertiary education, derives from the asymmetric polarisation of jobs noted above. At the top end, the demand for skills has been increasing fast. Yet those tertiary-educated workers who fail to obtain jobs commensurate with their qualifications find themselves doing the intermediate-skilled jobs, and these jobs have, over the long-term, become relatively more scarce, as indicated in Figure 4.

**Figure 5: The dispersion of the wage premium for tertiary education**

Source: Labour force survey, see Green and Henseke (2016). The wage premium is the percentage difference between the hourly pay of those with tertiary education compared with those with lower secondary education. The estimates derive from quantile analysis.

## The Drivers of Skills Demand

Understanding of the drivers of skills demand and in particular what lies behind the rising skills demand of recent decades, has progressed considerably beyond the historical debates noted above (Green, 2013).

The underpinning theory rests on the strategies of employers, both private and public. The simple profit-maximising models of economics are supplemented by the resource-based theory of the firm, which stresses the importance of rent-seeking behaviour and in particular the ways in which employers seek to innovate with improvements that are less easy to replicate by competitors, and the consequent importance of management skills. The consequence is that, while the frontiers of technology are central to how the demand for skills evolves, also essential are the particular strategies adopted by employers. Some employers aim to be cutting-edge, doing their own research and development into new products and processes they themselves introduce; others to have the skills to absorb and adapt new technologies from outside the organisation; while others aim more for a mass market and to compete on the basis of cost rather than quality.

The main explanation for rising skills demand is the hypothesis of “skills-biased technical change” (SBTC), which suggests that predominantly new technologies raise the productivity of skilled workers especially and that, as skilled workers are substituted for lower-skilled workers, it raises the relative demand for the high-skilled. The “nuanced” version of this theory suggests, however, that new technologies – principally computerised technologies – tend to displace jobs that are intensive in routine tasks (whether manual or non-manual), and to raise the demand for

non-routine tasks (Autor et al., 2003; Goos and Manning, 2007). The latter are mainly concentrated in jobs at the upper end of the skills spectrum, but there also remain many non-routine jobs at the lower end that are described as low-skilled, such as in the caring industry, that are expanding. This nuanced theory is the main explanation for asymmetric polarisation of employment.

Also relevant, however, is changing work organisation (Green, 2012). There is evidence that jobs which involve greater employee involvement also require greater skills, often including high-level professional communication skills. The changing work organisation sometimes follows from the technology, but it can also depend on the overall strategies that employers are following. The skills required of workers are linked, therefore, to the skills of their managers and the strategies that they adopt in particular markets.

The final major explanation of changing skills demand is the changing structure of industrial and consumer demand, which depends, first, on the industrial structure. For example, the large role of the finance sector in the British economy has enhanced the demand for relevant financial skills. Many trained engineers are deployed in the sector, wanted for their mathematical skills. To take another example, it is recognised that the adoption of an industrial strategy would have important implications for the demand for skill, as it had in many east Asian countries during the 1990s and 2000s (Green and Mason, 2015). According to that analysis, an industrial strategy in Britain would require a balance of both graduate-level and intermediate skills, in order to support a move towards a more balanced knowledge economy. Even in a successful economy driven by high levels of innovation, good intermediate-level skills are also required in order to facilitate the “absorption” into organisations of new processes and products that have been developed elsewhere by other employers or in universities. It is held that currently too many organisations in Britain lack sufficient absorptive capacity for innovative methods.

Demand also depends on consumers, however, and so the changing nature of consumer markets also has skills implications. The aging of the population is thought to be an important factor, raising the demand for skills associated with medical provision and caring. Similarly, an increasingly unequal distribution of income is thought to lead to a rising demand for the service jobs associated with the needs of the well-off.

### **Graduate Jobs**

An especially salient question in the current conjuncture concerns the prospects for the future of graduate jobs -- those jobs that require the skills normally associated with having had a tertiary education. The future of graduate jobs depends on the demand for high-skilled labour, but is also influenced by the extent to which that demand could be met by substitutes, especially workers who have followed the alternative route of a high-level apprenticeship. Set against the changing prevalence of graduate jobs, the mass expansion of higher education in Britain (in parallel with similar trends in most other countries) means that the stock of graduates at all levels has expanded in recent years and is sure to expand further in coming decades.

Table 1 shows the results of an analysis of recent changes in graduates and graduate jobs, using a statistically-derived index of graduate jobs based on the use of high-level skills, based on data from the Skills and Employment Survey.

It shows that, in total, there was a rising share of graduate jobs by ten percentage points between 1997-2001 and 2006-2012 (reflecting the previously described analyses that showed rising skills demand). This increase was approximately matched by the rise by twelve percentage points in the share of tertiary graduates in the workforce. This roughly-matched increase is consistent with there being no great change in the median wage premium shown in figure 5.

The breakdown by age, however, suggests a possible concern about the future. Among the younger half of the workforce, the share of graduates increased by as much as 18 percentage points over the period. This was faster than the rise in the number of graduate jobs. While so far this has not raised the number of younger graduates working in non-graduate jobs, the future prospect is different, as the now-younger adults become the older adults of the next decades and as new and higher-educated generations enter the workforce.

We have already seen the increasing dispersion of the wage premium for graduates. In parallel, analyses showed that the penalty for graduates being under-employed, compared to being in a graduate job, is increasing. With the current and future generations taking on unprecedented levels of debt to finance their studies, the future prosperity of many of them will depend much upon whether the expansion of graduate jobs will persist.

**Table 1: Trends in the Graduate Labour Market between 1998/2001 and 2006/2012 by age (in %)**

	Employed in graduate jobs		Graduates employed in the labour force		Graduates in non-graduate jobs	
	<u>97/01</u>	<u>06/12</u>	<u>97/01</u>	<u>06/12</u>	<u>97/01</u>	<u>06/12</u>
Age 25-39	30.3	41.9	30.4	48.9	31.9	32.0
Age 40-60	32.5	40.5	29.5	37.4	26.5	29.0
Total	31.5	41.1	30.0	42.3	29.1	30.5

Source: Skills and Employment Survey (table adapted from Green and Henseke (2016))(forthcoming). Population averages.

## **Future Considerations: high uncertainty over the demand for skilled jobs, and the need for monitoring**

All of the above factors – technology, strategy, work organisation, industrial composition, demographics and income distribution – ought to be included in any framework for considering the future demand for skills.



The standard method for forecasting the demand begins with a prediction of industrial demand, based on an economic model that incorporates some or all of these factors. The method then proceeds with a derivation of the demand for skilled labour, based on assumptions about the occupations used in each industry and the skills used in each occupation. The latter assumptions are difficult because the skills used in each occupation may change over time: forecasters find it hard to estimate how much, or assume implicitly that there will be no change. The result is that there is a peculiar variation in the predictions available of what skilled demand will be in future years. This uncertainty contrasts with the near certainty that, for the next two decades, the stock of higher-educated labour in the British economy will continue to expand, as newer generations that have been to university replace retirees with lower qualification levels.

While this report does not aim to describe in detail the possible forecasting methods and assumptions, this variation is itself noteworthy. It is symptomatic of the fact that the future demand for skills is especially uncertain at the current juncture. Not only is it contingent upon the future direction of the British economy, its industrial composition (which could be affected through an exit from the European Union) may change. Most of all, the future is uncertain because of the unpredictable effects of new technologies, not least the so-called “fourth industrial revolution” which some commentators are convinced will be unleashed by the widespread introduction of robots. The possible effects of extended automation of both high- and low-skilled tasks over the coming decades is currently the subject of intense debate in both academic and wider discourse. Here, I just summarise three positions that will need to be considered when thinking about the future demand for skills.

One argument is that information technology (IT) is a “general purpose technology”, which needs an increasingly well-educated workforce to perform the non-routine cognitive tasks associated with IT introduction and use, as it expands to become prevalent throughout most industries and occupations. However, when the new IT capital is in place, IT investment reaches a point of saturation. In the second phase of the life-cycle of a general purpose technology, including IT, it is thought that there will be declining skills demand relative to the peak. Beaudry et al (2016) have advanced the hypothesis that this stage was reached in the United States at the turn of the millennium. IT investment peaked in 2000, fell sharply in the ensuing dotcom recession, and has not recovered since that time. They note that 2000 saw a peak turning point in the employment rate, and from that point on Beaudry et al. could detect no increase in the usage of “cognitive tasks”, even though these had risen substantially in previous decades. It should be noted that their analyses of aggregate change in skills demand are based on their study of compositional change in the US workforce, and an assumption of constant skills demand within each occupation. That assumption might turn out to be incorrect.

Nevertheless, if they are right, then overall skills demand in the US has recently been decreasing. If, as often happens, the path of the UK economy, including UK investment in IT, follows with a lag and some variations that of the US economy, then a decrease in skills demand could already have started or might start in the near future in Britain also.

Second, a particularly pessimistic argument about future skills demand stems from the assumption that robot technologies have now advanced to the extent that a large proportion of tasks now being performed by humans are potentially replaceable by robots in the next two

decades. A widely cited, if disputed, analysis by Frey and Osborne (2013) came up with the figure of 47% of jobs that are potentially replaceable. The implications of these analyses are not just for jobs in general, but also for skilled jobs: although substitution by robots is expected to be greatest at the lower end of the skills spectrum, many jobs at the high end, hitherto considered beyond the reach of automation, are now held to be at risk.

The third argument is articulated by Autor (2015), who criticises pessimistic technology writers for focusing only on the jobs that could be lost. Predictions of mass job loss have also accompanied previous spells of technological change, and proved wrong. His central observation is that “tasks that cannot be substituted by automation are generally complemented by it” (Autor, 2015: 6). Among his illustrations, he notes how bank tellers have increased in number in the US, despite the introduction of ATMs, because the provision of bank services has become cheaper and because tellers now provide relationship banking services that complement cash flow services. He argues that there will always be jobs that require some flexibility and judgement, and that are not easily, if at all, describable in terms of rules or procedures that could be codified by computer programmers. The issue is termed “Polanyi’s paradox”, referring to tasks for which “we know more than we can tell”. Despite the possibilities starting to be opened up by machine learning, these tasks will be, Autor maintains, complementary with human labour. He even argues that some of these could be middle-level jobs, implying that the asymmetric polarisation of recent decades in the United States need not persist.

Given that the demand for skills is so uncertain, one recommendation for policy-makers is that steps should be taken to ensure that the evolving demand for skills in the UK is monitored at reasonably regular intervals. To monitor generic skills usage and ongoing education and training requirements of jobs, one option is that support continues to be found for the Skills and Employment Surveys, which have been generally funded from combinations of departmental and research council support at roughly five-year intervals. This option is currently under consideration by the Economic and Social Research, BIS and other agencies. A supplementary option is that Britain should participate in the second round of the OECD’s Survey of Adult Skills. Undertaken in 2012 (in England and Northern Ireland only), a repeat survey has been under consideration for roughly a decade later. The survey element will provide valuable element of changing skills demand, while the competence tests will show progress or otherwise in the resolving the problems of low and unequal numeracy and literacy skills among young adults in Britain. A third option might be to institute a short module covering some key tasks at work, for inclusion in the Quarterly Labour Force Survey at regular intervals of a few years. However, such a module could not be administered reliably to proxy voters (used for a significant minority of QLFS participants), so a way would have to be found to apply such a survey module to a nationally representative sample of people in work.

## 3. Training

### Introduction

The prevalence, intensity and effectiveness of workforce training are all important for an understanding of past and future of the skills of the workforce in Britain. These form the focus of interest for much research over recent decades, and are continually addressed through policy interventions of one kind or another. Despite the long acceptance of a need for better policy, it remains an unsolved and contentious area.

Key issues surround both initial training for young adults and continuing training. The concerns are for both the volume of training received and the quality; its inequality as well as its average level (those with the least education get the least training); the interface between education and training; and who should or does fund the acquisition of skills, many of which can only be learned at work. These issues are likely to carry over to any consideration of the future for training.

The intention of this section is quite specific: to draw attention to recent research on trends in the volume of training received.

### Training Volumes

The volume of training – that is, the average amount of time (or sometimes resources generally) spent in formal or informal training – is the best single indicator of the extent of new skill acquisition outside education. For judging the future prospects for the skills of the workforce, training volume should be considered alongside estimates of educational participation. In one respect, training volumes are especially important in the short and medium term, given that any changes to education take many years to filter through into the workforce, and that most people set to be in Britain's workforce of 2030 are already through with education and in the workforce now, in 2016.

By comparison with the statistical picture of education available at the ONS, however, the picture of skill acquisition through training is seriously inadequate. In part this inadequacy may be due to the fact that much workforce training takes place inside organisations, rather than through colleges and other training providers. Moreover, since much training is funded by employers, rather than the public purse, figures on it can only be obtained from employer surveys or censuses. Reliable data are therefore more difficult to obtain. Nevertheless, much more could be done by focusing on the right indicator, namely the volume of training (and limited indicators of quality) rather than on indicators of training participation which on their own can be misleading.

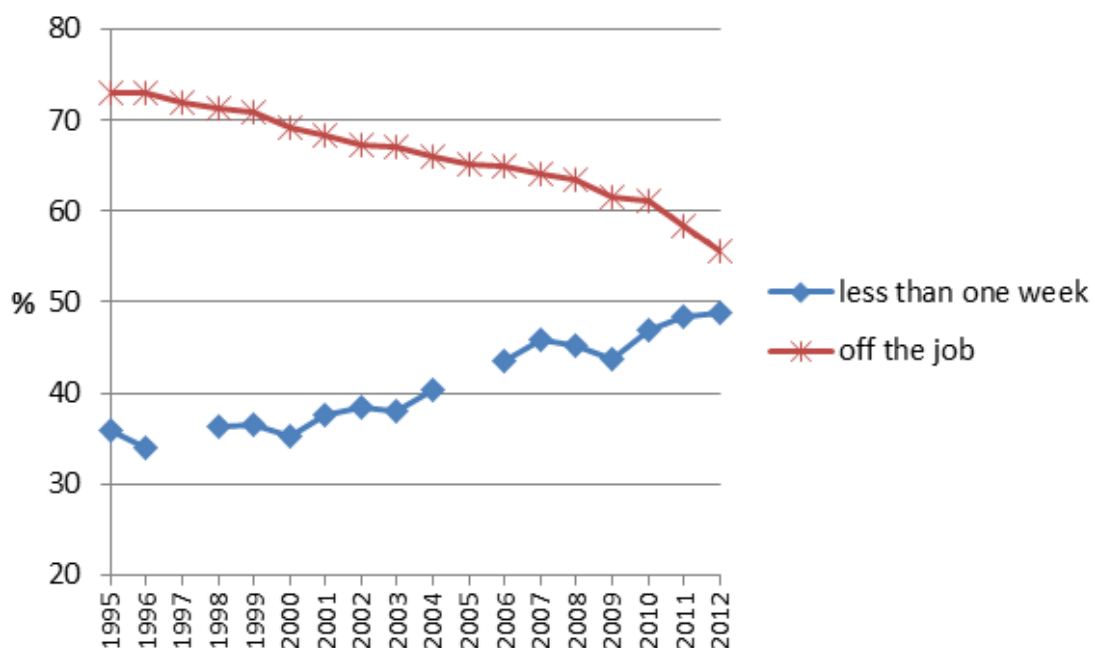
The main published indicator of both initial and continuing training in Britain is the proportion who participate in training over a period of four weeks: in the first quarter of 2016, 14% of workers. The figure varies somewhat between the different quarters, but over the years since at least the early 1990s has not changed by more than 2 or 3 percentage points: it reached a peak

of around 15% in the early 2000s. In comparison with other European countries, the British figure is above average, and as a consequence Britain is regularly checked off as more than satisfying its training target.

However, training participation can mean lots of things, ranging from an hour set aside on Monday mornings for some updating health and safety training to long-term participation in upgrading of skills. The duration of training is relatively low in Britain among those who do train, so that even though its participation rate is high, its volume of training is only average. The potential problem to which I draw attention is that the volume of training has been decreasing substantially over the long term (Green et al., 2015).

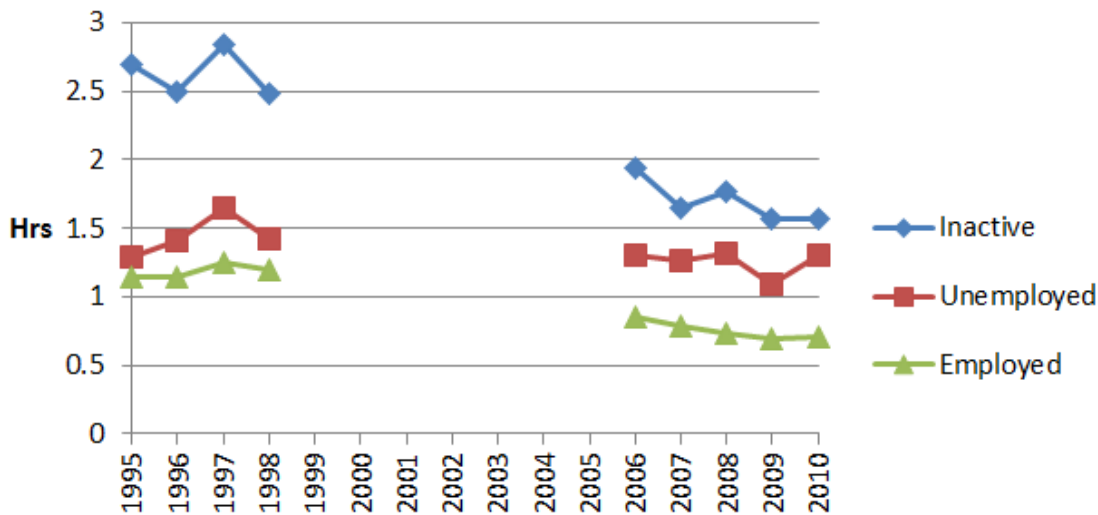
This decline is suggested first by the rise in the prevalence of short-spell training, as shown in figure 6. The proportion that lasted less than one week had risen from about a third to about a half, between 1995 and 2012. It is possible that this decline in time spent training is related to the fact that training was increasingly being transferred to the work space: the proportion of off-the-job training was also declining sharply and steadily over this period.

**Figure 6: Training in the UK, 1995-2012**



Source: Green et al (2016). Persons in employment aged 16-65.

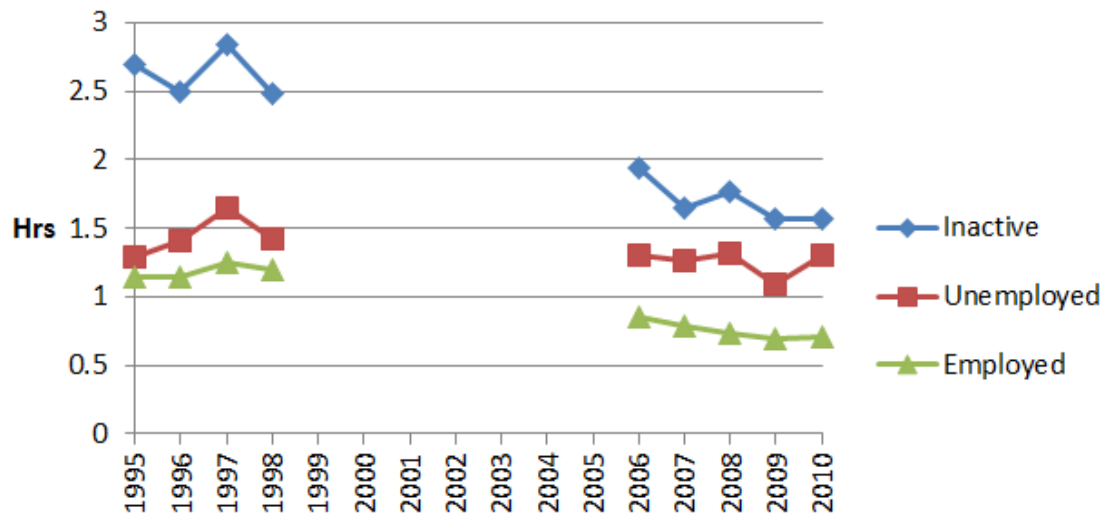
Note: Some off-the-job also involves on-the job training.



The consequence for the volume of training – measured as the average time spent per employee per week – is shown in figure 7. The volume fell from around 1.2 hours in the mid-1990s down to about 0.6 in 2010. Unfortunately, the series is incomplete, with a number of years in the middle of this period for which the data are not available in the Labour Force Survey. Nevertheless, the series is consistent over time. That the downward trend is real is reinforced by other surveys that present a similar picture, including the British Household Panel Survey and the Skills and Employment Survey. Taken together, the evidence suggests that the volume of training per employee roughly halved between the mid-1990s and around 2012. While the fall was widespread across Britain’s regions and sectors, a disproportionate amount of change appears to have been among young workers, and those in Northern Ireland. Since that time, a renewed and adapted question has been asked in the Labour Force Survey, focusing on the volume of training undertaken over a 4-week period. This series suggests little further change in the overall volume of training between 2011 and 2013.

According to data from the Employer Skills Survey, the fall in the volume of training is matched by a fall of around 14% in real-term training expenditure per employee between 2006 and 2011, but there was in addition a further 5% expenditure cut by 2013 (Davies et al., 2012; Winterbotham et al., 2014).

**Figure 7: Training Volume per Person by Employment Status in the UK, 1995-1998 & 2006-2010**



Source: Green et al (2016). Persons in employment, aged 16-65.

## The Future for Training Volumes

Whether falling training volumes are a matter for concern depends on how the recent falls since the 1990s are interpreted. Optimistic interpretations suggest that the decline has been countered by increased quality in training, perhaps reinforced by the 2008-2009 economic crisis which may have obliged human resource managers to focus more carefully (if narrowly) their declining training budgets on their business strategies. There is some qualitative evidence for this (Felstead et al., 2012). If so, for each pound spent managers might be gaining more in terms of skill acquisition: the quality could have risen. It might also be opined that to some extent training has been substituted by other channels for skill acquisition. The workforce is now more educated, with greater proportions having gone through some form of tertiary education: this could have obviated the need for remedial training among young adults especially. Alternatively, organisations may have become more oriented to fostering work-based learning, through non-training channels such as job rotation, greater workplace autonomy and more employee involvement. There is only limited evidence for this possibility.

Any of these explanations would suggest that there is no necessary cause for concern that the decline in training volume is depleting the ability of British workforces to become more upskilled. However, a fourth possible explanation is that there has been a declining interest on the part of employers in skill acquisition, suggesting that, rather than breaking out of a low-skills equilibrium and conforming to the notion of a “knowledge economy” in which skills become the key channel for competitiveness, Britain’s workplaces are entering a greater state of low-skills equilibrium. This explanation is as likely as the more optimistic ones. If correct it would suggest that neither the future volume of training, nor its quality, are likely to pick up again. This interpretation implies the prospect of an ongoing future skills deficit in Britain, which should be of considerable concern for policy-makers.

To move forward, two recommendations can be made, in order to help future analysts better understand the direction being taken in this part of the skill system. First, training duration data need to be taken more seriously by the statistical authorities in Britain, so that analysts and policy-makers can regularly monitor the trend in training volume and thereby also more easily investigate its causes. It is misleading and insufficient simply to monitor participation in training. Year after year there is little change in participation, so little notice is taken of it. But the ONS should not be content with publishing only this data (which they have to collect as part of the European Union Labour Force Survey obligation). The ONS should use the Quarterly Labour Force Survey data to also publish more relevant training statistics.

Second, steps could be taken to monitor more closely the quality of training. While this will be no easy task, its payoff would extend not only to understanding better the overall trend in training, but also to evaluating better the effects of imminent changes in young people's training through the apprenticeship levy. A pooling of experts in the field of training management and regulation can be suggested as a means to develop acceptable measures of training quality and to make progress on this issue.

## 4. Skills Mismatch

The invited specification for this report asks a key question: “how do we understand skills mismatch and gaps in skills provision?”, and it is to this specific issue that this section is devoted. The issue of skills mismatches, in one form or another, is a continuing focus for debate. One of the problems, in addressing mismatch, is that there is confusion over the meaning of the terms involved; another is that the measurement of some of the forms of mismatch is problematic. The aim of this section is to clarify both concept and measurement, and in so doing point to issues of concern for future policy.

Table 2, adapted from Green (2013), summarises the different concepts that have come under the general term “skills mismatch”. The variety itself makes the point that clarity of meaning is going to be important.

It is useful to think about mismatch in the market for skilled labour explicitly in terms of supply and demand. Thus, some concepts refer to situations where the supply of skilled labour is less than the demand, others the opposite. In both these cases we have a disequilibrium, and concern implicitly arises only when this disequilibrium is long-lasting. Another important concept is a “skills deficit”, where the market is in equilibrium with supply equalling demand, yet both supply and demand are below what they could be.

“Skill shortages” refer to the situation when supply is less than demand on the skilled labour market. Skill shortages are of concern for employers, not least because they are associated with productivity shortfalls (Haskell and Martin, 1993). The main indicator of skill shortage is evidence that employers cannot fill vacancies for skilled workers. The evidence can be easily obtained from surveys, but it is important that the reason for the vacancy being hard to fill is recorded, namely lack of skills (as opposed to poor working conditions that applicants are loathe to accept). The hard-to-fill skills shortage vacancy, which has become the accepted indicator for a skills shortage, has been at the centre of debate about Britain’s skills problems over the years. Typically, the indicator varies pro-cyclically, reflecting the growth of demand for skilled labour in the upswing of the cycle. For a review of indicators of skill shortage, and indeed a range of indicators of skills imbalance that focus on the indicators of insufficient (rather than surplus) skills, see Mavromaras et al., (2014); also see Gambin et al., (2016).

The case of demand exceeding supply internally within a firm or organisation is termed a “skills gap”, which is indicated when employees are perceived by their managers to lack some competencies needed to carry out their tasks and follow management strategies. Skill gaps are also measured in surveys, such as the UK Employer Skills Survey. Often, however, the estimated prevalence is quite low, depending on how the question is phrased – perhaps not surprisingly, since if workers were deemed by managers as not competent one would expect them to either train them to become competent or let them go.

“Undereducation” is where an employee’s education level is less than what would now be required from a new applicant to do a job. Although it has been linked in part to low productivity (Kampelmann and Rycx, 2012) it is not widely deemed an issue for concern, because it is quite



feasible for incumbent workers to have acquired the necessary skills in the past while working at the job.

The situation where supply is greater than demand in the market for skilled labour is typically seen as a concern for employees. For unemployed skilled workers the loss is not only for them but for society generally. Concern has also grown in recent years for the situation where skilled workers are in work but are not using their skills fully. Several studies have shown that skills underutilisation is associated with lower pay and well-being at work, compared with equally skilled workers who are using their skills more fully (e.g. Allen and van der Velden, 2001).

The problem with understanding and remedying skills underutilisation is that its measurement is especially difficult. Usually, measurement relies on subjective indicators in surveys, but the answers obtained vary a great deal, depending on how questions are phrased. Underlying this variation is the fact that the skills that people have are an important part of their identity and self-esteem. Questions that focus on people's skills are very poor indicators of actual skills, though they may say something about self-efficacy or self-confidence. Recently, the OECD (2013) has attempted a new measure of skills underutilisation, using a combination of occupation coding and responses to subjective questions and the results of the competence tests in the Survey of Adult Skills. But the measure is contested strongly by other commentators. Cross-country variations of skills underutilisation, using the various measures available, bear little resemblance to each other. In my view, the scientific understanding of subjective skills underutilisation (as opposed to "skills deficit") is insufficiently developed, as yet, for supporting policy interventions in at least the near future.

"Overeducation", or "underemployment", where someone has a higher level of education than is required to do the job, is an indirect way of trying to capture skills underutilisation. However, it has to be recalled that education is only a loose measure of skill. Rather, overeducation might be thought of as a problem in itself, apart from its link with skills underutilisation. If people have acquired "too much" education, this could be a worry both for them and for the rest of society if they have helped to pay for it. The concern for individuals may be alleviated if they aim to get more out of their education than just access to jobs. The concern for society might be alleviated in so far as education has external benefits for everyone, not just those being educated (Green and Henseke, 2016). There is a sizable academic literature on underemployment, studying mainly its effects on wages, job satisfaction and firm productivity (e.g. Kampelmann and Rycx, 2012; McGuinness and Sloane, 2012).

Last but not least, there is the concept of a "skills deficit", which refers to the state where the skills both supplied and demanded are below some optimal (and in principle feasible) level. This concept should have as much or more prominence in thinking about future scenarios, as the concept of skills shortage. Several commentators have argued, over the years, that the problem facing the skills system in Britain – or at least some regions of Britain – is a skills deficit rather than a skills shortage. In this perspective, managers' have too low ambitions, or are too risk averse, to opt for a strategy of high investment in their workers' skills (both through recruitment and training), while workers have insufficient resources to invest heavily in their own human capital and to choose their best course of skills investment. In a very uncertain world, neither managers nor workers can see substantive incentives to alter their plans, which is the hallmark

of an equilibrium. Only a substantial change in the institutional framework and in the incentives can disrupt this “low-skills equilibrium” (Finegold and Soskice, 1988; Froy and Giguère, 2010).

The measurement of skills deficits is difficult, because the comparison point is some implicit optimum, a level of skills supply and demand that could in principle be obtained, but which is greater than currently found in the country or region. The only way of measuring it is through benchmarking against other countries or regions which are thought to have similar characteristics in other respects but greater supplies and demands for skills. Hence, the importance of international comparisons in the area of skills acquires considerable importance. The main indicators for this are educational and skills comparisons, both supplied through the work of the OECD, which along with UNESCO helps to collect and coordinate comparable education statistics. As well as the PISA studies of skills among school pupils, the OECD runs the Survey of Adult Skills (Kuczera et al., 2016). The latter provides indicators of both the numeracy and literacy skills that individuals have and the generic skills needed for the tasks performed at work. For example, the Survey of Adult Skills revealed that the numeracy and literacy skills of young adults in Britain were generally quite low, and especially unequal (Green, A. et al. 2015, Kuczera et al., 2016).

Parallel to the skills mismatch concepts and indicators, there are mismatches in the market for acquiring skills – that is, training barriers and learning barriers. The latter, however, are also quite hard to measure satisfactorily. Perhaps the most salient indication of a learning barrier is unemployment: if you are involuntarily unemployed you do not have the opportunity to acquire new skills on the job. Those who enter the work force at a time of high unemployment are known to be “scarred” for many years in the labour market (Gregg and Tominey, 2005), the main explanation being the denial of an early opportunity to acquire work skills. Training and learning barriers also occur when in work, arising from discriminatory practices (for example, denying training for older workers) or from lack of information and support, and from low self-esteem. Indicators can be derived from these phenomena, but there is no scientifically accepted practice. The mere fact of low training is not in itself an indicator of a training barrier, since that low training could be the consequence of choice in the context of high costs and low training value.

To conclude this section, there are several quite different concepts that are grouped under the phrase “skills mismatch”, each associated with potential concerns for policy-makers. “Skills shortages” continue to be prominent, especially in times of growing demand. However, the “skills deficit” also reflects a potential deep problem for the British economy and skills system, pointing to the need for policy interventions to influence both the supply and the demand side of the skilled labour market. Graduate under-employment (overeducation) has not hitherto been a major problem for policy-makers but might become so in the coming decades.

**Table 2: Concepts and Indicators of Skills Mismatch**

Concepts	Indicators	Pros/Cons	Example(s) of use
<b><u>Supply &lt; Demand</u></b>			
<b>Skills shortage</b>	Skills shortage vacancy.	Close to concept but loose interpretation.	Strietska-Illina (2004).
<b>Skills gap</b>	Managers' assessment of employees' competence.	Closely relevant to performance but subjective.	Strietska-Illina (2004); Shury et al (2010).
<b>"Undereducation"</b>	Worker's education level less than now required.	Close to concept but looseness of interpretation of required education.	McGuinness (2006); Green et al (2007).
<b><u>Supply &gt; Demand</u></b>			
<b>Skilled worker unemployment</b>	Skilled unemployment rate.	Close to concept, measurement easy.	...
<b>Skills underutilisation</b>	Worker reports; occupation based measures.	Subjective and unreliable.	Allen and van der Velden (2001); OECD (2013)
<b>"Overeducation"/"under-employment"</b>	Worker's education level more than currently required.	Close to concept but looseness of interpretation of required education.	McGuinness (2006); Green et al (2007).
<b><u>Supply = Demand</u></b>			
<b>"Skills deficit"</b>	Benchmarking of skills levels against other countries/regions.	Increasingly possible but benchmarking countries not always similar to UK.	CIPD (2011).

Source: Adapted from Green (2013).

## 5. Policy Issues

The above analyses cover only some of the many issues of concern in Britain's skill system, and are not intended to be a systematic or complete analysis from which a policy perspective could emerge. My approach stems from the importance of thinking about the skills system from a holistic perspective, that is, from both the supply side and the demand side of the market for skilled labour. Through this overall framework, one can perceive the importance of having policies that encourage growth in the demand for skills alongside strategies for raising the stock of intermediate and high-skilled labour.

Nevertheless, along the way I have alluded to some policy recommendations surrounding monitoring and I conclude here by summarising what these are.

For balancing supply and demand, in this report I have noted two areas in particular need of better monitoring. The first concerns the volume and quality of training, not just for young people but for the whole workforce. I have recommended that more attention should be given to publishing and assessing trends in the volume of training, using existing data sources, especially the Labour Force Survey. I also hold that it should be possible to develop some, albeit imperfect, indicators of training quality. The maintenance of a good training volume and quality through the life course is essential for a future high-skills-based economy. Whatever intervention policies are followed by the present and future governments, it is vital for analysts and policy-makers to know how these two variables are changing.

With regard to skills mismatch, I have argued that the skills deficit is as important as skills shortages for understanding the problems facing the economy. Both need continued close watching. The maintenance of instruments to monitor skills shortages, such as the Employer Skills Survey (previously run by the UK skills Commission) would seem to be vital, as is continued participation in comparative international surveys such as the European Labour Force Survey, the OECD's Survey of Adult Skills, and the European Union's Adult Learning Survey.

Second, in the analysis of the changing share of graduate jobs it is seen that, while until 2012 no problem of major imbalance had occurred, it is possible that the next decade will see an increasing imbalance between the numbers of graduates and the proportions of jobs wanting graduate-level skills. The likelihood of this eventuality will depend on the impacts of robot technologies as they unfold. This uncertain outcome also adds to the monitoring imperative. Options for tracking graduate jobs are the same as for the monitoring of skills deficits noted in Section 2: continued funding for the Skills and Employment Survey (planned next for 2017) and for the OECD's Survey of Adult Skills (planned for the early 2020s). It will not be adequate to base the monitoring of graduate jobs on static assumptions about the skills required in occupations, or (even worse) on projections of where graduates will actually work.

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