Article

Analysis of the UK labour market - estimates of skills mismatch using measures of over and under education: 2015

This article follows a statistical methodology used by the International Labour Organisation (ILO) to compare how far the educational attainment of groups within the UK workforce differs from the average education level for their occupations. In the literature this is referred to as a type of skill mismatch.

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1. Abstract

This article follows a statistical methodology used by the International Labour Organisation (ILO) to compare the distribution of educational attainment of those in employment in the UK against the average educational attainment level for their occupation. In the literature this is referred to as a type of skills mismatch.

This method, will, by construction always result in a proportion of workers who can be classified as:

- Matched

- Overeducated and

- Undereducated

compared to the average level of educational attainment for the occupation they are in. Aggregating these groups over all occupations gives an estimated matched, over and undereducated rate for the whole economy. The proportions for each matched and mismatched group will be sensitive to the assumptions made in the statistical method and should not be used in isolation.

This article discusses how characteristics of workers affect their likelihood of having an educational level that is closely matched to the average of their current occupation. Periods before, during and after the economic downturn are considered. The characteristics of workers included in the analysis are:

- Gender

- Age

- Full-time/part-time

- Self-employed/employees

- Country of Birth

2. Main points

Using a statistical approach, based on International Labour Organisation (ILO) (Skills mismatch in Europe - 2014), between early 2002 and the end of 2015 the UK has seen a gradual increase in the proportion of UK workers who have a level of educational attainment which is matched to the average of those in their occupation. This can be described as a type of skills match and has implications for assessments of the efficiency of the labour market.

The matched rate in the UK fell by around 1 percentage point during the recent economic downturn which coincided with an increase in the share of self-employment and part-time work. The matched rate had recovered to pre-downturn rates by the end of 2012.

In 2015, there was a slightly higher percentage of overeducated workers in the UK than undereducated. This is partly attributable to the cohort effect of younger workers having higher average levels of education compared to older workers and who were not yet in occupations that matched their level of education.

The cohort effect is also seen with 25-34 year olds consistently having the highest level of over-education compared to the UK average. Conversely 50-64 year olds have the highest level of under-education over the period 2002 to 2015.

In 2015 the self-employed and part-time workers have lower rates of matching relative to the UK overall. Both groups tend to be more undereducated than the workforce as a whole.

Those born outside of the UK and in employment have a lower propensity to be matched by educational attainment to occupations they are working in, compared to the UK as a whole. Non-UK born groups of workers have a higher rate of overeducated than the workforce as a whole. This is partly attributable to their age (being on average younger than the UK workforce as a whole) and their reason for working in the UK, for example a graduate may take a lower skilled job to improve their English language skills while they are living in the UK.

3. Introduction

Skills mismatch is a difficult concept to measure, and the approach often taken by international organisations such as the International Labour Organisation (ILO) is to proxy the skills offered by workers by their years of education or highest level of qualification. From the employer side, the type of occupation itself can be categorised into approximate skill levels, with elementary occupations traditionally regarded as lower skilled and managerial occupations as higher skilled.

The reason skills or educational mismatch is important is that it can be an indicator of inefficient allocation of labour within the economy. This can have potential implications for aggregate productivity – for example if overeducated workers could better utilise their skills or qualifications in a more productive occupation.

The statistical approach

A statistical method for comparing the education distribution in the UK labour market against the average level of educational attainment for their occupation is used by the International Labour Organisation. This will, by construction always result in a proportion of workers who can be classified as:

- Matched

- Overeducated and

- Undereducated

compared to the average education level for the occupation they are in. Aggregating these groups over all occupations gives an estimated matched, over and undereducated rate for the whole economy. The proportions for each matched and mismatched group will be sensitive to the assumptions made in the statistical method.

The choice of measure for the average (mean or mode) and tests for normality is discussed in the Background notes.

Interpretation:

The statistical method can therefore be interpreted as a way of comparing the proportion of different groups of workers in the UK who closely match the average education level of all workers in their occupation. Match rates can be compared across groups of workers, over time, or across countries using a consistent methodology. The absolute level of matched and mismatched is determined by the assumptions in the statistical method and should not be used in isolation.

The ILO (Skills mismatch in Europe - 2014) report finds the total mismatch (the percentage of workers who are either over or undereducated[1]) in 24[2] countries to be between 20.9 and 30.7% in 2012. Of them, the UK had the

5th highest level of mismatch, with 28.9% of its workforce in jobs not suited to their skill level. Of this, 15.0% of the workforce has a higher than average education level for their occupation (overeducated), and 13.9% have a lower than average education level for their occupation (undereducated).

This article, using the Labour Force Survey[3] (LFS), looks to replicate and update the statistical findings of the ILO, analysing how characteristics of workers affect their likelihood of having an educational level that is closely matched to the average education level of their current occupation. Periods before, during and after the economic downturn are considered. A number of characteristics of the UK labour market are analysed for their degree of skills match and mismatch. These are:

- Gender

- Age

- Full-time/part-time

- Self-employed/employees

- Country of Birth[4]

Details on alternative measures of skills mismatch are outlined within the background notes.

Notes for Introduction

1. The ILO use years of education as a proxy for skill, so total mismatch is based on aggregating over and under-education, rather than over and under skilled.

2. Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, Germany, Hungary, Iceland, Ireland, Israel, Kosovo, Netherland, Norway, Poland, Portugal, Russia, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom.

3. The LFS was used as the data source for this article as at the time of preparation data for the whole of 2015 became available. The analysis is all at a UK level which is robust to the use of the LFS. Results using the Annual Population Survey could be requested under the ONS Publication Scheme

4. Country of birth analysis is used in this article to allow for a more stable comparison over time. Similar trends of matched, over and undereducated rates were achieved when people were grouped by nationality, although levels were generally further away from UK averages.

4. Main definitions

This article uses a number of main definitions.

Matched are individuals in employment whose highest level of educational attainment lies within one standard deviation of the mean for their given occupation. See methods for more detail.

Mismatched are individuals in employment whose highest level of educational attainment lies greater than one standard deviation about the mean for their given occupation. See methods for more detail.

Undereducated are individuals in employment whose highest level of educational attainment is greater than one standard deviation above the mean for their given occupation. See methods for more detail.

Overeducated are individuals in employment whose highest level of educational attainment is greater than one standard deviation below the mean for their given occupation. See methods for more detail.

Educational attainment refers to the highest level of qualification an individual has achieved, covering everything from Higher Degree to No qualification. Further detail on what is captured and how it has been grouped is available in the Annex.

Job requirements: The statistical method assumes that the mean level of educational attainment represents the requirement for the occupation. It should be acknowledged, however, that educational attainment does not fully capture the skills required for each type of job e.g. experience, on-the-job training, non-exam based learning and some vocational qualifications. However, the approach does benefit from being measurable and generally comparable over time.

Cohort effect: The statistical method, by its construction, permits the average job requirement to increase across all occupations if participation in education and the average level of educational attainment in the population increases. The effect on the degree of matching across the whole economy is therefore dependent on the age composition of each occupational group and the distribution of older and younger workers across occupations. For example, as older people leave the labour market – other things being equal – this will tend to increase the average job requirement level for the whole economy, and reduce the percentage of the labour market that are classified as undereducated. Such cohort effects are discussed in more detail in the Age section of the article.

5. Method

This article broadly follows the ILO's statistical approach, although is based on data from the Labour Force Survey (LFS) and uses highest qualification/trade apprenticeship as a proxy for educational attainment and job requirement, instead of years of full-time education. By working out the average level of educational attainment for each occupation for each quarter, we can estimate the percentage of those in employment that are matched, as well as those who are outside the range and are mismatched.

Within this article, a proxy measure of a worker's skill is taken from their highest level of educational attainment or qualification. Educational attainment does not encompass all skills such as experience, on-the-job training, non-exam based learning and some vocational qualifications. Therefore, the estimates in this article will be called estimates of overeducated and undereducated, rather than estimates of over-skilled and under-skilled. Details on the 7 education category breakdown used are included in Annex.

A range for the required level of education for a particular occupation is established by calculating the mean level of highest educational attainment within each 3 digit SOC occupation group[1]. The range is defined as being one standard deviation above and below the mean level of educational attainment.

Each individual is then assigned a status based on whether their own level of education falls within or outside of this range for their particular occupation. Table 1 gives an illustrated example of this.

Table 1: An example of the statistical approach

Individual	Occupation Code	Educational Level	Mean level of Education for the 3-digit occupation	Lower Bound	Upper Bound	Status
1	111	1	2.5	0.8	4.2	Matched
2	111	2	2.5	0.8	4.2	Matched
3	111	2	2.5	0.8	4.2	Matched
4	111	5	2.5	0.8	4.2	Undereducated
5	112	2	3.75	2.5	5	Overeducated

6	112	4		3.75	2.5	5	Matched
7	112	4		3.75	2.5	5	Matched
8	112	5		3.75	2.5	5	Matched

Source: Office for National Statistics

For each of the eight individuals we have their occupation code (111 or 112) and educational level (1-5). For all those within occupation code 111, we can determine an average level of education of 2.50 and for those in 112 a level of 3.75. Similarly, we can work out the upper and lower bounds of education which is suitable or is matched for each occupation.

We can then see that all individuals have a suitable level of education for their occupation, except for individual number 4 and number 5. Individual number 4 has an educational level of 5, which falls above the upper bound. Because we have graded our educational levels with 1 being the highest and 7 being the lowest (See Annex), individual number 4 is classified as being undereducated. The reverse is true for individual number 5, having an educational level of 2, which is below the lower bound, they are overeducated.

Applying this approach to each quarter of the LFS data creates a time series, which displays how the pattern of educational mismatch has been changing between April-June 2002 and October-December 2015 while also accounting for changes in the education demand for each occupation.

An advantage of this approach is that if the mean level of educational attainment within a given occupation rises over time (in comparison with other occupations), this may indeed reflect change in the job requirements. Alternatively, overall increases in attainment due to cohort effects will also result in higher mean levels of attainment which are not purely driven by job requirements (see definitions for more detail).

Details on alternative measures of skills mismatching are outlined within the background notes.

Notes for Method:

1. Other levels of occupational groupings have been used within the literature on this subject. The approach here uses the 3 digit level as this provides a good balance between a strong sample size, as well as reducing the level of heterogeneity in roles within occupational groupings.

6. Whole Economy

Matched rate

Looking at the whole economy, Figure 1 suggests that in the three months to December 2015, 68.7% of those in employment had a level of education close to the average of their job. This was 1.3 percentage points higher than the beginning of the series, in the three months to June 2002. However, the matched rate has fluctuated during this period and, in the last few years, has been falling. The rate is down 1.0 percentage points on the three months to December 2014 and 1.2 percentage points on the three months to December 2013.

While it is possible that this general upwards trend shows improvements in the UK labour market, as individuals are able to find jobs better suited to their qualifications, this does also reflect a cohort effect. Over this time, the average level of educational attainment held by those in employment has been increasing – rising from GCE, A-level or equivalent to Certificates of Education (i.e. higher diplomas and teaching qualifications). This is likely to be driven by two key changes in the overall demographic. Firstly, those entering the UK labour market are entering with higher average levels of qualification than previously seen. Secondly, those leaving the labour market – through retirement – are older workers and they are typically those with the lowest average level of qualification.

One of the periods of lower matched rate comes about the time of the recent economic downturn.

Figure 1: Percentage of those in employment defined as "Matched", 16 to 64, UK, 4 quarter rolling averages, April to June 2002 to October to December 2015
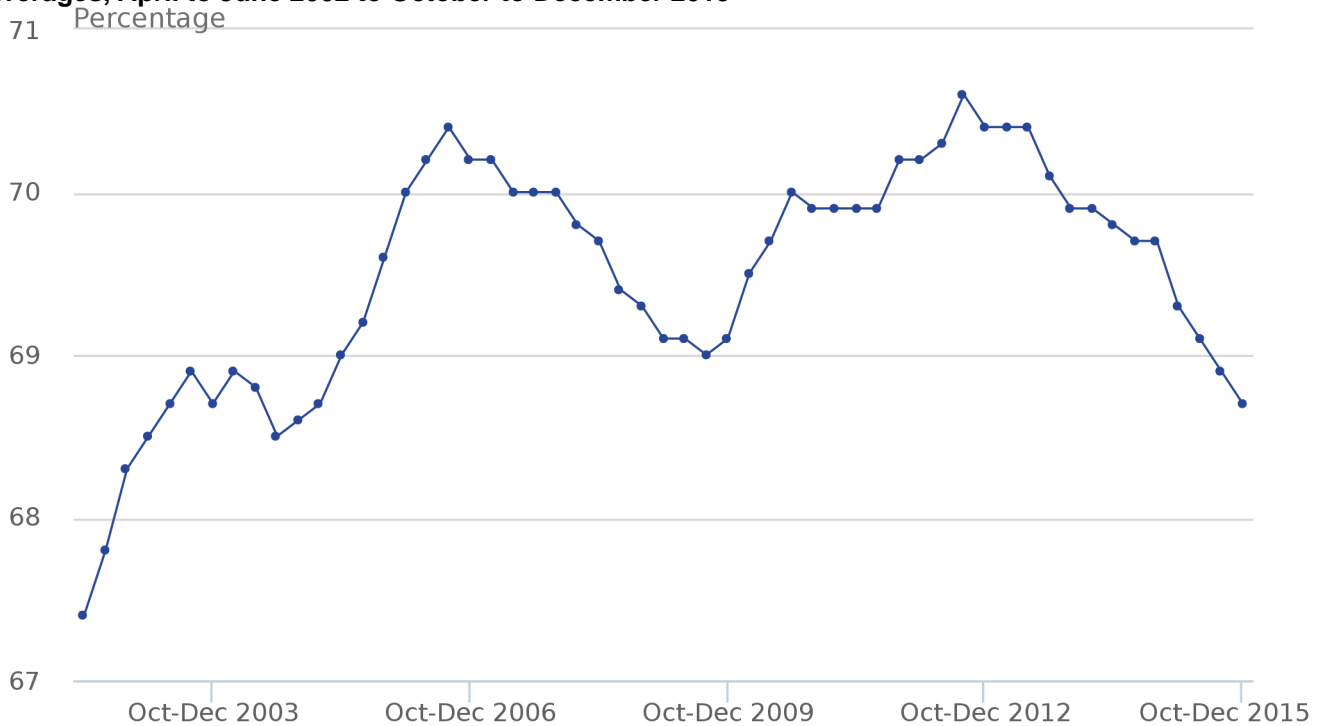
Figure 1 shows that with the onset of the economic downturn, the matched rate for the UK experienced a decline of around 1 percentage point. Coinciding with a decline in the UK employment rate, it may suggest short-term frictions as individuals left employment, changed their work patterns or switched to jobs they are not matched to.

Then, as the UK employment rate stabilises around late 2009 and early 2012, the matched rate experiences a recovery, rising from a trough of 69.1% to a peak of 70.6%. This could suggest a rebalancing, as firms address their distribution of staff and skills, and individuals are able to find more suited employment.

The second decline from 2012, unlike the first, coincides with the growth and record high rates of employment in the UK. This could suggest that, while the matched rate falls, it has been as a result of the supply-side factors, with individuals entering jobs they are mismatched to.

Over and undereducated

Figure 2 gives the percentage of those in employment who are classed as over or undereducated.

Figure 2: Percentage of those in employment defined as "Mismatched", 16 to 64, UK, 4 quarter rolling averages, April to June 2002 to October to December 2015
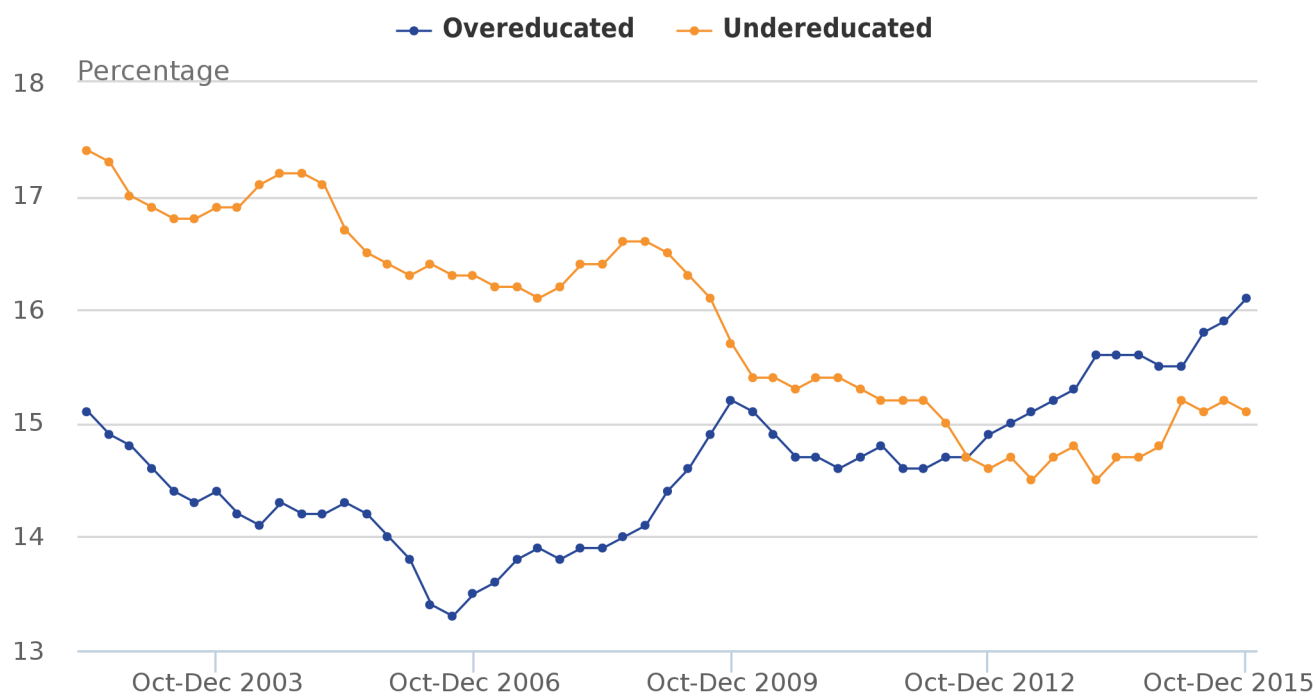
Source: Labour Force Survey

Prior to the downturn, the rate of undereducated is seen to be on a downwards trend. While suggesting an improvement in the allocation of workers and individuals becoming more matched on average, it also reflects a cohort effect with natural flows in and out of the labour market. Over this time, older workers classified as undereducated are leaving the labour market, while higher educated younger workers are joining.

Then we can observe the likely impact of the recent economic downturn. At its onset, the rate of undereducated experienced a sharp fall – suggesting those who were found to be undereducated may have been targeted when firms were releasing employees.

At the same time, this fall in the undereducated was mirrored by an increase in the rate of those who were overeducated – a possible sign of individuals finding employment who were either previously unemployed, new to the UK labour market, or who were inactive and re-entering the labour market in jobs that they are overeducated for.

Following its original impact, we can observe the two stages of the recovery. Between late 2009 and early 2012, the rate of overeducated stopped increasing and remained relatively flat at just below 15%. The undereducated rate, however, continued its pre-downturn downwards trend.

Then, around the start of 2012, the rate of overeducated began to rise once again – reaching 16.1% by the end of 2015. This may reflect factors such as increased competition for higher skilled jobs and a surplus of candidates. Similarly, we can see a small upwards trend in the undereducated rate albeit emerging only in the last year and a half.

The whole economy results in Figure 1 and Figure 2 will hide much of the variation in the incidences of mismatch across different groups of workers within the economy. The remainder of this article will focus on a number of factors such as gender, age, country of birth and job characteristics (full-time/part-time and self-employed /employee) that could impact on how likely an individual is to be over or undereducated in their occupation.

7. Gender

Figure 3: Percentage of those in employment defined as "Matched" by gender, Age 16 to 64, UK, 4 quarter rolling averages, April to June 2002 to October to December 2015
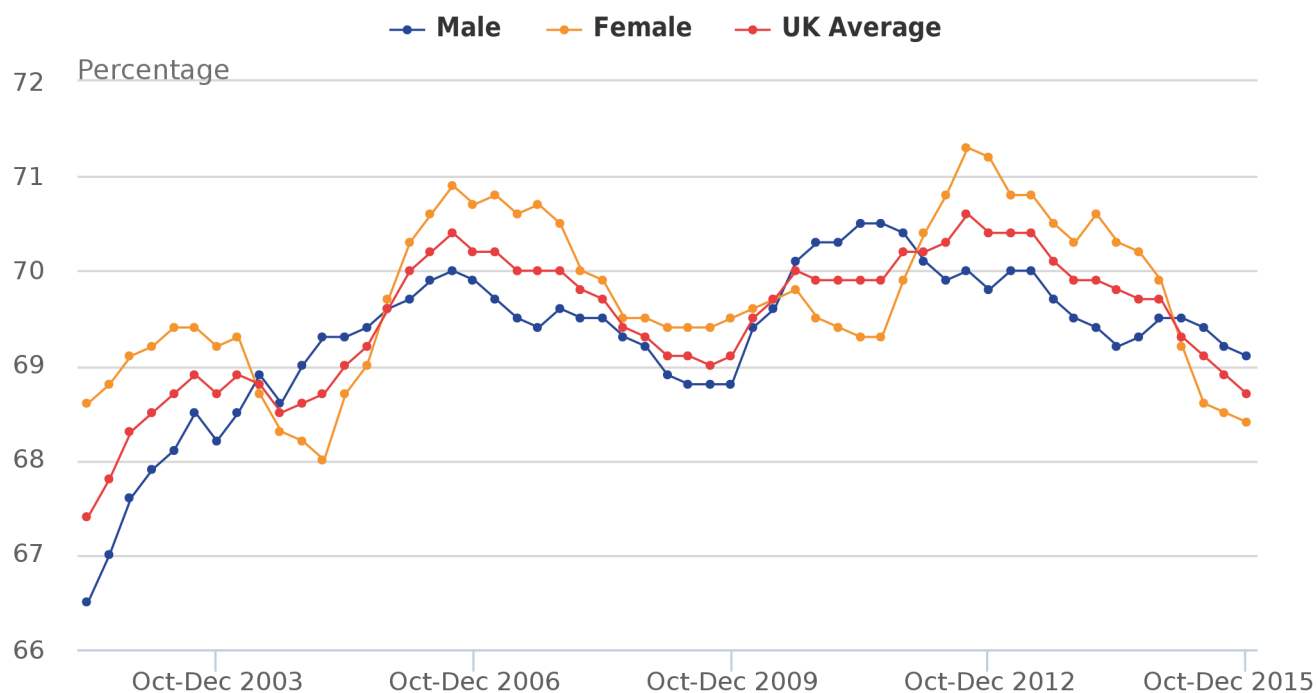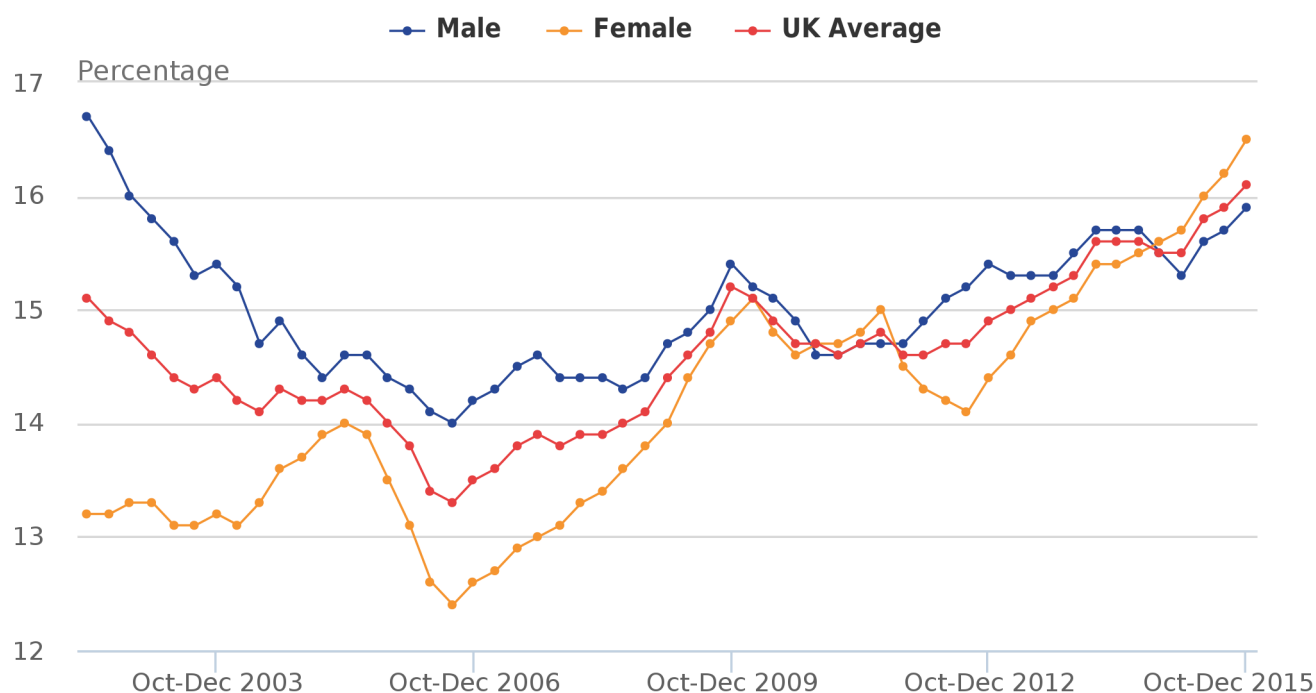

Source: Labour Force Survey

Matched rate

Figure 3 shows that the matched rates for males and females fluctuate around the UK average throughout the time series. Although volatile over this time period, the male matched rate increases and rises above the UK average at the end of the series. Conversely, the female matched rate decreases at the end of the time series, which reduces the match rate for females to 0.3 percentage points below that of the UK average in the three months to December 2015 and 0.7 percentage points below the male matched rate.

Overeducated

Figure 4: Percentage of those in employment defined as "Overeducated" by gender, 16 to 64, UK, 4 quarter rolling averages, April to June 2002 to October to December 2015
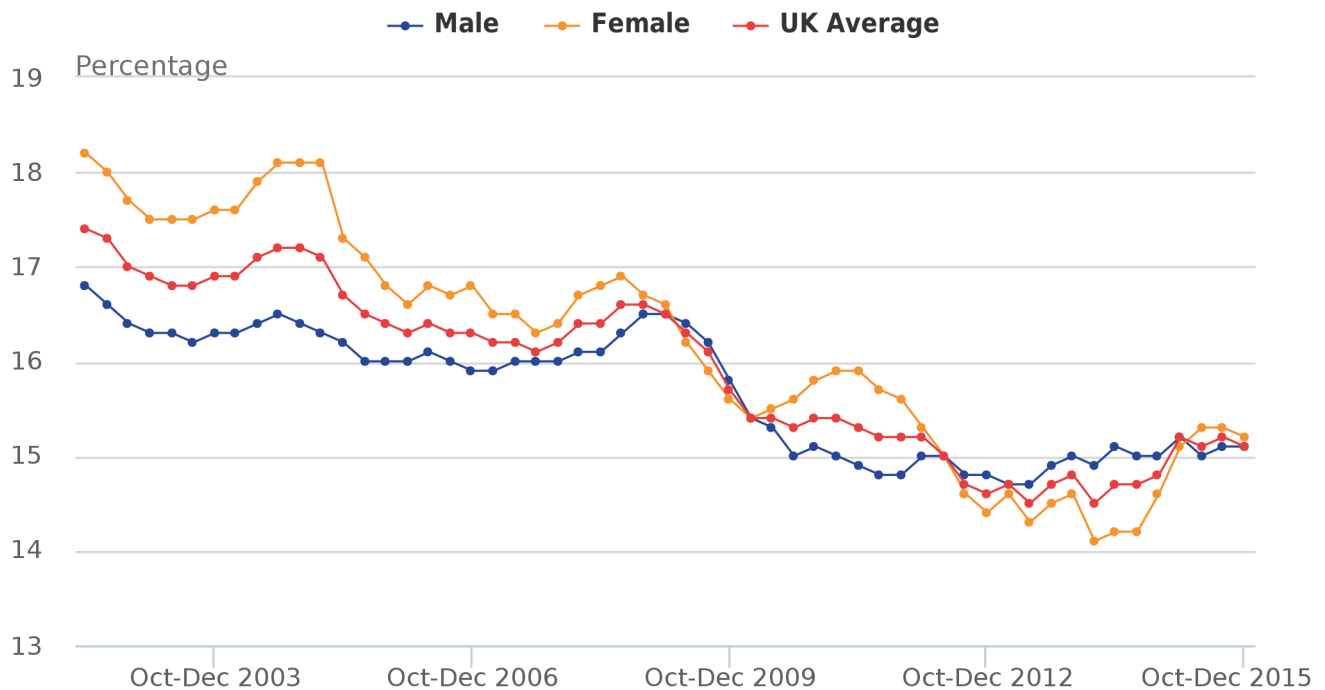

Source: Labour Force Survey

Figure 4 shows there to be a degree of convergence for overeducated males and females. Most of the convergence occurs between 2002 and 2009 when females become more overeducated whereas males become slightly less. From around 2009, male and female overeducated rates broadly move together. It becomes apparent that the greatest frequency of the highest qualification held by females over the time series switches from being GCSE or equivalent to First Degree by the end of 2011.

Undereducated

Figure 5: Percentage of those in employment defined as "Undereducated" by gender, 16 to 64, UK, 4 quarter rolling averages, April to June 2002 to October to December 2015
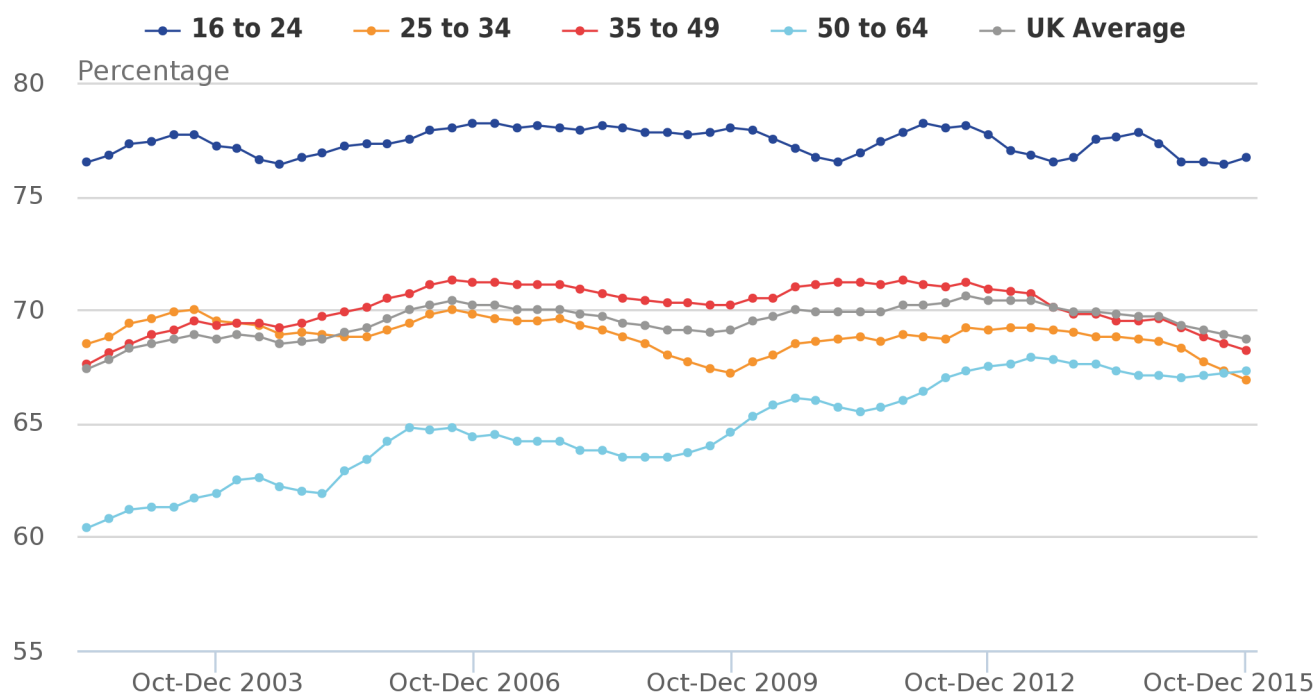

Source: Labour Force Survey

Figure 5 illustrates that under-education rates for both males and females follow a downward trend for much of the time series. Again the gap narrows between males and females, and the two converge around the economic downturn. The relationship switches in 2012 as males have a higher rate of under-education than females. However, this is interrupted by the uptick in female under-education in later quarters, which coincides with an increase in overall female employment.

8. Age

Matched rate

Figure 6 shows that the matched rate of different age groups remains fairly constant, with those aged 25-34 and 35-49 tracking closely to the UK average – as they make up the majority of those in employment. Figure 6 also shows a relatively high rate of matched for those aged 16-24, averaging between 76% and 78% over the entire period which has also remained relatively constant.

Figure 6: Percentage of those in employment defined as "Matched" by age groups, UK, 4 quarter rolling averages, April to June 2002 to October to December 2015
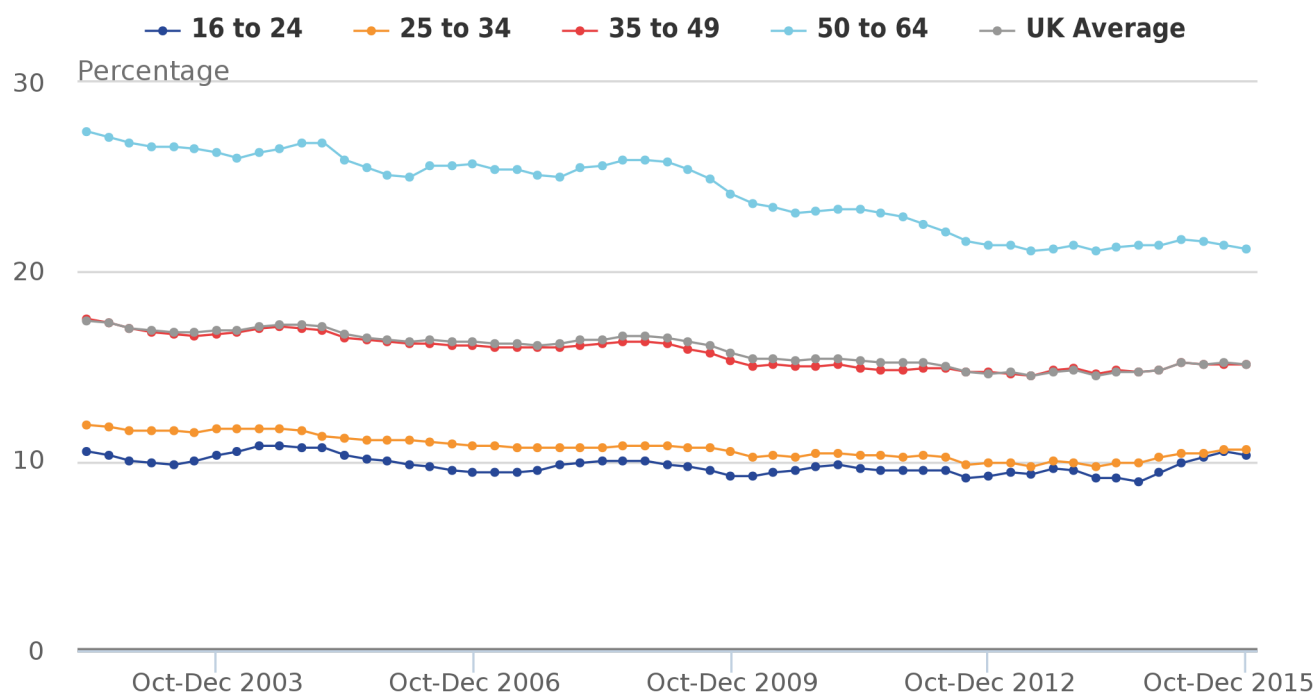

Source: Labour Force Survey

However, since the middle of 2002 to the end of 2015, the rate of matched for those aged 50-64 has increased by 6.9 percentage points. This may be a clearer reflection of the shifts of a cohort effect over this period, with those retiring and leaving the UK labour market typically having the lowest level of educational attainment and being the poorest matched by this measure. Similarly, those newly turning 50 have a level of education higher than their contemporaries and are more similar to the UK average as a whole.

Undereducated

Looking at the rates of undereducated, Figure 7 shows that while all age groups have seen a slight downwards trend in their undereducated rates, the rate for the oldest age group has seen the steepest decline, falling by 6.2 percentage points. Mirroring the improvement in the age group's matched rate, it reiterates the impact of the cohort effect. While by the end of 2015 still over one-fifth of those aged 50 to 64 are classified as undereducated – those aged 50-64 are becoming relatively more educated on average.

Figure 7: Percentage of those in employment defined as "Undereducated" by age groups, 16 to 64, UK, 4 quarter rolling averages, April to June 2002 to October to December 2015

Source: Labour Force Survey

Overeducated

Comparing the rate of overeducated for each age group to the UK average in Figure 8, once again those aged 35-49 follow a very similar trend to the UK as a whole, while those aged 16-24 and 50-64 experience a slightly lower rate – reflecting their relatively higher matched and undereducated rates respectively. Those aged 25-34, however, have a clearly higher rate of overeducated with a slight upwards trend over the time period.

Figure 8: Percentage of those in employment defined as "Overeducated" by age groups, 16 to 64, UK, 4 quarter rolling averages, April to June 2002 to October to December 2015
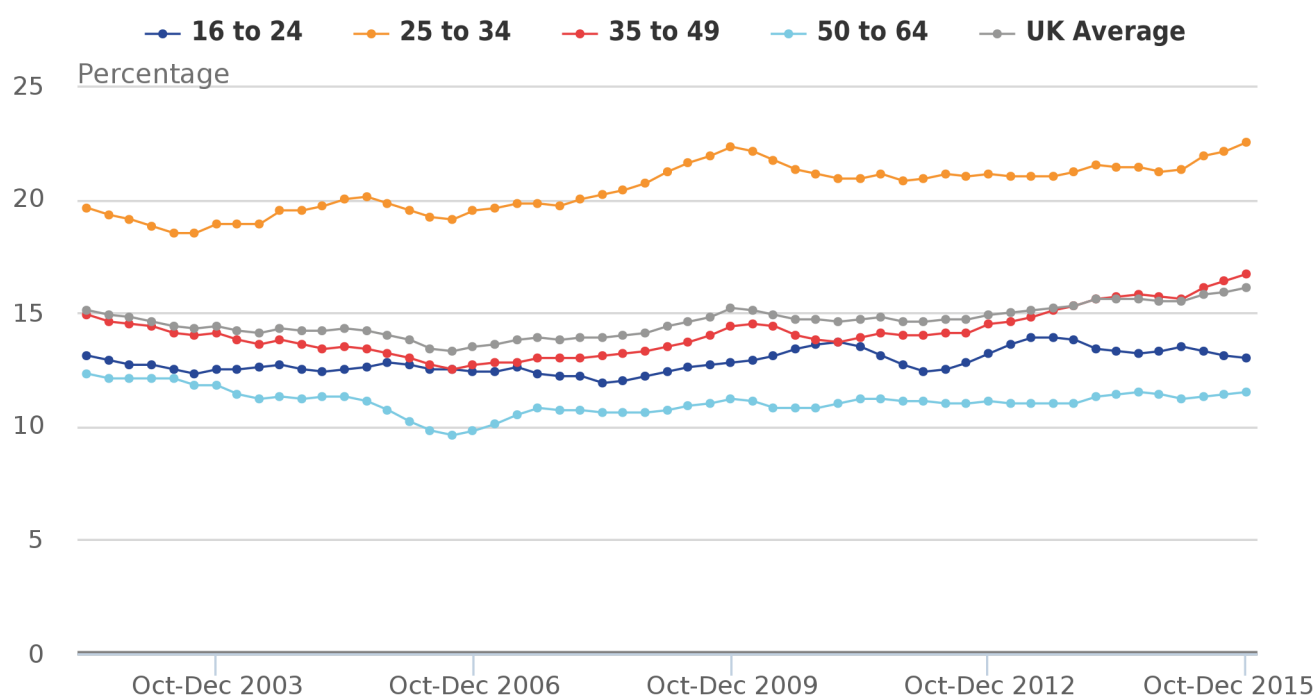
The size of this difference and its consistency, would suggest a demographic trend. As this group would capture everyone in the early years of finishing typical forms of education – previously classified as inactive and in full-time education – it would suggest around 1/5th of them are entering jobs they are overeducated for. However, for those aged 35 to 49, the rate of overeducated is consistently lower and a more typical picture of the UK as a whole. Therefore, the relatively high rate of overeducated for 25-34 year olds may be more a reflection of the relationship between this age group, their occupation in these years and their position in their careers.

9. Full-time/Part-time

Match rate

Figure 9: Percentage of those in employment defined as "Matched" by working pattern, 16 to 64, UK, 4 quarter rolling averages, April to June 2002 to October to December 2015
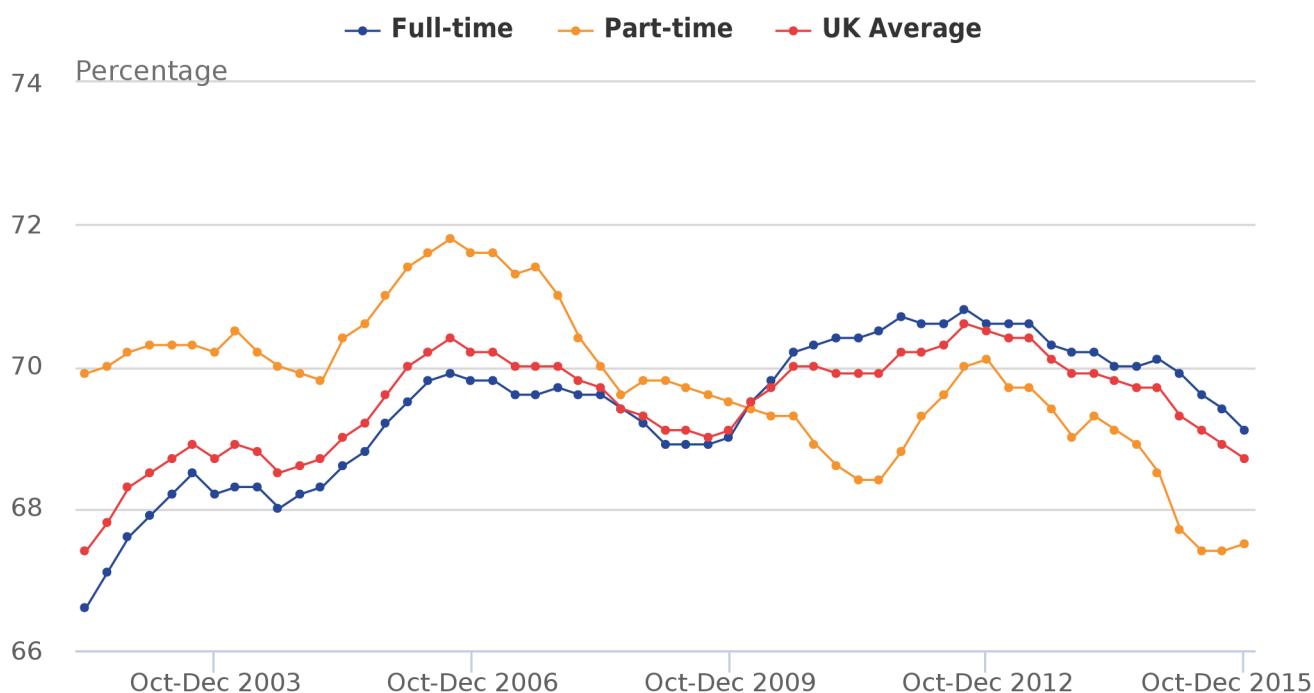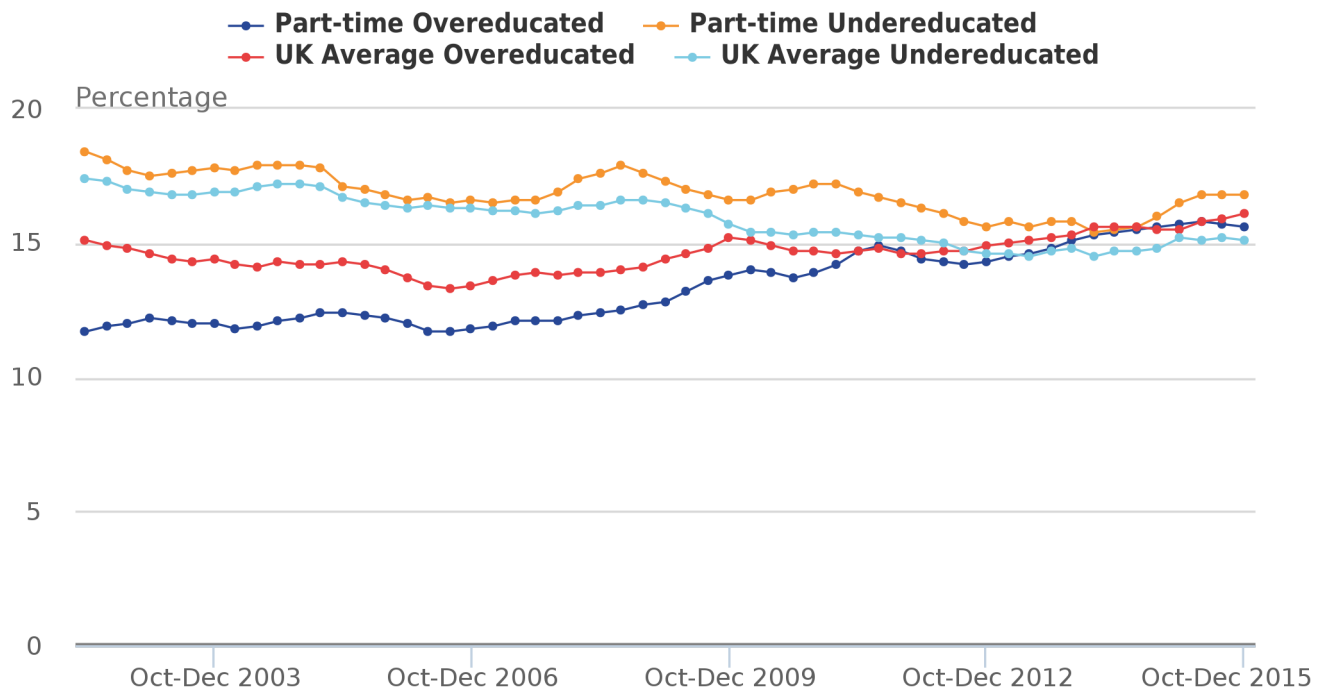

Source: Labour Force Survey

Figure 9 shows that part-time workers see a decrease in matched rates over the time series. Although it has also been volatile over this period, the part-time rate falls below the UK average in April to June 2010. Full-time workers follow an almost identical pattern to the UK average as they account for a larger percentage of the workforce than part-time workers.

Over and undereducated

Figure 10: Percentage of those in employment defined as "Mismatched" by working pattern, 16 to 64, UK, 4 quarter rolling averages, April to June 2002 to October to December 2015

Source: Labour Force Survey

Figure 10 shows there has been a steady increase in overeducated part-time workers throughout the time series, which may be linked to the similar rise seen by overeducated females. Furthermore, undereducated part-time individuals experience a slight uptick from late 2014 onwards, which mirrors that of undereducated females. 78% of part-time workers are females, and hence the increases for both characteristics can be somewhat explained by this correlation. Anecdotally, this makes sense as in many instances females leave the labour market to start a family, then return to work in part-time roles.

10. Self-employed/Employees

Matched rate

Figure 11: Percentage of those in employment defined as "Matched" by employee or self-employed, 16 to 64, UK, 4 quarter rolling averages, April to June 2002 to October to December 2015

Source: Labour Force Survey

When comparing rates of matching by employment status, Figure 11 shows that self-employed workers have a consistently lower matched rate than employees. As for employees, the rate of matched trend just above the UK average, and follows a similar pattern. This is unsurprising given that employees constitute around 85% of the overall employment status. As differences exist in match rates and trends over time for self-employed workers, the following analysis focuses on self-employed individuals.

Over and undereducated

Figure 12: Percentage of those in employment defined as "Mismatched" by employee or self-employed, 16 to 64, UK, 4 quarter rolling averages, April to June 2002 to October to December 2015
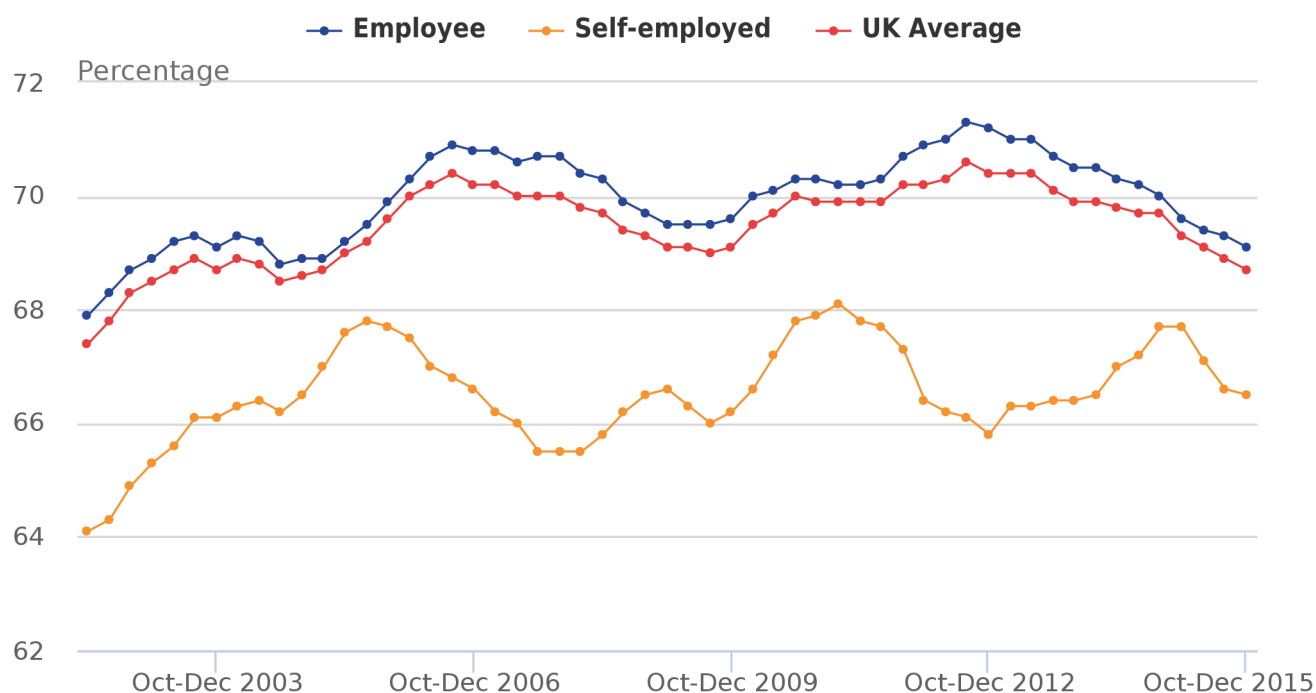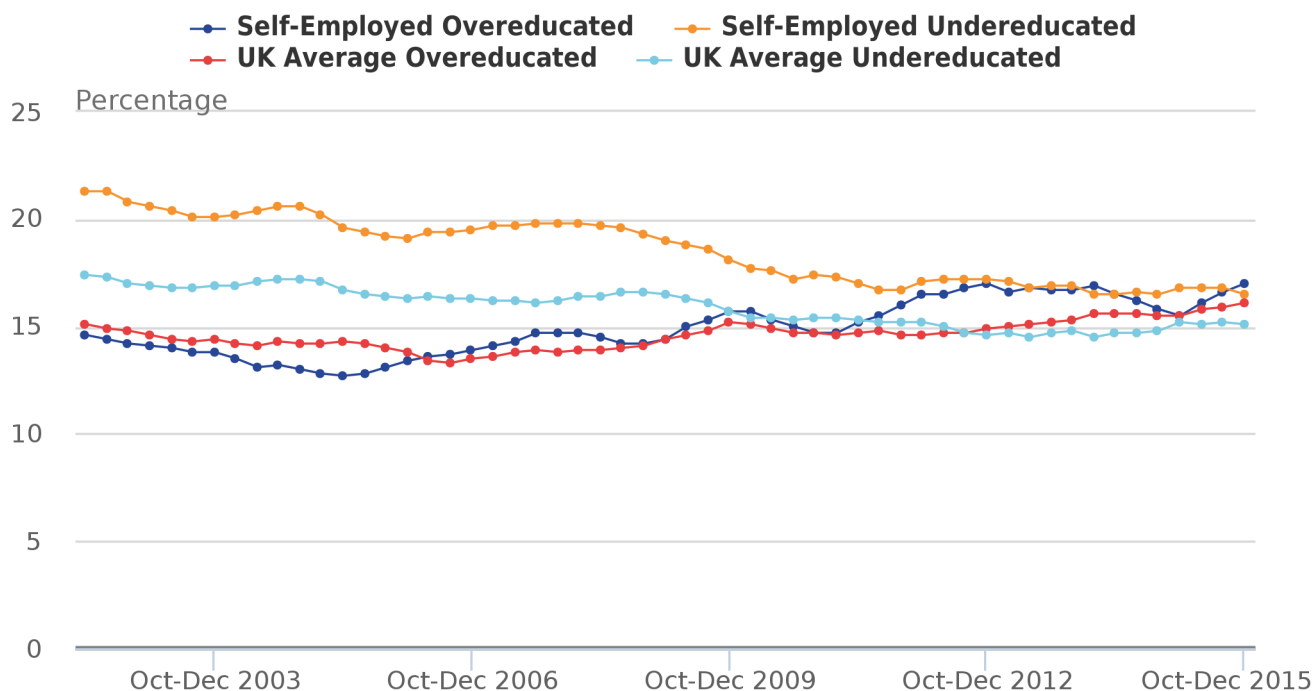

Source: Labour Force Survey

Figure 12 shows that the undereducated rate for self-employed workers are higher than that of the UK average; however, it does follow a similar downward trend. Both peak in the three months to December 2004 before continuing downward until becoming almost flat from the three months to June 2012 onwards.

The rate of overeducated shows a more varied picture. Initially showing a similar rate as the whole economy, it moves away from the UK average in the three months to September 2011, as the overeducated rate for self-employed workers becomes significantly higher.

11. Country of Birth

When looking at country of birth[1] there is a known issue with using highest qualification/trade apprenticeship as a proxy for educational attainment. This is with regards to treatment of non-UK qualifications in early iterations of the variable. In these case a secondary proxy – age when completed full-time education – is used. For detailed explanation of their treatment in this article, please see background notes 3.

Matched rate

Breaking down by country of birth, Figure 13 shows that those born outside of the UK and in employment generally experience a lower matched rate for their occupations, relative to the UK as a whole.

Figure 13: Percentage of those in employment defined as "Matched" by country of birth, 16 to 64, UK, 4 quarter rolling averages, April to June 2002 to October to December 2015
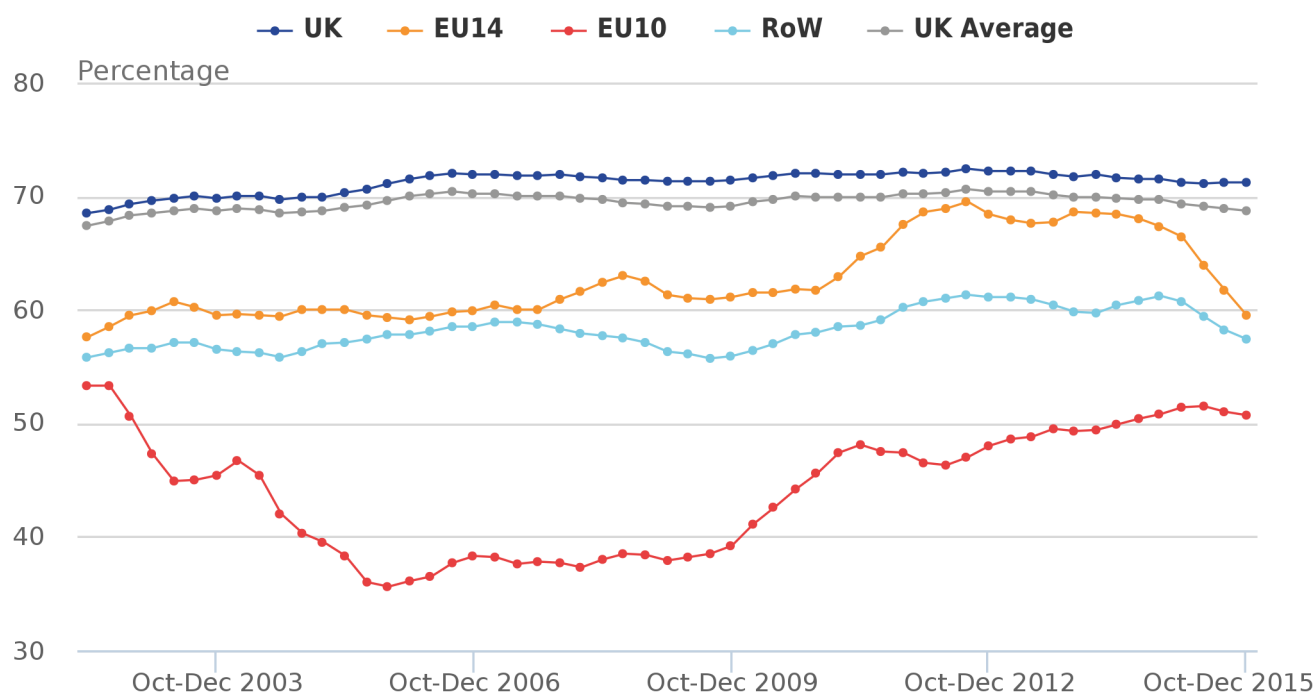
Source: Labour Force Survey

Notes:

1. EU14 consist of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Luxembourg, Netherlands, Portugal, Republic of Ireland, Spain and Sweden.

2. EU10 consists of Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia.

3. RoW stands for Rest of World and consists of all other countries not listed.

Those born in the EU14[2] had a matched rate closest to the UK average, with a narrowing of around 11 percentage points between 2002 and 2013. However, from 2014 onwards the matched rate for the EU14 fell by around 9 percentage points to return to the rates seen at the beginning of the time period. While classified as born in the Rest of the World (RoW) had relatively constant match rates between April to June 2002 and October to December 2015.

Of the groups identified, the EU10 – made up of the Accession 8 [3] (A8) and Accession 2 [4] (A2) nations – consistently have the poorest rate of matched and relatively more volatile, although improving towards the end of the time series.

The initial decline for the EU10, coincides with a period of increased migration into the UK from the A8 countries, following their joining of the EU in May 2004. It suggests that those that came to the UK after 2004, were entering jobs for which they had a higher level of educational attainment relative to others in the same occupation. Then, between early 2009 to early 2011, Figure 13 shows an improvement in the EU10 matched rate of around 10 percentage points. Again coinciding with an increase in migration of individuals born in the A8 countries into the UK – potentially due to the relatively good economic performance of the UK – it suggests workers born in the EU10 where in or entering jobs, were their level of educational attainment was similar to the UK as a whole.

Overeducated

While the rate of matched for each non-UK born group has been consistently below that of the UK average, the majority of those mismatched are classified as overeducated. Looking at Figure 14 the rate of overeducated is relatively similar for those in the EU14 and RoW at around 25%, while the rate for those born in the EU10 is larger at around 40% – although this has been falling gradually over the last decade.

Figure 14: Percentage of those in employment defined as "Overeducated" by country of birth, 16 to 64, UK, 4 quarter rolling averages, April to June 2002 to October to December 2015
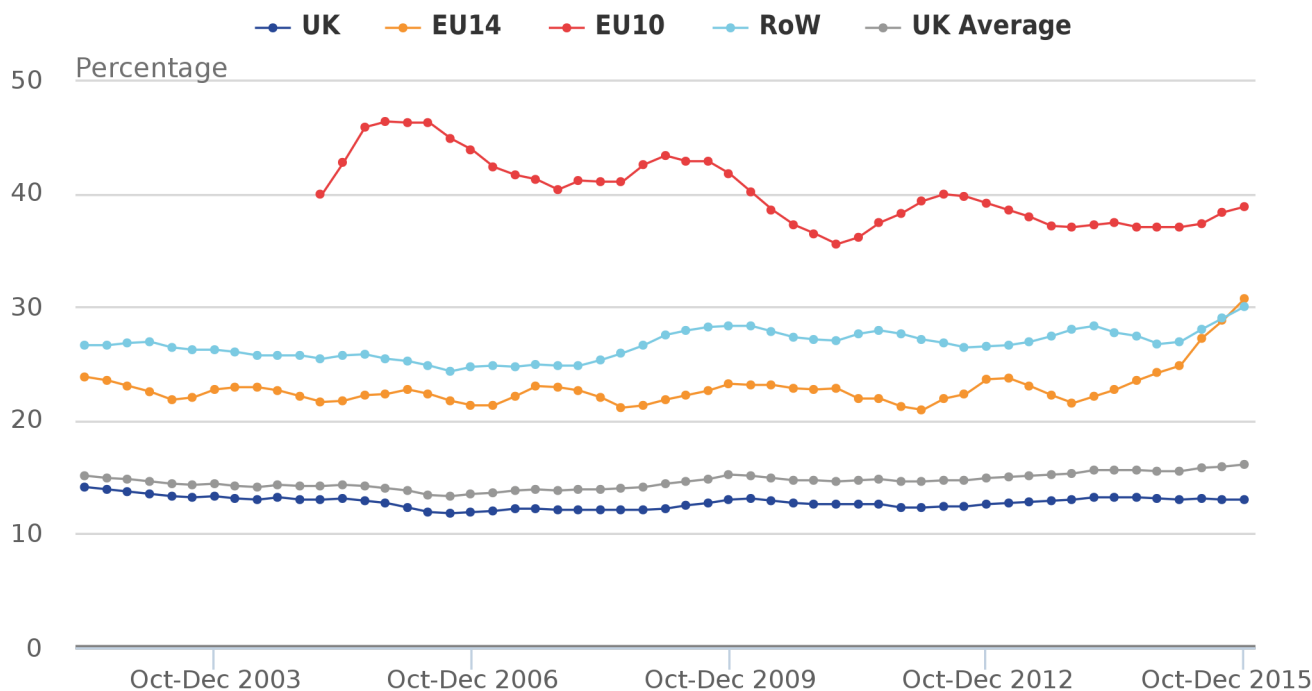
Source: Labour Force Survey

Notes:

1. EU14 consist of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Luxembourg, Netherlands, Portugal, Republic of Ireland, Spain and Sweden.

2. EU10 consists of Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia

3. Data for EU10 overeducated is unavailable prior to 2005. This is due to small samples sizes.

4. RoW stands for Rest of World and consists of all other countries not listed.

However, while Figure 13 and Figure 14 show that the experience of those born outside of the UK is different to the UK as a whole, there are key differences in the demographic make-up of each group, such as age.

For those observed and born outside of the UK, around 30% of them were aged between 25 and 34 – this is relative to around 19% for those UK born. Of those born in the EU10 and in employment, nearly half of them were in this age group. Taking this into account, they are naturally disposed towards being relatively more overeducated– see Age for further details.

In addition to non-UK born tending to be younger than the UK workforce as a whole, their reasons for coming to the UK could be wide-ranging. For example, some graduates may see working in the UK as a temporary step within their careers such as wanting to improve their English language skills. Some non-UK born people may find it difficult to obtain jobs matched to high education levels because of language barriers. Further analysis of

different sources would be required to more fully understand the reasons for the over-education of the non-UK born.

Notes for Country of Birth:

1. Country of birth analysis is used in this article to allow for a more stable comparison over time. Similar trends of matched, over and undereducated rates were achieved when people were grouped by nationality, although levels were generally further away to UK averages.

2. EU14 consist of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Luxembourg, Netherlands, Portugal, Republic of Ireland, Spain and Sweden.

3. Accession 8 consists of Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia.

4. Accession 2 consists of Bulgaria and Romania.

12. Annex

Table 2 describes the six different iterations of the variable HIQUAL that are used in this article between 2001 and 2015. The numbers relate to the response codes for individual qualifications which represent each main type of attainment level. For example, any code between 15 and 24 in response to the HIQUAL variable would be classed as education attainment level 4 – GCE A level or equivalent.

Table 2: Aggregate groups of highest level of educational attainment

	Example	Educational Attainment Variable[1]					
		HIQUAL	HIQUAL4	HIQUAL5	HIQUAL8	HIQUAL11	HIQUAL15
1 Higher Degree	Higher Degree	1	1	1	1	1	1
2 Degree or equivalent	First degree	2 to 4	2 to 4	2 to 4	2 to 4	2 to 9	2 to 9
3 Certificates of Education	Higher Diploma	5 to 14	6 to 15	7 to 15	8 to 15	10 to 29	10 to 29
4 GCE, A-Level or equivalent	A-level	15 to 24	17 to 28	18 to 28	19 to 28	30 to 47	30 to 47
5 GCSE grades A*-C or equivalent	A*-C GCSE	25 to 30	29 to 32	29 to 35	29 to 35	48 to 57	48 to 59
6 Other qualification	NCQ level 1	31 to 39	33 to 44	36 to 47	36 to 48	58 to 78	60 to 83
7 No qualification	None	40	45	48	49	79	84

Source: Office for National Statistics

Note:

1. The ordering of qualifications here differs to other international classifications such as ISCED levels and National Qualification Framework

Details on variable composition and responses are available on the National Archives.

13. Authors

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14. Background notes

1. **Data source**

   The data within this article come from the Labour Force Survey (LFS) quarterly person datasets. The LFS is a sample survey and all estimates from it are subject to sampling variability. Sampling variability is dependent on several factors, including the size of the sample, the size of the estimate as a percentage of the population and the effect of the design of the sample on the variable of interest. Therefore, it is subject to a margin of uncertainty, as different samples give different results.

   The data in this statistical bulletin are not seasonally adjusted but rolling four quarter averages are used to smooth out seasonal fluctuations.

2. **Data quality**

   Quality and methodology information papers for labour market statistics are available on the ONS website. Further information about the Labour Force Survey (LFS) is available from:

   - the LFS user guide, and

   - LFS performance and quality monitoring reports.

3. **Treatment of non-UK qualifications**

   Prior to 2011, limited information on non-UK qualifications was collected via the educational attainment variable HIQUAL – Highest qualification/trade apprenticeship. As a result a large number of respondents were classified as "Other qualification".

   Using these estimates, alongside our categorisations of highest level of educational attainment – see Annex – those with non-UK qualifications would be grouped as "Other qualification", at the lower end of the used scale.

   To correct for this, a proxy for educational attainment is used: EDAGE – age when completed full-time education. This is applied to those who are not UK born and are categorised as having "Other qualification" in all iterations of the HIQUAL variable. Then, using the age they finished full-time education and the typical experience of someone born in the UK, they are re-categorised into our aggregated groups of highest level of educational attainment. An example and table of the new groups are listed below.

   Example

   If a non-UK born worker, previously classified as having "Other Qualification", finished full-time education at 18, then they are assumed to have GCE, A-Level or equivalent.

   Table 3: Treatment of non-UK qualifications

	Example	Age range when completed full-time education
1 Higher Degree	Higher Degree	N/A[1]
2 Degree or equivalent	First degree	21-23
3 Certificates of Education	Higher Diploma	19-20
4 GCE, A-Level or equivalent	A-level	17-18
5 GCSE grades A*-C or equivalent	A*-C GCSE	15-16
6 Other qualification	NCQ level 1	24-95
7 No qualification	None	Never had education

   Source: Office for National Statistics

   Notes:

   1. Due to the bespoke nature of this level of education and their international recognition, it is considered that HIQUAL will capture this level of education more effectively than EDAGE.

2. EDAGE is a variable that captures the age the respondent completed continuous, full-time education.

4. **Testing for normality of the distribution of education attainment and use of the mean**

In order to be considered as matched to a given occupation, an individual must have a level of education attainment within one standard deviation either side of the occupation's mean of those in that occupation – see methodology for more detail.

Based on the three-sigma rule – also referred to as the "68–95–99.7" rule – the use of one standard deviation band about the mean would capture 68.27% of sample, if the sample was normally distributed. As the average experience for the whole economy was 69.5%, tests were performed on the dataset, so as to assess the suitability of the method.

Although the data on educational attainment is ordinal, the mean still provides a useful benchmark for groups to be compared against rather than be compared to the mode or median education attainment level.

Using the mode or median would imply that six of the seven education levels would be unmatched in each period (or a given number of categories either side of the mode or median). This would not permit much detailed analysis of changes to the distribution of educational attainment over time or between groups of workers which is the purpose of this article.

Table 4 shows the results of a Kolmogorov-Smirnov (K-S) test for the distribution of the educational attainment variable of each quarter observed. From this it can be inferred that the distribution of educational attainment in each quarter is significantly not normal.

Table 4: Kolmogorov-Smirnov (K-S) test for normal distribution of educational attainment variable, July to September 2001 to October to December 2015, UK

Kolmogorov-Smirnov Test[1]

	Statistical Deviation	Degrees of Freedom	Significance Level	
Jul-Sep 2001	0.145	61929	0.000	$D(61929) = 0.15$, $p<0$
Oct-Dec 2001	0.147	62735	0.000	$D(62735) = 0.15$, $p<0$
Jan-Mar 2002	0.148	62283	0.000	$D(62283) = 0.15$, $p<0$
Apr-Jun 2002	0.147	61897	0.000	$D(61897) = 0.15$, $p<0$
Jul-Sep 2002	0.148	60896	0.000	$D(60896) = 0.15$, $p<0$
Oct-Dec 2002	0.149	60368	0.000	$D(60368) = 0.15$, $p<0$
Jan-Mar 2003	0.147	60063	0.000	$D(60063) = 0.15$, $p<0$
Apr-Jun 2003	0.146	59416	0.000	$D(59416) = 0.15$, $p<0$
Jul-Sep 2003	0.148	58588	0.000	$D(58588) = 0.15$, $p<0$
Oct-Dec 2003	0.148	58129	0.000	$D(58129) = 0.15$, $p<0$
Jan-Mar 2004	0.148	58106	0.000	$D(58106) = 0.15$, $p<0$
Apr-Jun 2004	0.145	56779	0.000	$D(56779) = 0.15$, $p<0$
Jul-Sep 2004	0.147	56663	0.000	

				D(56663) = 0.15, p<0
Oct-Dec 2004	0.148	57422	0.000	D(57422) = 0.15, p<0
Jan-Mar 2005	0.150	57204	0.000	D(57204) = 0.15, p<0
Apr-Jun 2005	0.150	56685	0.000	D(56685) = 0.15, p<0
Jul-Sep 2005	0.151	56477	0.000	D(56477) = 0.15, p<0
Oct-Dec 2005	0.152	55558	0.000	D(55558) = 0.15, p<0
Jan-Mar 2006	0.153	55620	0.000	D(55620) = 0.15, p<0
Apr-Jun 2006	0.152	55444	0.000	D(55444) = 0.15, p<0
Jul-Sep 2006	0.151	54654	0.000	D(54654) = 0.15, p<0
Oct-Dec 2006	0.150	54665	0.000	D(54665) = 0.15, p<0
Jan-Mar 2007	0.147	54703	0.000	D(54703) = 0.15, p<0
Apr-Jun 2007	0.146	54805	0.000	D(54805) = 0.15, p<0
Jul-Sep 2007	0.148	54834	0.000	D(54834) = 0.15, p<0
Oct-Dec 2007	0.149	54777	0.000	D(54777) = 0.15, p<0
Jan-Mar 2008	0.150	54871	0.000	D(54871) = 0.15, p<0
Apr-Jun 2008	0.150	54146	0.000	D(54146) = 0.15, p<0
Jul-Sep 2008	0.151	52919	0.000	D(52919) = 0.15, p<0
Oct-Dec 2008	0.151	53314	0.000	D(53314) = 0.15, p<0
Jan-Mar 2009	0.151	52237	0.000	D(52237) = 0.15, p<0
Apr-Jun 2009	0.148	50591	0.000	D(50591) = 0.15, p<0
Jul-Sep 2009	0.149	49984	0.000	D(49984) = 0.15, p<0
Oct-Dec 2009	0.152	49095	0.000	D(49095) = 0.15, p<0
Jan-Mar 2010	0.151	48602	0.000	D(48602) = 0.15, p<0
Apr-Jun 2010	0.151	49002	0.000	D(49002) = 0.15, p<0
Jul-Sep 2010	0.151	48146	0.000	D(48146) = 0.15, p<0
	0.151	47365	0.000	

Oct-Dec 2010				D(47365) = 0.15, p<0
Jan-Mar 2011	0.156	46605	0.000	D(46605) = 0.16, p<0
Apr-Jun 2011	0.154	46153	0.000	D(46153) = 0.15, p<0
Jul-Sep 2011	0.155	46025	0.000	D(46025) = 0.16, p<0
Oct-Dec 2011	0.154	46906	0.000	D(46906) = 0.15, p<0
Jan-Mar 2012	0.155	46947	0.000	D(46947) = 0.16, p<0
Apr-Jun 2012	0.155	46843	0.000	D(46843) = 0.15, p<0
Jul-Sep 2012	0.156	46089	0.000	D(46089) = 0.16, p<0
Oct-Dec 2012	0.154	45714	0.000	D(45714) = 0.15, p<0
Jan-Mar 2013	0.154	45358	0.000	D(45358) = 0.15, p<0
Apr-Jun 2013	0.155	44756	0.000	D(44756) = 0.16, p<0
Jul-Sep 2013	0.156	45204	0.000	D(45204) = 0.16, p<0
Oct-Dec 2013	0.156	46288	0.000	D(46288) = 0.16, p<0
Jan-Mar 2014	0.158	46557	0.000	D(46557) = 0.16, p<0
Apr-Jun 2014	0.160	46282	0.000	D(46282) = 0.16, p<0
Jul-Sep 2014	0.161	45347	0.000	D(45347) = 0.16, p<0
Oct-Dec 2014	0.162	45516	0.000	D(45516) = 0.16, p<0
Jan-Mar 2015	0.161	45620	0.000	D(45620) = 0.16, p<0
Apr-Jun 2015	0.161	45082	0.000	D(45082) = 0.16, p<0
Jul-Sep 2015	0.161	44037	0.000	D(44037) = 0.16, p<0
Oct-Dec 2015	0.161	43730	0.000	D(43730) = 0.16, p<0

Source: Office for National Statistics

Note:

1. Lillefors Significance Correction

Alternative methods of estimating skills mismatch

There is no one internationally accepted way of measuring skills or educational mismatch, but the ILO (Skills mismatch in Europe - 2014) identifies three main approaches in addition to the statistical approach to measure under and overeducated used in this article. Table 5 describes the three alternatives, reproduced from their article.

Table 5: Approaches of measuring skill and education mismatch

Approach	Description	Advantages	Disadvantages
Normative	Use a pre-determined mapping between the job and the required education level	Relatively easily measurable Objective	Assumes constant mappings over all jobs of a given occupation A thorough mapping is costly to create and update
Self-assessment	The respondents are asked about their perceptions of the extent their education or skills are used in their job	Always up-to-date Corresponds with requirements in the inidividual firm	Subjective bias: respondents may overstate job requirements, inflate their status, or reproduce actual hiring standards
Income ratio	Over-education is a continuous variable measured by comparing actual and potential income	Reflects that one of the goals of investment in education is maximising income	An indirect measure, can be influenced by many other factors

Source: Extract from Table 4, ILO (2014)

Skills mismatch in Europe, ILO (2014)

The normative approach assigns occupations to a particular level of education which remains constant through time. Someone with a greater level of qualification or years of education than the assigned level required for the job will therefore be overeducated. Similarly, someone with a lower level of qualification or years of education will be classified as undereducated. This will produce a proportion of the workforce which is matched, over or undereducated but will be a fairly crude measure and not take into account changes in qualification requirements or up-skilling of jobs over time.

An alternative is a self-assessment of skill levels and workers' views on what skill or education level is required for their current job. This approach has for example been used by CIPD (Over-qualification and skills mismatch in the graduate labour market – 2015) in a study of skills mismatch among graduates across Europe. This used survey results from the European Social Survey and the European Working Conditions Survey to compare rates of graduate under-utilisation. This found relatively high rates of graduate under-utilisation in the UK compared to other EU countries. Results from UK-based surveys which also report skill levels of individuals are also reported such as the 2012 Skills and Employment survey.

The income ratio approach equates the gap between actual and potential earnings, with those identified as overeducated workers being paid less than their potential earnings. The opposite would apply to undereducated workers.

McGowan and Andrews (Labour Market Mismatch and Labour Productivity - 2015) report that OECD Employment Outlook (Skills Outlook 2013) find that normative and statistical qualification mismatch methods produce similar results and cross-country rankings to the self-reported surveys of education and skills matching.

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