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Hollowing out and the future of the labour market

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Executive Summary

- There is widespread evidence for the existence of 'hollowing-out' or job polarisation, whereby if jobs are ranked by their initial wage at a point in time in the late 1980s or early 1990s, then increases in employment share are observed at the top and bottom of this distribution, whereas those jobs that were in the middle have lost employment share over time.

- Most of the increase in low-level (in terms of initial wage) jobs is in social (caring) services and in personal services.

- The declining volume of mid-ranked jobs is in occupation areas such as administration and production.

- The pattern of job polarisation has been found in each country that has been considered.

- The growth in the number of low-level service jobs has been larger in the UK than in many other European countries.

- Job polarisation seems to be caused by task-biased technological change. The falling cost of computing power has led to technology replacing jobs involving routine tasks that are easily programmed, such as in administrative and production jobs. These jobs are often found in the middle of the job distribution when ranked by initial wages.

- There is little evidence for wage polarisation – the growth in wages has been highest for high-ranking jobs, followed by middle-ranked jobs, and lowest for low-ranked jobs.

- If only demand-side factors such as task-biased technological change are behind changes in the labour market, we would expect wages and employment to move together, producing similar changes in the job distribution and wage distribution. The fact that we do not observe this, with growth in jobs but not in wages at the lower end of the labour market, suggests supply-side factors could also be important there, with increased supply potentially coming from displaced intermediate workers, former benefit recipients pushed into work by eligibility changes, or immigration.

- The analysis of wage distributions, revealing differential wage growth at different points in the distribution, shows that wage distributions are changing over time. The job polarisation literature, in which occupations are classified according to their *initial* wage, will not allow for this change. Thus, even though intermediate jobs according to their initial wage may be declining in number, new intermediate-ranked jobs can emerge as jobs move up and down the wage distribution, as well as the creation of totally new jobs.

- It is therefore not the case that intermediate jobs are disappearing to a large extent. Large numbers of intermediate-level jobs remain, and in addition, due to replacement demand, job openings in these occupations will continue to be created.

- This does not mean the issues can be ignored. Certain types of intermediate jobs, particularly in skilled production, have suffered a large fall in employment. This may have implications for worker mobility.

- First, what happens to those workers displaced from routine intermediate jobs? The limited evidence available from birth cohort data sets suggests that they can either move up to high-level non-routine jobs, or down to lower-level non-routine jobs, with younger workers and those with better qualifications more likely to make the former transition. There appears to be less downward movement than in the US, though more evidence is needed.

- Second, has the changing composition of intermediate-level jobs, and the decline of particular intermediate jobs, affected progression from entry-level to mid-ranking jobs? There is very limited evidence available. What there is suggests a fall in the amount of progression from entry-level jobs over time, though this has not been linked to job polarisation, which therefore cannot be stated as the definite cause. More evidence is needed here.

- In terms of policy, it would be wrong to conclude from an initial reading of the job polarisation literature that there is no need to develop, or even maintain, intermediate level education provision, or to encourage individuals to reach such levels of attainment. The evidence presented has shown that intermediate-level jobs remain and will continue to remain, though changing in nature. It is therefore necessary for individuals to receive the education and training required to prepare them for the intermediate jobs that exist now (with more research needed to identify those jobs). Such education will also need to provide learners with flexible skills, to enable them to face future further changes.

1. Introduction

'Hollowing-out' or 'job polarisation' is the process by which the shares of total employment in high-ranked and low-ranked jobs have expanded relative to middle-ranked jobs over time, where jobs are ranked by their initial wage. Thus, more high-level jobs are created, such as professional and managerial positions, but there is also a growth in the relative share of low-level, typically personal service jobs (caring jobs being a good example). These increases in employment shares have come at the expense of mid-level jobs, typically administrative and production jobs.

Hollowing-out is a phenomenon that has been increasingly observed in the UK and many other developed countries. Such research has only gained prominence in the last 5 or 6 years, but refers to the period since the late 1980s/early 1990s, or even earlier. The aim of this report is to summarise and discuss this literature, rather than add new research. This is a relatively new, but rapidly expanding area in labour economics research. This report will therefore not provide a comprehensive review of everything that has been written on the topic, but rather focus on some of the most influential papers, outline the key debates that have taken place, and address some of the issues set out below.

Section 2 presents the evidence for the existence of hollowing-out, while the following section discusses the research that investigates why it has occurred. Section 4 is the first of three sections that consider the implications of hollowing-out, examining whether job polarisation has led to wage polarisation. Section 5 looks at the outcomes in terms of how the distribution of jobs has changed across occupations groups over the last quarter of a century, and how it is forecast to change in the next decade. Section 6 then takes these changes and asks whether the decline in the number of intermediate-level jobs has any implications for job mobility and progression from entry-level jobs. A final section concludes by describing policy implications, and assessing where further research would be fruitful.

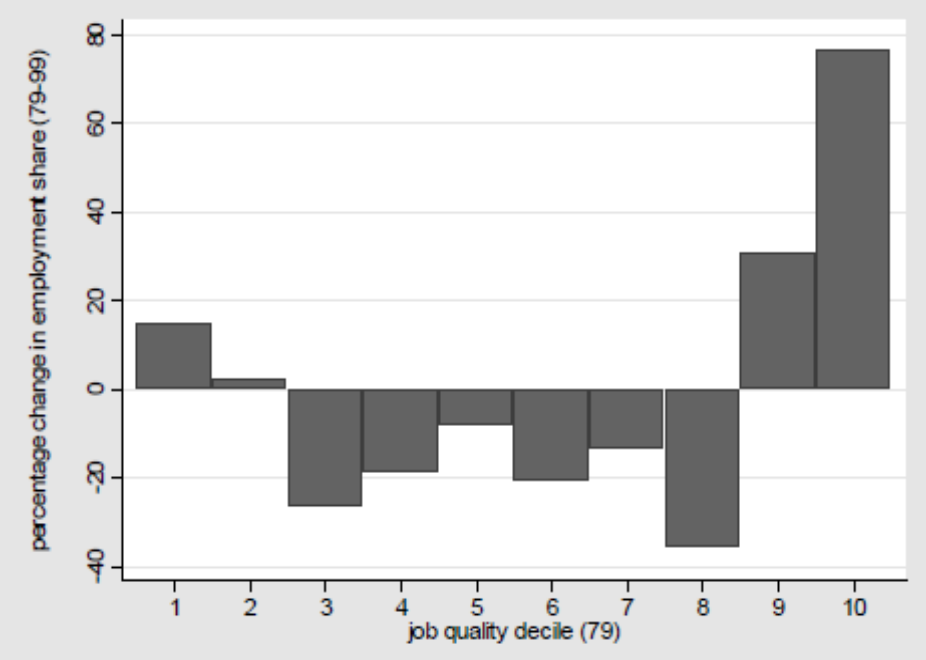
2. The existence of hollowing-out

(i) UK

The first study of which I am aware, that drew attention to job polarisation in the UK, and without doubt the most referenced as the original source, is the paper by Goos and Manning (2007). Figure 1 in this paper is their famous diagram first showing job polarisation, shown below.

In order to draw such a diagram, it is necessary to rank jobs, so that 'high-level', 'mid-level' etc. can be defined. Goos and Manning rank jobs according to the wage that they paid in 1979, which is the first year available in their data set (the Labour Force Survey, LFS). 'Jobs' are defined as 3-digit occupations in the 1990 SOC (Standard Occupational Classification), producing around 370 jobs. For ease of illustration, these jobs are divided into ten deciles, where decile 1 is the 10% of jobs paying the lowest median wage in 1979, etc. The authors then calculate the percentage change in the employment share of the jobs in each decile.

Figure 1: Percentage change in employment share by job quality decile, 1979-1999, UK



Source: Goos and Manning(2007): Figure 1

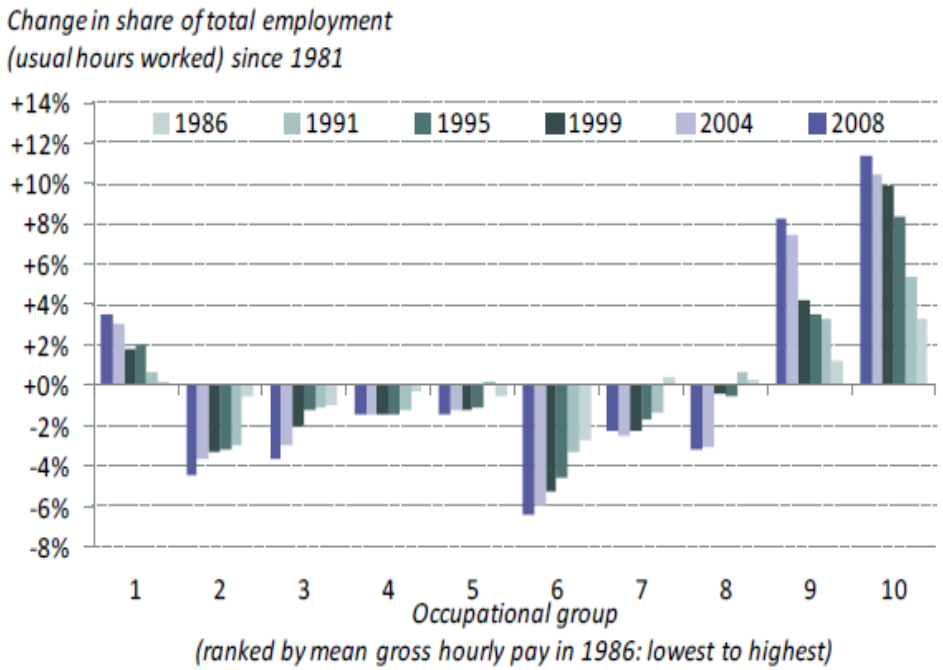
Their results show that by far the largest increase in employment share has been experienced by the top 10% of jobs in 1979, followed by decile 9. The largest growth in jobs in the 1980s and 1990s has therefore been in high-level jobs. The only other two deciles to have increased their share of employment over this period are decile 1 and decile 2, representing job growth in the lowest ranked jobs. Deciles 3-8 have all seen a decline in their employment share over this period.

To illustrate their results, and in particular their most surprising finding that employment was growing in the lowest level jobs, Goos and Manning listed the ten occupations that had seen the largest increases in employment share between 1979-1999. This list is dominated by high-level jobs in business and finance (as Figure 1 would suggest), but within this list, in positions 1, 6 and 7 respectively, are care assistants, education assistants and hospital assistants. The number of care assistants in the UK increased by over 400% over this period (from 103,837 in 1979 to 539,407 in 1999), while the increase was 286% for education assistants and 262% for hospital assistants. Furthermore, of the ten lowest paid occupations in the UK in 1979, six increased their employment share in the following twenty years (bar staff, shelf fillers, sales assistants, retail checkout operators, waiters and beauticians). For example, the number of sales assistants increased from 954,200 to 1,321,251, the number of checkout staff from 112,816 to 218,581, the number of bar staff from 119,455 to 188,319 and the number of waiters from 124,780 to 187,391.

On the other hand, the ten occupations to suffer the largest falls in employment over the period all receive wages close to the median (with one exception, namely face-trained coal mining workers, who receive an above-average wage due to the inherent danger of their jobs), and so are found in the middle of the job quality distribution. These declining occupations are all production or energy workers at various skill levels. Some of the largest falls in employment are for boring and drilling machine setters (94% decrease, from 29,276 to 1,731), for face-trained coal miners (93% fall, from 76,301 to 5,095), for grinding machine setters and operators (86% fall, from 56,426 to 8,164) and for labourers in engineering and related trades (78% fall, from 58,243 to 12,758).

Other studies have replicated the results of Goos and Manning, using different data sets and studying slightly different periods. For example, Holmes and Mayhew (2012) again use Labour Force Survey data, but for the longer period of 1981-2008. Jobs are again ranked by early mean average pay (this time in 1986), and then divided into deciles. When the employment figures are adjusted to take account of hours of work (rather than just number of workers) Holmes and Mayhew find that employment share grew in deciles 1, 9 and 10, with the largest increases in the latter two, while employment share fell in other deciles, with the largest fall in decile 6, as shown in Figure 2 below. One other LFS study is an unpublished UCL MSc dissertation by Kate Mieske, quoted in van Reenen (2011), which considers the 1979-2008 period, and ranks jobs by decile according to their 1979 wage. Again, growth in employment share is observed only in deciles 1, 9 and 10.

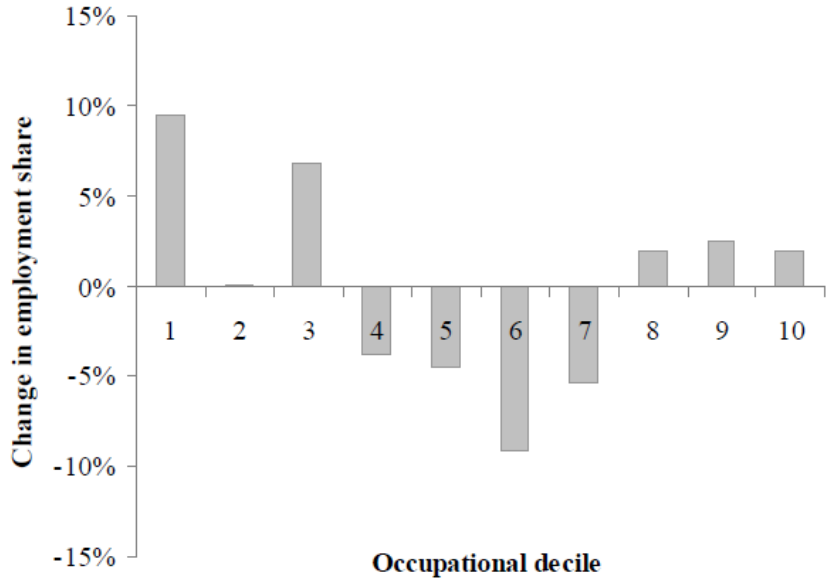
Figure 2: Employment share growth of occupations, 1981-2008, employee hours, UK



Source: Holmes and Mayhew (2012).

An alternative data source is used by Holmes (2010), namely the National Child Development Study (NCDS). This is a longitudinal birth cohort data set, following a particular group of individuals born in a certain week in March 1958, throughout their lives. Holmes makes use of the fourth and seventh waves of the survey, undertaken in 1981 (when the cohort were aged 23) and in 2004/5 (when the cohort were aged 46/47). Creating a common occupation classification from the different classifications used in the various sweeps of the survey, Holmes is left with 70 job categories. These are divided into deciles of the distribution of wages in 1981. The subsequent change in employment share between 1981 and 2004/5 is positive in deciles 1-3 and 8-10 (and larger in the higher deciles) and negative in deciles 4-7, as shown in Figure 3 below. It is clear, therefore, that there has been a polarisation of the UK jobs market, though since the analysis is based on a single cohort of individuals in this case, the change in occupations could also reflect career progression as the cohort age.

Figure 3: Percentage change in employment share by job quality decile, 1981-2004, UK

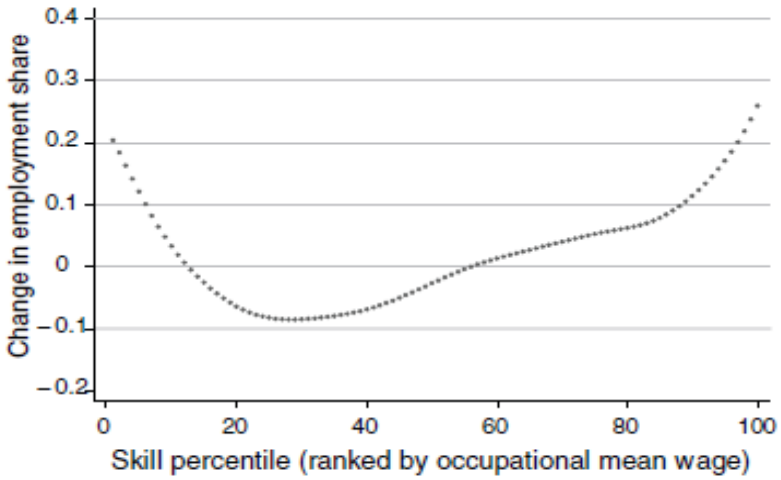


Source: Holmes (2010): Figure 1.

(ii) US

A similar pattern of polarisation has been observed in the US labour market. As an example, Autor and Dorn (2009a), using US census data with therefore large sample sizes, group occupations into one hundred percentiles of their 1980 mean hourly wage distribution, and then plots the change in the share of aggregate hours worked in each percentile over the period 1980-2005. The usual U-shape is observed, shown in Figure 4 below, with positive changes in employment share observed up until about the 15th percentile, and then from the 60th percentile upwards (with the largest change at the top end).

Figure 4: Smoothed employment share growth of occupations, 1980-2005, US



Source: Autor and Dorn (2009a): Figure 1.

An alternative method of ranking occupations is by their initial average education level, rather than their initial average wage. When Autor et al. (2006) do this, they find the usual pattern, with higher employment growth in occupations with both low and high initial mean education levels, over the period 1990-2000. However, for the 1980-1990 period, the relationship is linear, with larger employment growth for occupations with higher initial education levels, suggesting that polarisation took off in the 1990s.

As pointed out by Mishel et al. (2013), the trend of a rising employment share going to high-level jobs and a falling share going to mid-level jobs is not a new phenomenon, and they show that such trends have been occurring since at least the 1950s in the US, reflecting skill upgrading. The 'disappearing middle' is therefore probably not the defining characteristic of job polarisation, but rather the increase in the share of low-level (in terms of initial wages) jobs, which, Mishel et al. report, does seem to have begun some time around the end of the 1980s and continued since, probably at an increasing rate. This growth in low-level jobs is dominated by the service sector.

(iii) Other countries

Research on job polarisation and hollowing out has also now taken place in other European countries. Spitz-Oener (2006) creates her own Skill Index, based on predicted levels of education, and ranks occupations in Germany into deciles of this index. She then plots changes in the employment shares of each decile over the period 1979-1999, and obtains similar findings to those in the UK and US, with a rising employment share for deciles 1, 9 and 10 (and also positive, though very small) changes in deciles 6 and 8. Kampelmann and Rycx (2011) extend the period under consideration to 1985-2008, thus including the post Hartz reforms period. Using data from the German Socio-Economic Panel (SOEP), the authors rank 3 digit occupations by their 1985 mean wage, and find the usual polarisation pattern remains in Germany over this longer period.

A final example of a country level study is Adermon and Gustavsson (2011), who consider Sweden for the period 1975-2005. This paper is of interest, given the very different labour market in Sweden compared to, in particular, the UK and US. There is a greater importance of unions, employment protection and welfare support in Sweden, together with a narrower wage distribution. It is therefore of interest to see whether similar patterns of polarisation have emerged in such a labour market with its different institutions. Using data from the Swedish longitudinal micro-database, they create 1,377 non-empty industry-occupation cells, and then rank them into quintiles according to their 1975 mean wage. The results show positive employment growth in quintiles 1, 4 and 5 (largest in the highest quintile) and declining employment in quintiles 2 and 3. Dividing the period, the authors find an approximately constant increase in low-level relative to mid-level jobs, whereas the growth in high-level relative to mid-level jobs has been more concentrated in the second half of the period from 1990-2005.

As well as these single-country studies, a small number of papers have considered multiple countries in the same research. An example is Goos et al. (2009), who use data from the European LFS to investigate the extent of polarisation in sixteen European countries. Their results find widespread evidence of job polarisation across Europe, with the employment share of the lowest-paying jobs increasing relative to the share of mid-level jobs in every country studied over the period 1993-2006, while the employment share of the highest-paying jobs increases relative to the share of mid-level jobs in every country

except Portugal. There is no obvious pattern in the size of the changes across countries. The largest increases in the employment share of the low-level jobs are observed in two Scandinavian countries (Norway and Finland) and two Anglo-Saxon countries (UK and Ireland). The labour markets of these two groups of countries are very different and so do not suggest a common pattern. Similarly, the largest falls in the employment shares of mid-ranking jobs are observed in Austria, France and the UK, which again defy the establishment of a common pattern.

Finally in this section, Oesch and Menes (2011) compare polarisation in four countries; Britain, Germany, Spain and Switzerland. These countries were deliberately chosen for their different labour market institutions. In particular, the weaker institutions such as trade unions and unemployment insurance in the UK compared to the other countries might have been expected to lead to more low-wage employment in that country. The authors use separate national level data sets, covering the period 1990-2008, and have data on approximately 150 occupations, which they divide into quintiles according to the initial wage. The results they find show the largest increases in employment shares for the highest-quintile jobs, in all four countries. Similarly, there is evidence of a relatively 'declining middle' in each country, with the possible exception of Spain. It is at the bottom end of the labour market where the biggest differences are observed, with an expanding employment share, almost exclusively due to personal services, observed in Spain and particularly the UK, but not in Germany and Switzerland. It therefore seems that the growth in low-paid employment has been less in the more protected, less flexible economies of central Europe. This is beginning to hint at potential explanations for observed polarisation, which is an area to which the next section turns.

3. Causes of hollowing out

(i) Technological change

By far the most frequently offered reason for the hollowing-out of the job distribution described above is technological change. In particular the theory of task-based technological change (TBTC) has been developed, best associated with Autor et al. (2003). These authors first made the case that the impact of technological change does not depend specifically on the skill level of the worker doing a job (as was the case with the earlier skill-biased technological change theory), but rather depends on the task that the worker is doing in their job. In particular, technological change was argued to impact on routine jobs, where the task being undertaken is repetitive and does not require response to outside stimuli, so that computer technology can be programmed to undertake the task more quickly and efficiently than any human input. Thus, when the price of computing power fell, as it has done exponentially per task completion, it was routine jobs that were most substitutable for technology.

In order to undertake their analysis, Autor et al. defined the tasks involved in each of approximately 450 occupations in the Dictionary of Occupational Titles (DOT). The tasks considered were classified according to one of five types: non-routine cognitive/analytic, non-routine cognitive/interactive, routine cognitive, routine motor (manual) and non-routine motor. Each occupation was given a score for each of the task measures. The resulting scores were consistent with expectations. Thus, aggregating the occupations to the 1-digit level, the highest-scoring task amongst managers was non-routine cognitive/interactive, amongst professionals was non-routine cognitive/analytic. For technician/associate professional, administrative workers and machine operators/assemblers, the dominant task was routine cognitive and routine motor skills. Non-routine motor skills were most strongly observed amongst protective service occupations, and ‘Handlers, equipment cleaners, helpers and laborers’.

Autor et al. then analyse changes in employment by occupation, to determine changes in the task involvement. The results show that both measures of non-routine cognitive work have trended upwards since the 1960s, and at an increasing rate since the 1980s, until 1998 which is the final year studied. Both routine cognitive and motor task involvement increased in the 1960s, before beginning a downward trend in the 1970s which has become steeper over time. Non-routine manual tasks have declined over this period.

In an attempt to relate these trends to technological change, Autor et al. create an industry level data set, where the change in the use of tasks within in each industry is determined by changing occupation structures. They measure technological change by the change in the fraction of workers in the industry who use a computer in their jobs in each industry, between 1984-1997. Regressing the change in task involvement on the change in computer use for each of the five tasks reveals that technological change is strongly positively and significantly related to the increased use of non-routine cognitive tasks, from the 1980s onwards. On the other hand, routine tasks (both cognitive and manual) are strongly negatively and statistically related to technological change after 1980. As for non-routine manual tasks, they appear unrelated to technological change, until the 1990s when there is a positive and significant relationship between them.

Autor et al.'s (2003) research did not specifically discuss hollowing-out and job polarisation. However, the link between the two was made by Goos and Manning (2007), who pointed out that the routine jobs affected by TBTC are most often found in the middle of the jobs distribution. As found by Autor et al. (2003) as described above, the jobs that most involve routine tasks are administrative office tasks, and skilled production jobs. Both of these categories of occupations contain reasonably well-paying jobs, typically paying wages around the median, and so they are found in the middle of the jobs distribution. Thus, following the fall in the price of computing power, it is these sorts of jobs that were easily replaced, leading to a fall in the employment share of mid-level jobs.

Considering non-routine jobs, if they are also cognitive, such as managerial and professional jobs, then these cannot easily be replaced by computer technology, and indeed, such technology is likely to be complementary to these tasks, for example aiding in information-searching, diagnostic decision-making, statistical analysis etc. Thus, TBTC would be expected to increase the share of employment in such jobs, which of course are most often found towards the top of the occupational hierarchy.

Finally, in terms of non-routine manual jobs, such as labouring and low-level (in terms of wages) service sector jobs, technology has typically been irrelevant, neither a substitute nor a complement. Such work typically involves a response to given stimuli, for example responding to a customer, and technology cannot be programmed sufficiently easily to respond to all eventualities, leaving a human response as the most efficient method. Thus, technological change should have no effect on the level of employment in such jobs, which when combined with the declining middle, can produce an increase in employment *share* of low-level jobs, though to a lesser extent than the increase in high level jobs.

(ii) Other Theories

Other explanations have been offered for job polarisation. As discussed by Goos et al. (2011), an alternative explanation is offshoring and the global competition for labour, whereby firms in the home countries take advantage of lower labour costs in foreign countries to 'offshore' part of the production process or service provision to such countries. The most likely jobs to be offshored are production jobs, producing partly-completed goods to be fully completed in the home country, or administrative tasks (low-level legal tasks, record-keeping, and perhaps the most well-known example, customer call centres). Thus it is the jobs in the same intermediate occupation categories that were affected by TBTC, that also have a greater susceptibility to being offshored. Highly-skilled managerial and professional jobs are unlikely to be offshored, because the overseas countries with low labour costs do not have a comparative advantage in the provision of skills for such jobs. Similarly, low-level service sector jobs are unlikely to be offshored, since in most cases there is a need for the customer to be present for the service to be provided. The effect on intermediate jobs is therefore similar; they are replaced either by a computer, or by a lower cost worker in another country.

Another possible cause, discussed in Goos et al. (2009), is the growth in income inequality that has been observed in many developed countries since the 1980s. The idea here is that the simultaneous emergence of relatively 'cash-rich-time-poor' and relatively low income individuals has led to an increase in demand for personal services (cleaning, caring etc), as the rich spend some of their spare income on buying services that they do

not want to undertake themselves, while the low-income individuals provide a supply of individuals willing to do the work.

(iii) Evidence on the Causes of Hollowing-Out

Goos et al. (2009) test the theories discussed in the previous two sections, by estimating equations for the log of hours worked, as a measure of employment, for a country-occupation-year dataset aggregated from the European LFS. The explanatory variables include the tasks used in each occupation, measured along three dimensions; abstract tasks, routine tasks and service tasks. The authors also include an 'offshorability' variable, measured as a count of news reports relating to offshoring in each particular occupation. Since both the task variables and the offshoring variable are only measured once for each occupation, they are interacted with a time trend to examine the impact on employment changes over time. The results reveal a positive and significant coefficient on the abstract task variable, showing the increased employment in jobs involving such tasks over time. The coefficient on the routine task variable is, however, negative and significant, showing that employment is declining particularly in such jobs. The remaining coefficients in the estimated equation are statistically insignificant. Thus, there appears to be no trend in occupations where service tasks are important, and also no systematic variation in employment with changes in offshoring (the offshorability coefficient is negative, suggesting lower employment in the home country in occupations where there has been more offshoring, but is statically insignificant). Note however, to the extent that 'offshorable' jobs are also routine, the more robustly measured 'routine task' variable could be picking up some of the effects of offshoring).

To investigate the income inequality hypothesis, it is necessary to move to a national data set rather than one at an occupation-level, since it is variation in income across the population, rather than amongst workers in one particular job, that is of interest. Goos et al. (2009) therefore plot the low-wage employment share in each of their sixteen European countries, against the 90^{th}-10^{th} percentile ratio for income inequality. The line of best fit through the scatter plot is upward-sloping, suggesting more low-wage employment in the countries with greater income inequality as hypothesised, but the slope of the line is so gentle to be almost flat, suggesting the relationship is weak at best.

Goos et al. (2011) also examine the income inequality theory, by interacting a measure of inequality (namely the 90-10 percentile ratio), with industry dummies in an equation for (log) industry output (as a measure of output demand in each industry). With the exception of financial intermediation, transport and telecommunications, construction and health, the coefficients on the interaction terms are statistically insignificant, suggesting that product demand is not a function of increased income inequality. In particular, the interaction coefficients for low wage service sectors such as retail and personal services are statistically insignificant, suggesting that there is no evidence that the demand for such services goes up when income is more unequal.

The causes of hollowing-out are also investigated by Michaels et al. (2010) who undertake their analysis at the industry level pooled across eleven countries (nine European countries plus Japan and the US). The data source is the EUKLEMS data set, which provides data at the industry level over time for a range of countries. This paper differs from most of the research discussed above, in that the focus is on the skills (qualifications) of workers, rather than the tasks of jobs. In particular, the authors distinguish between

high-, middle- and low-qualified individuals, and measure the wage bill share of each group within each industry-country-year observation. The main explanatory variable of interest is ICT capital in the industry-country-year, expressed as a proportion of value added. The data set produced has 208 industry-country observations in each year from 1980-2004.

The results of Michaels et al., when the change in wage bill share is regressed against ICT/value added plus other controls separately for each qualification level, reveal a positive and statistically significant coefficient on ICT in the high-qualified equation (i.e. the high-qualified wage bill share has increased more in the industries/countries that have increased their use of ICT the most), a negative and significant coefficient on ICT in the mid-qualified equation, and a positive but insignificant coefficient in the low-qualified equation. Thus ICT has increased the demand for highly-qualified workers, reduced the demand for mid-qualified workers, and had no effect on low-qualified workers. Under the assumption that highly-qualified workers are employed in high skill level jobs, etc, then these results are consistent with the ideas of hollowing-out and routinisation as discussed above. The coefficient results suggest that a one percentage point increase in ICT intensity is associated with a 0.8 percentage point fall in the proportion of mid-qualified workers.

The evidence of Autor and Dorn (2009b) provides further evidence for the link between TBTC and job polarisation, in this case for the US, and using a different methodology to the studies above. In particular, theirs is a regional level study, focussing on 722 commuting zones in the US. They measure the routine task intensity in each commuting zone, based on the occupations of the workers employed there, in 1980, and then regress the change in the share of routine employment against the initial level of routine intensity, pooling changes across three sub-periods: 1980-90, 1990-00, and 2000-05. The results reveal a negative and statistically significant coefficient, so that the decline in routine employment has been greater in the commuting zones with an initially higher share of routine employment. The size of the coefficient suggests that a commuting zone at the 80th percentile in the distribution of initial routine employment shares will witness a fall in the routine job share that is 1.8 percentage points larger than in a commuting zone at the 20th percentile. Autor and Dorn argue that areas are more likely to invest in new technology, the higher the initial proportion of routine jobs that can be easily and cheaply computerised, and this is why the fall in routine employment is higher where the initial share is larger. Further results show that it is non-college workers, rather than college workers who are particularly likely to see a decline in their routine jobs.

As well as looking at the decline in routine jobs, Autor and Dorn (2009b) also consider what type of jobs are increasing in share, in the high initial routine task intensive commuting zones. Their results reveal that it is low-level service sector employment, again particularly for non-college workers, that is increasing. In particular, their results shows that the growth in non-college service sector jobs is 3.2 percentage points higher in a commuting zone at the 80th percentile of initial routine share distribution than in a commuting zone at the 20th percentile.

The authors consider alternative explanations for the growth in service sector employment that they observe, which are similar to the theories considered by Goos et al. (2009) above, namely offshoring, and income inequality leading to greater demand for personal services from richer individuals. However, they observe a statistically insignificant effect of

the initial level of offshorability on the growth in service sector employment. Similarly, a rise in the 90th percentile wage in the commuting zone is shown to be only weakly related to service sector employment growth, while rising work hours amongst graduates is associated with *lower* service sector job growth. As with Goos et al. (2009) therefore, Autor and Dorn conclude that it is TBTC and routinisation that is the driver beyond the observed employment changes.

A variation on this conclusion is provided by Bloom et al. (2011). The authors have data on firms in 12 European countries over the period 1996–2007. They regress different indicators of technology (computers per worker, patents, R&D and total factor productivity) on the growth of Chinese imports. In their results they find positive and significant coefficients which imply that 15% of the technological upgrading in Europe from 2000–2007 is due to Chinese imports. The authors therefore talk about 'trade-induced technological change' whereby new technology is introduced in order to maintain a competitive advantage over countries competing more on the basis of lower labour costs. Therefore, although technology seems to be driving the hollowing-out of the labour market discussed above, Bloom et al. argue that actually, technological change could itself be being driven by globalisation and international competition.

A related analysis to that by Autor and Dorn (2009b) is undertaken by Autor et al. (2012). They again focus on local labour markets (commuting zones) in the US, with the explicit intention of comparing the roles of technology and globalisation/trade. Given the results of Bloom et al. (2011) discussed in the previous paragraph, suggesting a close relationship between technological change and globalisation effects, it could have been that the same areas were affected by both effects in Autor et al.'s (2012) study. This proves not to be the case, however, with the areas susceptible to technological change (measured, as in Autor and Dorn, 2009b above, by the initial proportion of the workforce in routine production and administrative jobs) proving not to be the same areas that are susceptible to trade effects (as measured by import penetration from China, where national imports are allocated to regions according to their industrial structure).

The results, based on Table 3 in Autor et al. (2012), are contained in Table 1 below. The results show that both globalisation and technology have had their largest effects on reducing employment in intermediate (production, clerical and sales) occupations. As hypothesised, it is therefore the jobs in the middle of the distribution that are affected by both technological change and competition from abroad. The difference between the two effects is that globalisation and competition from China has reduced employment in all three occupation groups, albeit to a smaller extent in the top and bottom job categories, and insignificantly so in the former. By contrast, technological change is associated with a (statistically insignificant) growth in employment in the highest-ranked occupations, and essentially no change in employment in the lowest-ranked occupations.

Table 1: Determinants of 10 Year Changes in the Share of the Share of Population Working in Given Occupations

	Managerial, professional, technical occupations	Production, clerical, sales occupations	Craft, mechanic, agricultural, service occupations
Change in imports from China per worker	-0.14 (0.09)	-0.48** (0.08)	-0.22** (0.08)
Initial share of employment in routine occupations	0.15 (0.12)	-0.36** (0.13)	0.01 (0.06)

Source: Autor et al. (2012): Table 3
Standard errors in parentheses.
** significant at 1% significance level.
* significant at 5% significance level.

Therefore Autor et al.'s results suggest that, although technology and trade both have important effects, in terms of which has had the strongest impact on creating the hollowing-out pattern, it seems to be technological change that can make this claim. Note, however, that Autor et al. suggest that this could be changing, particularly in the manufacturing sector, where they show an increasing effect of globalisation, whilst technology is increasingly having its effect in the service sector. The effect of technology has therefore moved out from computerising manufacturing and production, to affecting services, particularly through information flows and remote communication.

4. Job polarisation and wage polarisation

Having established the widespread existence of 'hollowed-out' job distributions in all countries studied, this section and the next consider the impact of such job polarisation. The next section considers, as far as available evidence allows, the effect that job polarisation has had on worker mobility. Before that, however, this section considers whether wages have polarised in the same way that the job distribution has polarised. By 'wage polarisation' the literature means whether there has been faster wage growth at the top and bottom of the wage distribution (as opposed to the 'polarisation of the wage distribution' which means the movement of employment to the extremes of the wage distribution), Changes in relative wages are of interest, and indeed the explanation of changes in wage inequality was one of the main motives for the start of this literature amongst American economists. It is sometimes taken for granted that the changes in the job distribution will be mirrored by changes in the wage distribution, but this is not necessarily the case as the evidence below makes clear.

Other things equal, in particular holding the wage in each occupation constant, job polarisation should lead to an increase in observed wage inequality. Take the $90^{th}/10^{th}$ percentile wage ratio. If the number of high wage-jobs and the number of low-wage jobs both increase (as under polarisation), then this ratio should increase, as the wage at the 90^{th} percentile will be larger as the number of high-wage jobs increases, while the wage at the 10^{th} percentile will fall as the number of low-wage jobs increases.

However, occupational-level wages do not remain constant over time, and so the changes in the wage distribution may be more complicated than as described in the previous paragraph. How might job polarisation influence the wage distribution? It is useful to have in mind a supply and demand framework when answering this question. Job polarisation is basically a demand side story. The routinisation theory has reduced the demand for labour in jobs comprising predominately routine tasks, while increasing the demand for labour in non-routine cognitive/analytical jobs. Given the position of such jobs in the occupation hierarchy, this then leads to the prediction of an increased demand for labour, and hence an increased employment share, at the top of the distribution, and a falling demand for labour, and hence a reduced employment share, in the middle of the distribution. This is as observed in the hollowing-out/job polarisation literature, as described above. The routinisation hypothesis says that technological advances will have little effect on the non-routine manual jobs at the lower end of the jobs hierarchy, since the tasks mostly do not involve technology, and labour cannot be substituted by technology in such tasks at the current time. It is therefore more difficult to explain the increased employment shares of traditionally low-paid jobs using the demand-side routinisation hypothesis.

Authors have analysed data to look for evidence of wage polarisation, analysing whether wages are growing faster at both the low and high ends of the wage distribution. These results are of use to consider here, since they provide clues as to the causes of employment polarisation. Thus, from the supply and demand model, for wages and employment to move in the same direction, we need to be looking at a demand side effect.

Therefore if changes in the wage distribution follow a similar polarisation pattern to changes in employment, then this would be evidence in support of a demand-side explanation such as routinisation.

Evidence on wage polarisation is much less widely available than for job polarisation but has been provided by, for example, Mieske (2009) in an unpublished paper, reported by Holmes (2010). This analysis looks at the growth rate in wages at each decile of the *initial* wage distribution, over the period 1979-2008. The analysis is therefore analogous to the job polarisation analyses above, that measured the growth rate of employment within each decile of the initial wage distribution. In Mieske's results, the growth rates in real hourly wages are presented as annualised changes, averaged across the years within each of the three decades studied. The results are reported in Table 2 below.

There is no evidence for wage polarisation (stronger wage growth at the top and bottom of the distribution, and weaker in the middle) in Table 2. In the decade that saw the strongest growth in real wages (the 1980s), the growth in wages is strongest at the top of the distribution, with decile 5 also having a high annualised growth rate. Real wages increased the least at the bottom of the distribution. Real wage growth was weaker in the 1990s, with no consistent pattern in growth rates across the deciles. There is no evidence of wage polarisation, however, and if anything, growth rates of real wages were *highest* in the middle of the distribution, with the exception of decile 6. Finally, the 2000s saw a similar pattern to that of the 1980s, with the growth in wages being the largest at the top of the distribution, and the smallest at the bottom.

Table 2: Annualised Growth Rates of Real Hourly Wages, by Decile of the Initial Wage Distribution

Decile	1979-1989	1989-1999	1999-2008
1	1.98	0.50	1.75
2	1.95	0.47	1.75
3	2.41	0.39	0.98
4	2.20	0.89	1.01
5	3.47	0.80	1.80
6	2.08	0.11	2.07
7	2.79	0.91	1.36
8	2.80	1.11	1.14
9	3.83	0.87	2.03
10	3.67	0.50	2.43

Source: Mieske (2009), reported in Holmes (2010) Table 3. Data: NES and LFS

Similar results are found by Machin (2011) who analyses the growth in wages at specific percentiles of the wage distribution (as opposed to within deciles as in Mieske, 2009), separately by decade and by gender. Specifically, he looks at the 10th, 25th, 50th, 75th and 90th percentiles, and he also finds no evidence of wage polarisation. For every decade from the 1980s on, and for both genders, he finds the growth rate of wages rises monotonically with percentile of the wage distribution, with the exception of women in the 2000s (the National Minimum Wage decade), were the growth in wages at the 10th percentile is slightly higher than at the 25th percentile. There is no evidence of a hollowing-out of the wage distribution.

Other authors have found results to show that job polarisation does not automatically lead to wage polarisation. For example, Goos et al. (2011) find that changes in wages across occupations are not strongly related to the technology and offshoring variables discussed with reference to their work above, in their analysis of European LFS data. Thus, these variables affect employment but not wages, consistent with the above evidence. Goos et al. suggest that this result is due to labour market institutions that prevent free movement of wages in many European countries, particularly at the bottom end of the wage distribution.

Another example is in the Autor and Dorn (2009b) paper discussed above. As well as the job polarisation results that they discuss, they also look for evidence of wage polarisation, but do not find such a strong relationship between routine task intensity and the growth in wages. The main reason for the lack of such a relationship is the quite strong wage growth in a routine occupation that has suffered employment losses, namely clerical jobs. Autor and Dorn argue that this is due to the changing nature of administrative jobs. Thus, while technology has replaced many of the routine clerical workers, for those that remain, the nature of the job has become less routine, more demanding, and better paid on average.

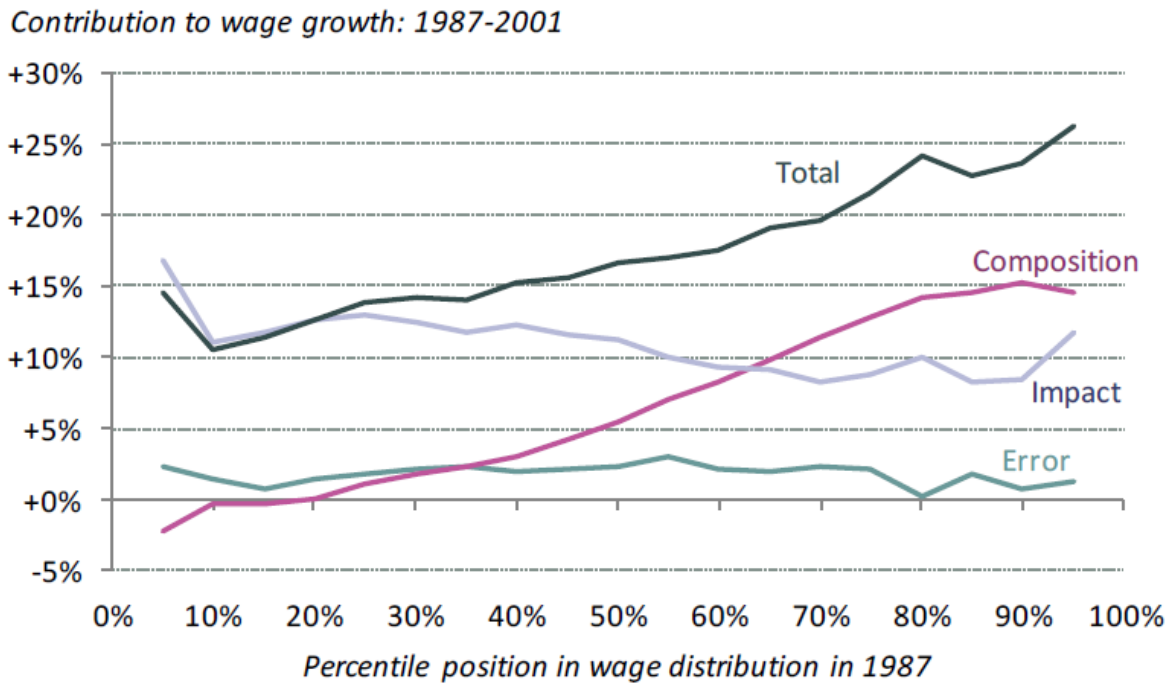
What are the implications of these results? They are important for our understanding of the causes of changes in the labour market, as well as helping us get an idea of the potential for middle-ranked jobs to continue to exist in the labour market, with the opportunities that they provide. Considering the first of these points, if the cause of the pattern of job and wage changes observed above had been only a demand-side explanation such as routinisation, then we would have expected the pattern of wage changes to be similar to the pattern of job changes, given demand shifts affect wages and employment in the same direction. However, the U-shaped 'hollowing-out' pattern of job changes is not replicated for wages. This suggests that there are other factors at play, particularly at the lower end of the lower market, where strong growth in the number of jobs is accompanied by only small changes in real wages. This would suggest that supply-side effects have been important at the lower end of the labour market, with an increased supply of labour to low wage jobs increasing the employment share of such jobs, but pushing down their wages below what they otherwise would have been. Where has this additional supply come from? There are numerous candidates, with the most likely being displaced workers from mid-ranking jobs, former benefit recipients pushed into work by changes to benefit eligibility, and incoming migrants.

Second, how has the wage distribution been affected? Is there evidence that the wage distribution has polarised, in terms of there being more low and high paid jobs now, and fewer mid-pay level jobs. Holmes and Mayhew (2012) provide an analysis of the causes of the changes in the wage distribution, over the period 1987-2001, using data from the Family Expenditure Survey. They consider the changing *composition* of workers and jobs in the labour market, including the changing occupations performed (thus picking up the effects of the job polarisation discussed above), but also including declining union membership, improved educational attainment, increased female participation, and increased use of flexible working arrangements. As well as the changes in the numbers employed along these various dimensions, Holmes and Mayhew also consider the *impact* of these characteristics on the wage distribution, i.e. the wage returns to each of these characteristics relative to a base category for each characteristic. It is these wage returns that will change, as the demand for and supply of the various characteristics change.

Thus, job polarisation is one of a number of factors that could cause changes in the wage distribution.

Figure 5 below shows the total change in real hourly wages observed at each percentile of the wage distribution over the period 1987-2001, and the decomposition of this total change into composition and impact effects, and an error term.

Figure 5: Composition and impact effects on the wage distribution, 1987-2001



Source: Holmes and Mayhew (2012). Figure 3.1. Data from FES.

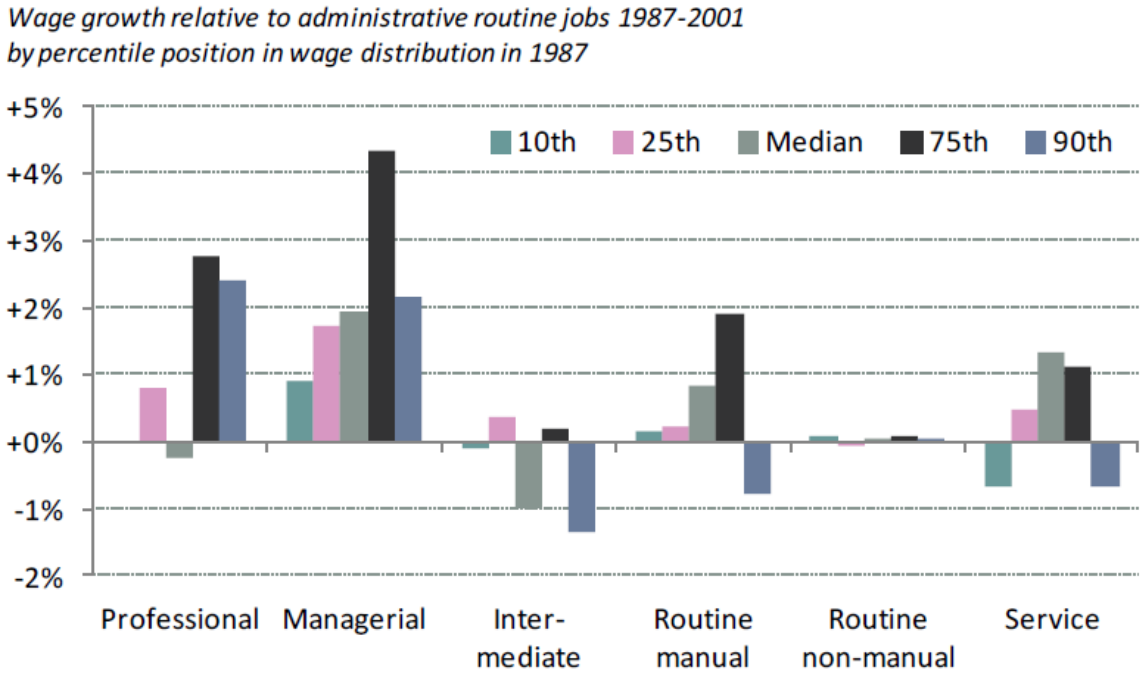
Looking at the line for the total wage changes first, this confirms the results of other analyses discussed above, which have failed to find evidence of hollowing-out in the wage distribution. The growth in real wages has been greatest at the top end of the wage distribution, with no evidence that it is lowest in the middle of the distribution. The composition effects show a largely neutral impact on the growth in wages at the bottom end of the distribution, or even a negative effect below the 10th percentile. Further analysis by Holmes and Mayhew (2012), that cannot be deduced from Figure 5 above, shows that the cause of the negative composition effect at the bottom of the distribution is declining unionisation rates, and changes in the occupational distribution towards low pay jobs.[1] This latter effect is the exact effect of job polarisation: a growth in the number of low-pay jobs increases the spread of low-pay work up the distribution, thus lowering the wages at any percentile point.

What about the impact effects? The impact line in Figure 5 shows a positive effect at low wages, which is entirely responsible for the growth in wages at the bottom end of the

[1] These two negative effects on wages are offset by a positive effect from increased educational attainment, even here at the lower end of the labour market.

distribution, given the negligible gross composition effects and error term. So the returns to some of the characteristics at the lower end of the labour market have improved over time. If this was an increased return to occupations at the lower end of the distribution (i.e. an improved wage differential between such jobs and other jobs), then this would be evidence in support of a growth in demand for workers in low-wage jobs. Holmes and Mayhew (2012) look at these differentials in their Figure 3.3, reproduced as Figure 6 below, where all differentials are evaluated relative to routine administrative jobs.

Figure 6: Impact on the wage distribution of changing occupational wage differentials, 1987-2001



Source: Holmes and Mayhew (2012). Figure 3.3. Data from FES.

Of most interest here are the service jobs. Figure 6 shows that the wage differential between service jobs and the reference category (routine administrative jobs) is actually falling at the 10th percentile, and is only rising around the median. There is therefore no evidence for rising demand for low-wage service sector work. Further analysis by Holmes and Mayhew (2012) (not shown in Figure 6), finds no evidence for rising returns to other characteristics, such as rising educational attainment, at the lower end of the wage distribution either. Their explanation for the rising real wages at the lower end of the distribution, as seen in Figure 5 above, is therefore 'shift' factors such as the introduction of the minimum wage.

To summarise this discussion of the changing wage distributions, there is no evidence of wage polarisation. In particular, though evidence has continually been found of rapidly growing real wages at the top end of the distribution, there has been no evidence to show faster wage growth at the bottom than in the middle of the distribution.

There are many reasons that can potentially explain the lack of polarisation in the wage distribution, even when we see polarisation of jobs. First, and most obviously, wages are

determined by the interaction of demand and supply. Thus, if employment changes are driven more by supply-side than by demand-side factors, then wages will change in the opposite direction to employment. This has already been discussed above.

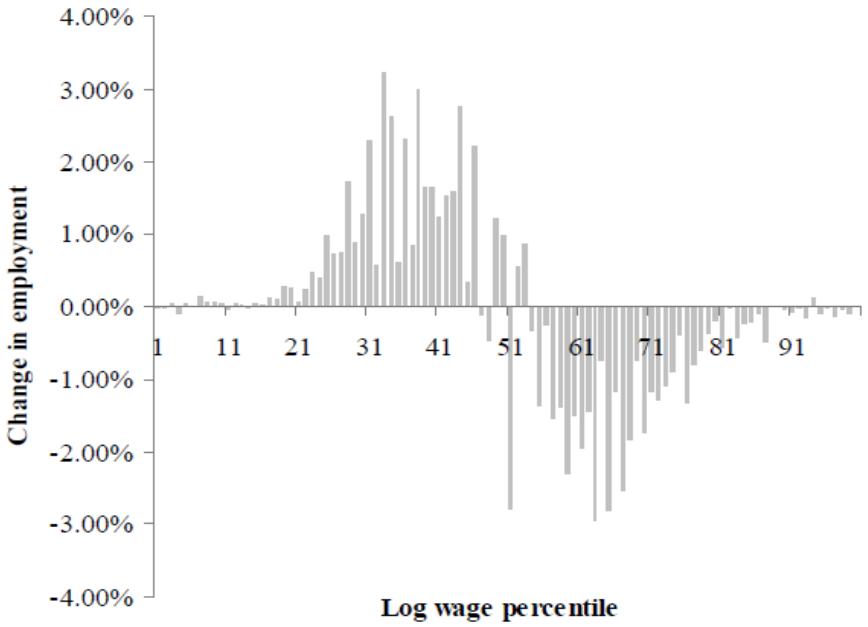
In addition, there are other effects of job polarisation on the overall wage distribution, which will further affect the final distribution of wages that we observe after a period of job polarisation, as explained clearly by Holmes (2010). Even if there is a disappearance of jobs paying middling wages, based on the wage at the start of the period (as is virtually irrefutable given the range of evidence discussed above), this does not mean that there will be fewer middle-wage jobs at the end of period. First, as the wages of a job change, its position in the wage distribution can also change. So a job may initially be defined as a low wage job, but if its wages grow by more than average (under the hypothesis that wages initially at the top and bottom of the distribution expand the most), then it may move up the distribution to become a mid-wage job. It is also possible that expanding jobs that are initially near the top of the distribution could subsequently move towards the middle of the job distribution. For example, if jobs expand rapidly, then they may exceed the growth in the availability of high-skilled workers, and so have to accept individuals from a wider ability range. To the extent that ability is reflected in wages to a certain extent, the lower ability workers in such jobs would therefore be receiving wages nearer the middle of the wage distribution, so again causing an expanding middle. In essence, therefore, the argument is that although we may observe growth in jobs and wages that were at the top and bottom of the *initial* pay distribution, this does not mean that at least some of such jobs will not move towards the middle of the *final* pay distribution.

Second, declining employment in jobs that were initially middle-ranking in terms of their wages does not mean that the wages of those that remain need necessarily fall. It could be that those who are kept on in these declining areas were the most able of the original workers in that job, so that the average wage amongst those who remain actually increases. Alternatively, it could be the case that the computerisation of these routine-intensive occupations changes the nature of the work, so that the jobs that remain are more highly-skilled and so better paid.

One of the most important points to realise from the discussion of wage distributions in this section is therefore that, though the number of middle-ranked jobs (as defined by their starting position) may have declined as part of the job polarisation, the wage distribution can, and has, changed over time, so that newly-classified middle-ranked jobs can emerge. A useful illustration is provided by Holmes (2010), who uses longitudinal data from the NCDS. He uses two sweeps of the data, from 1981 and 2004, and considers the wage distribution at both points in time for this cohort of individuals. This therefore differs from earlier work which took the distribution in an initial year, and looked at changes over time from there. Holmes' study rather considers the distribution at both the start and end of his period. In particular, he takes the full range of wages in each year, and divides this into 100 equally sized portions (so for example, if the full wage range was from £7 to £12 per hour, each portion would measure 5p). Looking at the change in the proportion of jobs in each portion of the distribution between 1981 and 2004 (his Figure 5, reproduced in Figure 7 below), he does not observe much change at the top and bottom. Thus, for example at the bottom, though the work discussed above has shown that the low paid jobs from an initial starting point do increase over time, this new evidence suggests that at the end of a period, the number of low paid jobs (not necessarily the same jobs) has not changed much, suggesting that the actual jobs which fall into the lowest parts of the distributions

have indeed changed over time. Away from the extremes, in the middle of the distribution, Holmes finds the change in the number of jobs between the 20th and 80th to be negligible overall, with an increase in the number of jobs between the 20th and 50th percentiles, and a fall between the 50th and 80th percentiles.

Figure 7: Changes in employment by wage percentile, 1981-2004, UK



Source: Holmes (2010): Figure 5.

Overall then, the evidence presented in this section suggests that intermediate level jobs are not disappearing to the extent implied by the job polarisation literature. The next section considers this further and turns to an analysis of current and future occupational job trends.

5. Implications of Hollowing-Out: the Occupation Structure in the Future

The hollowing-out literature discussed above takes a starting point, typically some point from 1980 to 1990, ranks jobs, usually by their average pay level, **at that point**, and then analyses subsequent growth in employment share for various quantiles of that initial distribution. The evidence has shown categorically that those jobs towards the middle of the initial distribution have declined in employment share. As already discussed in the previous section, however, this does not necessarily mean that there are fewer middle-ranked jobs at the end of the period than at the start, for various reasons. The key point is that the hollowing-out literature classifies each job by its **initial** position in the distribution. However, this is not necessarily its final position in the distribution. Thus, previously low-ranked jobs may move up the distribution and previously high-ranked jobs may move down the distribution. In addition, at a time of great technological change, completely new jobs could emerge in the middle of the distribution. A final point to note is that most of the hollowing-out literature looks at employment **shares** rather than employment **levels**. Middle-ranking jobs could therefore still be increasing in number, just at a slower rate than those at the top and bottom.

This section therefore looks at what the distribution of jobs looks like today, as well as considering projections into the future. The main source is the *Working Futures 2010-2020* report, undertaken by UKCES (Wilson and Homenidou, 2012). Table 3 below (based on their Tables 4.1-4.3) report the numbers employed in each 1-digit occupation, from 1990 projected forward to 2020, for all workers and then for females and males separately.

Looking at the first panel for all workers, Table 3 shows strong employment growth in the top 3 occupation categories of managers, professionals and associate professional/technicians. All three have grown strongly between 1990 and 2010, and are forecast to continue such strong growth up to 2020. The forecast figures for 2020 show that all three occupation groups will employ about 50% more workers in 2020 than they did in 1990. The employment shares of managers, professionals and associate professional/technicians were 8%, 14.5% and 11% respectively in 1990. By 2010, these shares had increased to 10%, 19% and 13% respectively, and by 2020 are forecast to reach 11%, 21% and 14% respectively. By 2020, almost one-half of all jobs are therefore expected to be in these top three occupation categories, up from one-third in 1990.

Below the top three occupations, we can see the patterns of hollowing-out, which therefore holds in terms of actual numbers of jobs, and not just employment shares. The largest falls in employment numbers are for mid-level occupations: Skilled trade occupations (1.2 million fall in jobs between 1990 and 2010) and Administrative jobs (0.75 million fall in jobs between 1990 and 2010). Both of these trends are forecast to continue to 2020, at a similar rate for Administrative jobs and at a lower for Skilled trade jobs. The declining middle is therefore clear to see in these figures.

In the lowest four occupation categories, there are different trends over time. The largest growth has been in terms of Caring, leisure and other service sector jobs, which have almost doubled their employment levels in the 20 years from 1990 to 2010, going from 1.4 million to 2.7 million jobs, increasing their share of total employment from 5% to 9% over the same period. This upward trend is forecast to continue to 2020, albeit at a slower rate. Sales jobs have also increased in number between 1990 and 2010, though are forecast to remain steady from 2010 to 2020. Finally, in the lowest two occupation categories, Process, plant and machine operatives have lost almost 1 million jobs between 1990 and 2010, while there are around a third of million fewer elementary jobs in 2010 compared to 1990. The former trend is forecast to continue, though in the case of the latter, the forecast is for a modest increase again in the number of elementary jobs. These are mostly service sector jobs, as service sector firms continue to need human input to perform various basic tasks. Overall, taking the lowest four occupation categories together, the numbers employed in these jobs have grown by about 0.4 million between 1990 and 2010, and are forecast to grow by a further 0.2 million by 2020.

Table 3: Employment Levels, 1990-2020 Projected (Thousands)

All	1990	2000	2010	2015	2020
1. Managers	2,284	2,540	3,016	3,279	3,560
2. Professional occupations	4,181	4,820	5,843	6,189	6,712
3. Associate professional/technical	3,050	3,561	3,926	4,138	4,476
4. Administrative/secretarial	4,437	4,078	3,698	3,466	3,312
5. Skilled trades occupations	4,736	3,767	3,526	3,389	3,295
6. Caring, leisure and other service	1,446	2,142	2,719	2,801	3,032
7.Sales and customer service	2,309	2,479	2,608	2,555	2,610
8. Process, plant, machine operatives	2,819	2,349	1,950	1,829	1,737
9. Elementary occupations	3,504	3,454	3,173	3,209	3,274

Male	1990	2000	2010	2015	2020
1. Managers	1,752	1,809	2,015	2,122	2,239
2. Professional occupations	2,458	2,596	3,026	3,125	3,289
3. Associate professional/technical	2,089	2,210	2,294	2,347	2,450
4. Administrative/secretarial	799	777	764	753	763
5. Skilled trades occupations	4,032	3,241	3,081	2,990	2,928
6. Caring, leisure and other service	257	376	505	538	600
7.Sales and customer service	686	744	915	898	906
8. Process, plant, machine operatives	2,185	1,950	1,737	1,654	1,599
9. Elementary occupations	1,424	1,747	1,791	1,922	2,031

Female	1990	2000	2010	2015	2020
1. Managers	533	731	1,001	1,157	1,321
2. Professional occupations	1,723	2,224	2,817	3,064	3,423
3. Associate professional/technical	962	1,352	1,632	1,791	2,026
4. Administrative/secretarial	3,638	3,302	2,934	2,713	2,549
5. Skilled trades occupations	704	526	444	399	367
6. Caring, leisure and other service	1,190	1,766	2,214	2,263	2,431
7.Sales and customer service	1,623	1,735	1,693	1,657	1,704
8. Process, plant, machine operatives	634	399	213	175	139
9. Elementary occupations	2,081	1,707	1,382	1,287	1,243

Source: Wilson and Homenidou (2012). Tables 4.1-4.3.

One interesting point to note, therefore, is that the strongest growth in employment in the lower half of the occupation classification is in groups 6 (Caring, leisure and other services) and 7 (Sales and customer service). The Standard Occupational Classification is described as being hierarchical in terms of skill, with the least skilled jobs being in the lowest category (Elementary occupations). When the hollowing-out literature has talked about growth in the lower-classified jobs, these have typically been in particular in group 6, such as care assistant and teaching assistant roles, and also in sales jobs in group 7. Therefore, it should be noted that the growth in jobs at the bottom end in the hollowing-out literature is when jobs are ranked by *wages*, and these are not necessarily the least skilled jobs in the economy. Indeed, many such service sector jobs in caring etc. require qualifications at Level 2 or even Level 3, again showing that they are not unskilled jobs.

The lower two panels in Table 3 report results for females and males separately, respectively. Similar patterns are observed for the two genders, with one or two differences. At the top end, both men and women have seen strong growth in the number of jobs in the top three occupation categories, which will continue until the end of the decade. By 2020, over 40% and approaching half of all male and female workers will be classified into one of these three groups. Below this, we see declining numbers employed in mid-level occupations (groups 4 and 5) for both genders. Within this group there are differences, however, with the fall being almost exclusively in Skilled trade occupations for males (1 million jobs lost between 1990 and 2010, with the number of Administrative jobs virtually unchanged), while for women most intermediate jobs have been lost in Administrative roles (0.7 million jobs lost between 1990 and 2010, compared to 0.25 million lost Skilled trade jobs). For the lowest-occupations (groups 6-9), there are some differences between the genders overall. The numbers of men employed in these groups has increased by around 0.4 million between 1990 and 2010, and is forecast to increase by a further 0.2 million by 2020. For women, the total number in these four categories has remained almost unchanged between 1990 and 2010, and forecast to remain so until 2020. Within this group, the number of both men and women in Caring roles has approximately doubled between 1990 and 2010, though from a substantially lower base for men. The growth in sales jobs has been almost exclusively amongst males. Perhaps the largest difference between the genders is observed in Elementary occupations. The

number of women employed in such jobs fell significantly, by about 0.7 million, between 1990 and 2010, while for men, the numbers increased by about 0.4 million. In 1990, there were many more women than men doing such jobs, but by 2000 the numbers were approximately the same. By 2010, there were significantly more men than women performing Elementary roles, with the gap forecast to become even wider by 2020.

Therefore, when we look at the raw levels of employment by occupation, rather than the employment shares ranked by initial wage as in the hollowing-out literature, a similar pattern emerges, of declines in the numbers of intermediate Administrative and Skilled trade jobs, and growth in lower-ranked jobs, particularly in the service sector. However, this does not mean that there are no intermediate-level jobs available for workers, either job-movers or new-entrants to the labour market, to fill. First, there are still over 7 million Administrative or Skilled trade jobs in the economy, and by 2020 there will still be 6.5 million. Second, when we look within these broad (1-digit) occupation categories, there is variation, so that not all intermediate level jobs are in decline. Wilson and Homenidou (2012) report (in their Table 4.5) the projected change in employment between 2010-2020 for more disaggregated (2-digit) occupations. Looking in particular at the intermediate categories showing a fall overall at the 1-digit level, for the Administrative classification, there is a clear distinction with the number of jobs in Secretarial occupations (SIC 42) forecast to decline by 32%, while the number of jobs in Administrative occupations (SIC 41) is expected to fall only by a negligible 3%. This shows the changing nature of such intermediate jobs, away from traditional secretarial roles towards more general administrative roles. Within the Skilled trade category there is even more variation when disaggregated to the 2-digit level. Thus, although there are relatively large falls expected in the number of Skilled trade jobs in textiles (SIC 54) that are available, and to a lesser extent for Skilled metal, electrical and electronic trades (SIC 52), there is actually a growth predicted in the projected number of jobs in Skilled agricultural (SIC 51) and Skilled construction and building (SIC 53) trades. Thus there are still expanding intermediate level jobs.

Finally, and most pertinently, just because the total number of intermediate jobs is declining does not mean that there are not still job openings in these areas, due to replacement demand. As workers leave jobs due to retirement, mortality, net occupational mobility or net migration, posts become available to be filled. Table 4 below displays the forecast net change in the total number of jobs between 2010 and 2020, as derived from Table 3 above. The third column reports the forecast replacement demand in each occupation category, while the final column shows the total requirement in terms of number of workers needed in each occupation. This total requirement is the sum of the net change and the replacement demand.

Table 4: Forecast Total Demand Flows 2010-2020 (Thousands)

	Net change	Replacement demand	Total requirement
1. Managers	544	1,306	1,850
2. Professional occupations	869	2,315	3,184

	Net change	Replacement demand	Total requirement
3. Associate professional/technical	551	1,450	2,000
4. Administrative/secretarial	-387	1,695	1,309
5. Skilled trades occupations	-230	1,383	1,153
6. Caring, leisure and other service	313	1,144	1,457
7.Sales and customer service	2	938	939
8. Process, plant, machine operatives	-213	845	633
9. Elementary occupations	101	1,243	1,344

Source: Wilson and Homenidou (2012). Table 4.4.

The data in Table 4 make clear that the replacement demand dominates the net change in number of jobs, in every occupation category. The total replacement demand over the decade is 12.3 million workers, with the smallest replacement demand (for Process, plant and machine operatives) being just less than 1 million workers, and the largest (for Professional workers) being over 2.3 million workers. Thus, every occupation category is going to need significantly more workers over the coming decade to fill vacancies. Even in the so-called 'declining middle', 1.3 million more Administrative workers and 1.1 million Skilled trades workers will be needed.

A similar situation, of continuing jobs in the middle of the distribution despite the documented polarisation, is observed in the US (for a discussion see Holzer and Lerman, 2009). In summary, though there is clear evidence of polarisation, to say that the job distribution has completely 'hollowed out' is misrepresentative. Though middle-ranking jobs have declined, they still employ many thousands of workers, and will continue to need new workers to replace existing ones who leave. Furthermore, jobs can change over time, such that increased responsibility can improve the profile of a previously low-skilled jobs, while technological change can put a previously high-skilled job within the reach of middle-skilled workers. Perhaps the most damaging conclusion that could be drawn from the hollowing-out literature is therefore that there is no longer any need for individuals to acquire intermediate level qualifications due to a 'declining middle' in the jobs distribution. The data in this section suggests that there will still be jobs available for workers with intermediate level qualifications.

6. Hollowing out and job mobility

This final section of the report considers whether the mobility of workers has been influenced by the hollowing-out of the job distribution. There are two issues here:

- Have workers previously found in intermediate routine jobs been forced to change jobs due to the replacement of such jobs by technology, and if so, where have such workers gone in the jobs distribution?

- Has the decline of mid-level jobs had an effect on entry-level jobs, such that the opportunities for promotion and career enhancement have been diminished by 'the declining middle'?

There is not much evidence in the literature addressing either of these questions, presumably because the analysis of job mobility over time is more demanding in terms of its data requirements, tracking individuals over time. There is slightly more evidence on the first question, which will be considered first.

(i) Mobility of workers replaced in routine jobs

For the UK, this issue of worker mobility caused by job polarisation has been considered in depth in a series of reports by researchers at SKOPE, in particular Craig Holmes and Ken Mayhew. For example, Holmes (2011) uses longitudinal data from the NCDS to track individuals over time, and so observe their career mobility. His particular interest is those in routine jobs, how many lose their jobs, and where they go when they have to change jobs. He therefore studies individuals who were in a routine job at the beginning of the period, 1981, and then studies their likelihood of transition into alternative categories of employment, in subsequent periods: 1981-1986, 1986-1991, 1991-1995, 1995-1999 and 1999-2004. The occupation categories considered are professional, managerial, intermediate/associate professional, service, manual non-routine, or remaining in a routine job.

Thus, a separate equation is estimated for each of the six occupation categories. The dependent variable in each is a dummy variable showing whether an individual moves into that occupation group in the period being considered. The estimation is undertaken by logit equation, to take account of this dichotomous nature of the dependent variable. The explanatory variables include gender, ethnicity, experience and qualifications. In order to attribute observed changes to a direct causal influence of TBTC/routinisation, it is necessary to separate job mobility for technological reasons from job mobility for normal career mobility reasons (i.e. just because we observe an individual in a routine job one period, and a more senior job the next period, does not mean that they were forced to move by TBTC, and this might have been normal career development). Therefore an additional explanatory variable is included indicating 'routinisation', measured as the overall change in employment in routine jobs in each period.

The results reveal a positive and significant coefficient on the routinisation variable in each equation except for the managerial equation (and of course, a negative coefficient in the routine equation itself). This suggests that in periods when technological change was

greater, then fewer workers stay in routine jobs, and instead move into all other occupation categories except managerial.

To illustrate the results, Holmes interacts the routinisation variable with the other explanatory variables, and then calculates the probability of an initially routine worker being in each occupation state. An example is given in Table 5 below.

Table 5: Predicted probabilities of transition – intermediate level qualifications

	0% routinisation			10% routinisation			
Occupation	No quals	Level 2-3	Marg. eff.	No quals	Level 2-3	Marg. eff.	Interaction
Professional	0.6%	0.5%	-0.1%	0.6%	0.9%	0.3%	0.4%
Managerial	1.3%	3.0%	1.7%*	1.5%	3.7%	2.2%*	0.5%
Intermediate	1.3%	2.3%	1.0%*	1.1%	2.8%	1.7%*	0.7%*
Routine	93.5%	91.5%	-2.0%*	92.2%	89.0%	-3.2%	1.2%*
Service	1.1%	1.2%	0.1%	1.5%	1.5%	0.0%	-0.1%

Source: Holmes (2011) Table 1.

The results in the 0% routinisation columns show estimated normal mobility, for example due to career progression, in the absence of routinisation/technological change. The results show that most routine workers remain as routine workers, however those with intermediate qualifications are more likely to move out of routine jobs than those with no qualifications, particularly upwards into managerial and intermediate jobs. The next three columns show that when there is 10% routinisation (i.e. a greater decline in routine jobs), the movement out of routine jobs is greater, with the gap between the movement out between those with no qualifications and those with intermediate qualifications being larger (as shown by the positive and significant 1.2% effect on the interaction term in the final column). Thus, when technological change reduces the number of routine jobs, Holmes finds that intermediate qualifications make it more likely that an initially routine worker will escape to a higher occupation level, compared to those with no qualifications.

Holmes conducts other similar counterfactual experiments, for example comparing those with high-level relative to intermediate-level qualifications, as shown in Table 6 below.

Table 6: Predicted probabilities of transition – higher academic qualifications

	0% routinisation			10% routinisation			
Occupation	Level 2-3	Level 4-5	Marg. eff.	Level 2-3	Level 4-5	Marg. eff.	Interaction
Professional	0.5%	3.5%	3.0%*	0.9%	7.6%	6.7%*	3.7%*
Managerial	3.0%	9.4%	6.4%*	3.7%	6.5%	2.8%*	-3.6%
Intermediate	2.3%	5.6%	3.3%*	2.8%	6.1%	3.3%*	0.0%
Routine	91.5%	85.7%	-5.8%*	89.0%	78.4%	-11.6%	-5.8%*
Service	1.2%	0.5%	-0.7%	1.5%	0.9%	-0.6%	0.1%

Source: Holmes (2011) Table 2.

In this case, the differences in mobility rates between the qualification levels are larger. Those with high level qualifications are much more likely (by 5.8 percentage points) to

move out of routine jobs into higher level jobs relative to those with intermediate qualifications, even in the absence of a decline in the availability of routine jobs. When a 10% decline in routine jobs is factored in, the gap in movement out of routine jobs between high and intermediate qualifications workers expands to 11.6 percentage points.

Thus, qualifications play a big role in escaping the declining routine jobs, and moving up into professional jobs (for higher qualifications) and managerial and intermediate occupations (for intermediate qualifications). Investigating other factors in similar way, Holmes also finds that the longer individuals have worked in routine jobs, the more likely they are to remain in such jobs, while those with fewer routine-specific skills are more likely to depart such jobs, particularly following a decline in the availability of routine jobs. General work experience, as measured by age, is also shown to increase the likelihood of remaining in routine work, but if they do leave such jobs, older workers are also more likely to move up to professional and managerial jobs than younger workers.

A very similar analysis is undertaken by Holmes et al. (2011), with the addition that it considers not only the cohort of individuals from the NCDS, but also the younger cohort from the British Cohort Study (BCS), who were all born in a particular week in April 1970. The same analysis as the previous paper is undertaken for each cohort separately, in both cases for all those individuals initially in routine jobs. The NCDS analysis covers the period 1981-2004, while the BCS covers 1996-2008. Results are shown in Table 7 below.

The results reveal that the younger cohort in the BCS are more upwardly mobile, in the absence of routinisation/TBTC. However, following the removal of 10% of routine jobs, the gaps between the older and younger cohorts narrow, with the older NCDS cohort showing much more upward mobility than they did under no routinisation, whereas the likelihood of the younger BCS cohort moving barely changes. Thus, the younger cohort in general show more occupational mobility, but when forced to move due to technological change, it is the older cohort who move more in response to this.

Table 7: Predicted probabilities of transition from routine occupation

	0% routinisation			10% routinisation			
Occupation	NCDS	BCS	Marg. eff.	NCDS	BCS	Marg. eff.	Interaction
Professional	1.2%	9.6%	8.4%	3.6%	8.9%	5.4%	-3.1%
Managerial	3.1%	12.8%	9.6%	6.3%	13.0%	6.7%	-2.9%
Intermediate	3.0%	5.6%	2.7%	5.4%	7.3%	1.8%	-0.8%
Routine	93.2%	82.1%	-11.1%	85.5%	78.0%	-7.6%	3.5%
Service	0.2%	0.1%	-0.1%	0.3%	0.1%	-0.3%	-0.1%

Source: Holmes et al. (2011) Table 1.

Holmes et al. (2011) also use their two cohort data sets to examine the likelihood of entry into a routine job in the first place. They find, as expected, that the younger cohort are less likely to enter a routine job than the older cohort, as expected, though this fall in likelihood is not as large as the actual fall in the proportion of routine jobs in the economy. There is therefore no evidence that the decline in younger workers entering routine work is any greater than the general decline in routine work would suggest.

The issue of job mobility from routine jobs is studied in an American context by Autor and Dorn (2009a). They consider commuting zones in the US, and examine the change in

employment, over the period 1980-2005, in routine-intensive jobs, high-skill non-routine jobs, and low-skill non-routine jobs. The change in employment is expressed as the change in each occupation's employment share within one of three age brackets: 16-29, 30-54 and 55-64. These changes were explained as a function of the commuting zone's initial share of routine occupations (as an indicator of its potential for rountinisation). The results are shown in Table 8 below.

Table 8: Changes in allocation of age groups across occupations in response to initial routine employment share in commuting zone, 1980-2005

	Young: 16-29	Prime: 30-54	Older: 55-64
Routine-intensive	-0.31** (0.02)	-0.21** (0.01)	-0.25** (0.03)
High-skill non-routine	0.10** (0.02)	-0.01 (0.02)	-0.06* (0.03)
Low-skill non-routine	0.21** (0.03)	0.22** (0.02)	0.31** (0.04)

Source: Autor and Dorn (2009a): Table 2
Standard errors in parentheses.
** significant at 1% significance level.
* significant at 5% significance level.

The results show that in areas with a higher initial proportion of routine jobs in 1980, there was a larger fall in the routine employment over the following 25 years, for all age groups. Thus, for example, a commuting zone with a 1 percentage point higher initial share of routine jobs will see the share of routine-intensive jobs fall by 0.31 percentage points amongst young workers, 0.21 percentage points amongst prime-aged workers and 0.25 percentage points amongst older workers. Where do these workers go? The results in the lower two rows show that amongst young workers, there is a growth in the share of 16-29 year olds in both high-skill and low-skill non-routine jobs, so young workers move both up and down the occupation hierarchy. Amongst the two older age groups, however, the high-skill coefficients are both negative, so that there is no evidence for older workers moving from routine into high-skill non-routine jobs. Instead, they are much more likely to move into low-skill non-routine jobs, typically in the service sector as we have seen previously. When the analysis is further divided by education (into workers with and without a college degree), the results show that amongst young workers, there is an increase in the high-skill employment share amongst those with a degree, and an increase in the low-skill employment share amongst those without. For the older two age groups, however, only the low-skill non-routine jobs increase their share of employment, whether we consider graduates or non-graduates. In summary therefore, in the US when technological change reduces the number of routine jobs, most of those displaced move down to low-skill non-routine jobs, except amongst young well-educated workers.

(ii) Mobility/progression from entry-level jobs

There does not seem to be any research that has explicitly studied the effect that hollowing-out has had on the probability of progression from entry-level jobs. Thus, while there are studies that document occupational mobility, to be discussed below, none examine and prove a link between changes in occupational mobility and hollowing-out.

This is therefore clearly a gap in the literature that should be filled. This section will therefore discuss some of the factors that have been identified in the literature concerning progression from entry-level jobs, without being able to show exactly how these factors have been affected by the job polarisation identified above. The concluding section that follows will discuss how progression likelihood *might* have been affected, in light of the discussion in this section about what does affect progression.

The issue here is that the reduction in the number of Skilled Trade and Administrative jobs in the labour market has reduced the labour market opportunities of low- and mid-qualified individuals, particularly young people at the start of their careers. Thus, while such individuals have always started out at entry-level, maybe their chances of progressing from that level during their careers have been harmed by the reduction in intermediate level jobs. The issue may be particularly relevant to males, who in the past could start out as an unqualified labourer in a manufacturing firm, and with experience, training and effort, rise to become a skilled craftsman or supervisor. Are such possibilities still as prevalent, with the decline in intermediate-level jobs, and the growth in lower-level, predominately service sector jobs? The issue is summarised nicely by a quote from Levy and Murnane's (2004) book:

"As recently as 1970, more than one-half of employed U.S. adults worked in two broad occupational categories: blue-collar jobs and clerical jobs.... Few people got rich in these jobs, but they supported middle- and lowermiddle-class living and many were open to high school graduates. Today, less than 40 percent of adults have blue-collar or clerical jobs and many of these jobs require at least some college education."
(Levy and Murnane, 2004, page 3).

One piece of direct, relevant evidence is provided by Crawford et al. (2011). This report is a wide-ranging study of education and labour market decisions and outcomes for young people. The authors use data from the British Household Panel Survey (BHPS), which allows them to track individuals over time. Of particular interest here is the analysis of longer-term (ten year outcomes) according to the initial status of young people aged 16-19. The results are based on quite small sample sizes, but show that the key status that affects people when they are older is being NEET (not in employment, education or training) when aged 16-19. Such individuals are significantly more likely to be unemployed in the future. The most interesting status for our purposes is 'in a job without training'. It is a reasonable assumption that a 16-19 year old undertaking a job that does not involve any training must be in a fairly low-quality job. The evidence reveals that labour market outcomes ten years later, in terms of likelihood of being unemployed and wages, are no worse for this group than for young people in education or in jobs with training. It would seem, on the basis of this evidence at least, that having a low-quality job whilst young does not make individuals more likely to have a lower quality job, on average, when older.

However, other evidence, focussing less specifically on only those initially aged16-19 in jobs without training, suggests that progression from low-level jobs is difficult. For example, a review of the literature on progression is presented by Devins et al. (2011). A study by Anderson et al. (2005) is discussed, which examines low earners in the labour market between 1993-2001. Most of this group remain in low-pay jobs, with only around one-quarter escaping. Similarly, reference is made to a study by Lawton (2009), which found that amongst a group of low-paid workers, 40% remained in such jobs, while a further 14% left employment altogether. A key factor identified that limits progression from

low-wage service sector jobs is job retention. Progression within a firm or an occupation to higher job levels requires continued job tenure. However, a key feature of the low-wage service sector jobs is low tenure and high turnover. Rather than progression to higher levels, the most frequent change in job status for those in low-pay jobs is movement into no work at all, as part of a low-pay-no-pay cycle. Such insecurity reduces the acquisition of experience, the likelihood of receiving training, as well as self-confidence and self-perception, further reducing the chances of future progression, and so on in a vicious circle. As well as individual characteristics associated with progression, characteristics of the firm worked for are also of relevance. Evidence suggests that progression is more likely with large firms, unionised firms, and firms offering higher wages. Of relevance to this review, evidence also suggests that progression is more likely in some low- and semi-skilled occupations than others. In particular, progression is more likely in construction, manufacturing, transportation and health services, than in other lower-paying sectors (and so not in many of the serivce sectors which we have seen expanding).

To the extent that training is required for progression, workers in elementary occupations are disadvantaged due to the fact that they are significantly less likely to receive workplace training than any other occupation group (see, for example, Lindsay et al., 2012).

Lloyd and Mayhew (2010) researched progression in five low-paying (mostly service) sectors: call centres, hotels, food processing, retailing and hospitals, focussing on seven jobs: call centre agent, hotel room attendant, food processing operative, check-out operative, sales assistant, hospital cleaner and healthcare assistant. Theirs was a case study approach, covering the period 2005-2007. Their evidence revealed extremely weak job progression opportunities in such jobs in these sectors. Workers in such jobs tended to be hired with either no qualifications, or low-level qualifications, and remain at a single employment level throughout their tenure. The best opportunities for progression were observed in the one public sector studied, namely hospital staff in the NHS. The introduction of Agenda for Change in the NHS, and the creation of a *Skills Escalator* means in principle that workers can progress continuously through the ranks. Examples were found of, for example, cleaners becoming healthcare assistants, and healthcare assistants becoming assistant practitioners. Such progressions were in the most part linked to the acquisition of appropriate qualifications. In practice, however, progression was often blocked, even when qualifications had been acquired, often because of a lack of suitable openings at the higher level. In the remaining jobs, it was reported there was basically no chance of reaching managerial positions having started out at entry level, with movement to team leader being the highest that could be reached. Even in this case, such promotions often were not linked to qualification acquisition, only to experience, performance and attitude on the job, and usually involved only minimal pay increases. Lloyd and Mayhew reported that across all of the jobs they studied, only a small minority of entry-level workers (between 1 in 15 and 1 in 30) would reach the level of team leader.

Case studies of progression in particular low pay sectors have been undertaken by Lloyd and Pane (2011) (hospitality) and by Devins et al. (2010) (retail). Lloyd and Pane consider the café sector. Their subjects work in a range of cafés, including national coffee shop chains and small independent cafés. They find that opportunities for progression vary, and are usually best in the national chains. Even here, though, the opportunities for advancement are limited, and typically offer little reward (an extra 20-50p per hour), moving to supervisory and assistant managerial roles (consistent with the more general evidence of Lloyd and Mayhew, 2010, above). For this reason, not all employees in this

sector want to progress, given the extra work demanded, and the limited reward for doing so. In their case studies, Lloyd and Pane interviewed 25 café assistants, only 10 of whom wanted to progress in the café business. Furthermore, of these 10 who wanted to progress, only 3 were confident of doing so, mostly because of a lack of available opportunities at a higher level. Therefore, although the national coffee chains had in place definite routes to progression, linked to experience and in-house training more than qualifications, it is not a route that all wanted to travel, and on which only a few would be successful.

In the national supermarket (Morrisons) studied by Devins et al. (2010) there is again a definite progression path, from entry level jobs to supervisors to various level of shop management and even beyond. The participants in their study were all already at management level. The majority had joined the company in an entry-level position, straight from school before the age of 21. They took between 5 and 12 years to reach store manager level. Most described Morrisons itself as having a dominant role in providing the path to this level, and the push to pursue this route. Of course, what this study cannot do, given it is limited to those who reach a managerial position, is consider those who do not progress in their career with their store, though the high turnover amongst entry-level staff that is mentioned would suggest that most would not follow this progression route.

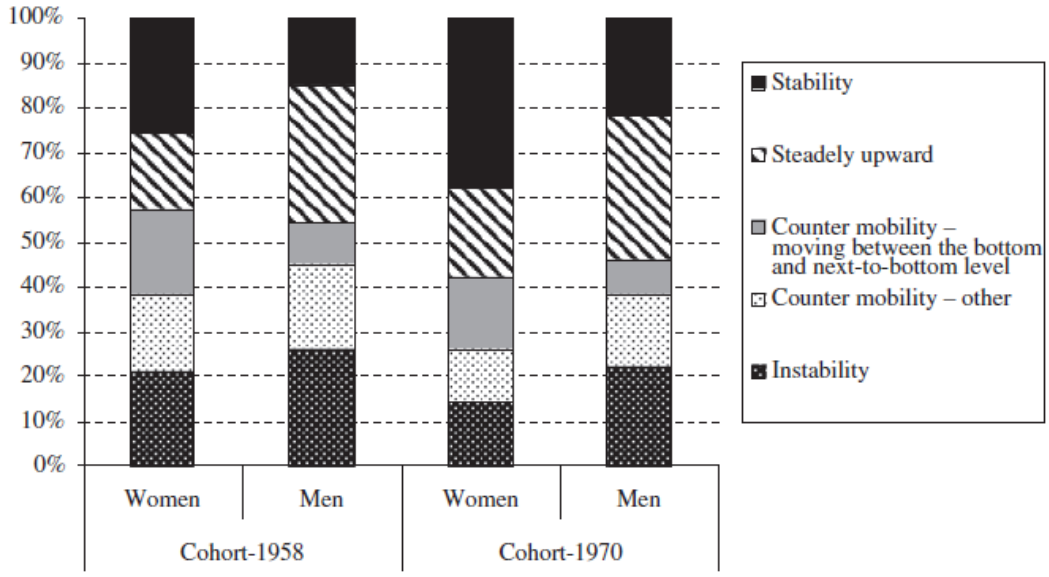
One aspect that has not been commented on until now is the gender aspect of the changing labour market structure discussed above. The 'declining middle' of lost production jobs, and the rise of low-wage personal service sector work can have important implications for the gender split in employment, given the male dominance in the former and the female dominance in the latter. The period of change in the labour market has coincided with growing inactivity amongst men, with Campbell et al. (2001) reporting that at the turn of the century, over a third of men with no qualifications are economically inactive at any point in time. Many of the social (caring) and personal service occupations have a mostly female workforce. For example, at least three-quarters of the workforce are female in the following occupations: receptionists, hairdressers/barbers, nurses, care assistants, primary teachers, retail cashiers, cleaners, sales assistants and waiters/waitresses. Men who do work in the low-wage service tend to be employed in a narrow range of jobs in distribution, transport and security. Qualitative evidence on the attitude of low-skilled men to entry-level service sector work is provided by Nixon (2009). He suggests that the main reasons that men do not compete with women in the social and personal caring sectors is that such work is seen as female and therefore undermines their masculinity, and that the women have stronger empathy skills needed for the direct contact with customers required in such roles.

Overall, then, there is evidence that progression from low-level occupations is difficult. The key question of interest here, however, is not just whether such progression is difficult, but in particular whether the hollowing-out of the job distribution has made such progressions more difficult over time. There is very little evidence on changes in job progression over time, and none that specifically analyses the impact of hollowing-out. One example of a relevant study, looking at differences in job progression between two cohorts and so considering changes over time, is Bukodi and Dex (2010). The main focus of analysis of this paper is gender differences, but the results of the cohort comparisons are of interest here with respect to the possible impact of hollowing-out. The two cohorts used are those found in the National Child Development Study (NCDS) and British Cohort

Study (BCS) birth cohort data sets. These data sets have followed a cohort of individuals born in particular weeks in 1958 and 1970 respectively, throughout their lives. Bukodi and Dex use the sweeps when the NCDS cohort members were aged 23 and 33, and the sweeps when the BCS cohort members were aged 26, 30 and 34, in order to create a continuous work history from the age of 16 to 33/34. They then analyse job progression over these periods. In order to do so, they need some ranking of occupations, and this is done by calculating the average wage in each 2-digit occupation in the 2002 New Earnings Survey. Occupations can then be divided into 5 quintiles according to their average wage. The focus of the paper is on those who initially enter the labour market via a job in the lowest quintile. The question is how many progress from this initial 'bad job'. In fact, Bukodi and Dex identify 5 possibilities: 'stability' (remain in the lowest quintile), 'steadely (sic) upward' (progress from the lowest quintile), 'counter mobility – moving between the bottom and next-to-bottom level' (progressing from the lowest quintile to the second lowest but falling back down again before age 33/34), 'counter mobility – other' (progressing to the third or even higher quintile, but falling back down to the lowest quintile again by age 33/34) and 'instability' (progressing from the lowest quintile before falling again, but not all the way back to the lowest quintile). Figure 7 (reproducing Figure 2 in Bukodi and Dex) shows the proportion of individuals, initially in the lowest job quintile, who fall into each of these five groups, separately by cohort and gender.

The results in Figure 8 show that only a minority of individuals who enter the labour market in a low paid job will permanently (by age 33/34) leave low pay. Over half of such women either never leave low pay, or leave only temporarily before falling back into low pay, while this is true for approaching half of such men. The key issue as far as this report is concerned is whether the younger cohort (in the BCS) are less likely to progress from a low-pay entry job than the older cohort (in the NCDS). Figure 7 shows clearly that this is exactly what has happened, for both genders and in particular for women.

Figure 8: Distribution of Individuals Initially in Lowest Quintile Jobs, by Future Career Type



Source: Bukodi and Dex (2010), Figure 2.

Bukodi and Dex also undertake an econometric analysis, estimating the likelihood of upward mobility. A range individual human capital and job specific explanatory variables are considered, including dummy variables to indicate the quintile of the job distribution in which the individual enters the labour market in their first job. The results show, firstly for women, the likelihood of upward job mobility is a statistically insignificant 7 percentage points lower if they took a bad (in the lowest quintile) first job than if they took an entry job in the middle quintile (the reference category) amongst the NCDS cohort. However, for the younger BCS cohort, those women who took a 'bad' entry-level job were a statistically significant 25 percentage points less likely to move up the occupation hierarchy. For women, the results therefore again suggest a falling likelihood over time of escaping low-quality entry-level jobs. For males, the pattern is similar, but not as a large or statistically significant. In the NCDS cohort, those in the lowest entry jobs are no less likely to progress than those whose first job is in the middle quintile, while for the BCS cohort they are 9 percentage points less likely to experience upward mobility.

These results do not prove that hollowing-out is the cause of reduced mobility from entry-level jobs, but the declining upwards job mobility over time is at least consistent with the hypothesis that the falling numbers of intermediate jobs has reduced the chances of progression from low entry-level to intermediate level jobs. This seems to be the case particularly for women.

7. Conclusions

This review of available evidence has shown that job polarisation is a real phenomenon, experienced by all countries that have been studied (always developed countries). Thus, taking a starting point in the late 1980s or early 1990s, the occupations that have increased their employment share the most from that point onwards are the ones that were paying either a high or a low wage at that initial point, while the occupations that have lost employment share were in the middle of the initial wage distribution. Most of the expanding low-wage sectors are in social and personal service sectors.

The dominant explanation for this phenomenon in the literature is task-biased technological change (or 'routinisation') whereby technological change (ICT) has replaced routine jobs that can be easily programmed, and which were typically found in the middle of the job/wage distribution, in occupations such as in administration and skilled production. There is also a role played by globalisation, either through UK companies offshoring some of their jobs, typically intermediate-level production or administrative roles, to other countries with lower labour costs, or via direct competition from imports, particularly from China, reducing domestic production. While there is only limited evidence that offshoring is a major determinant of the hollowing-out phenomenon, there is some evidence that increased competition from Chinese imports is affecting employment patterns, particularly in manufacturing, while some technological change could itself be a reaction to, and a defence against, international trade competition.

A key message to emerge from this review, however, is that the changes in the jobs distribution, particularly at intermediate levels, have not been as dramatic as the phrase 'hollowing-out' implies, and phrases such as the 'disappearing middle', that one sometimes hears used, wrongly imply that intermediate level jobs are going to become a rarity. Each paper in the job polarisation literature defines all jobs in terms of their wage at the start of the period being studied, and finds that at the end of the period, the employment share of those occupations initially classified as low-paid has increased, on average, while the employment share of those occupations initially classified with an intermediate level of pay has fallen on average. However, this does not necessarily have to mean that intermediate-level jobs are disappearing. The reason is that wages, and in particular relative wages, can change over time. This can be in response to changes in demand for different types of workers in different jobs, driven by technological change for example, or by changes in the supply of labour of different types, as a result of, amongst other things, changes in education and training, labour force participation, immigration etc. In addition, labour market institutions such as the introduction of the National Minimum Wage can affect wages, particularly at the lower end of the distribution. The result is that jobs that were classified by their initial wage as being at a high, intermediate or low level, need not necessarily end a period with the same classification. Thus, newly-classified intermediate jobs can emerge, as previously classified low-wage or high-wage jobs become classified at an intermediate level. Thus, intermediate-level jobs still exist in large numbers, and will continue to exist. The issues are therefore that the jobs classified as intermediate by their wage level are changing, that the 'old' intermediate-level jobs are declining in number, with a question as to whether there are sufficient 'new' intermediate-level jobs. Key pieces of evidence above of relevance here are the studies of the changes in the wage distribution and the absence of evidence for wage polarisation (Section 4), which show wage growth at intermediate levels that has been at least as large as at the lower end of the distribution,

and the analysis of Holmes (2010), which showed that when the unit of observation is a percentile of the wage distribution rather than an occupation, the employment share of intermediate level percentiles seems to have held up (Figure 7), so that there as many jobs in the middle percentiles of the wage distribution as ever, just different jobs. In addition, there is the work of Wilson and Homenidou (2012), who look at changes in the numbers employed by broad occupation groups, and provide projections into the future. Their analysis simply takes the hierarchical nature of the Standard Occupational Classification (rather than ranking jobs by wages, as in the polarisation literature), and shows that while the number of jobs in the Administrative (SOC 4) and Skilled trade (SOC 5) classes have fallen over time, substantial numbers still remain, while there is at least the possibility that some of the growth in Associate Professional (SOC 3) jobs will be in intermediate-level jobs in terms of their wages.

Thus, the conclusion would seem to be that while there has been some decline in the employment share of intermediate-level jobs, this has not been as dramatic as implied by the hollowing-out literature, and in some sense, the bigger conclusion is the changing nature of intermediate jobs. Thus, while traditional intermediate-level jobs (those that paid an intermediate wage at the start of the period) have reduced in number, significant numbers of such jobs remain, while newly-classified intermediate-level jobs emerge, as occupations move up and down the wage distribution, and perhaps even completely new occupations emerge. There is certainly a need for more research here, however, to identify exactly what these changing jobs are at the intermediate level. The hollowing-out literature itself offers no information, with most papers simply classifying jobs by decile, with no description of job titles involved. The work of Wilson and Homenidou (2012) discussed above provides data at a 2-digit level, to show that, for example at the intermediate level, the falling employment levels are mostly for secretarial occupations and amongst skilled manual workers in textiles, metals, electrical and electronic trades. Further down the distribution of jobs, the big growth in employment share in non-routine manual jobs has been in caring jobs. More detailed information, at a more disaggregated occupational level, is needed however, to know which jobs are in decline, and which are growing.

What are the implications of these trends? At the top end of the jobs distribution, there is clearly continuing, and growing, demand for skilled labour, particularly in professional and associate professional occupations. The relatively constant wage returns to a degree over the last couple of decades would suggest that, on the whole, the supply of skilled labour has kept up with this demand.[2]

It is in the middle and the lower end (in terms of initial wages) of the jobs distribution, that most attention on the implications of hollowing-out has been focussed. Intermediate-level jobs are typically seen as ‘good jobs’ for the non-graduate working population, whilst lower-level jobs, offering lower pay, less interesting work and fewer progression opportunities, are seen as ‘bad jobs’. The worry is therefore that the decline of the former and the growth in the latter weakens the labour market position of many workers. We have seen above that the situation is perhaps not quite as serious as might be thought on first reading of the hollowing-out literature, as there are still job opportunities at the

[2] Within the category of graduates, there could be differences in the match between supply and demand across subjects, but such detail at the top end of the distribution is not considered in the current report.

intermediate level, due to new occupations being created, jobs moving up and down the wage distribution, and replacement demand for exiting workers. Nevertheless, we cannot be complacent. Many of the 'traditional' intermediate-level jobs are in decline, as shown by the hollowing-out literature, which can have implications for the job mobility of workers, in particular for those initially in intermediate-level and low-level jobs (in terms of initial wages):

- For workers who initially hold an intermediate-level job, one implication of the decline in the jobs originally classified as intermediate, is that some individuals will lose that job and need to find new work. Research discussed above from the US suggests that previously intermediate routine workers displaced from their job can either move up or down the occupation hierarchy, but most move downwards unless they are young and well-educated. Research for the UK did seem to suggest greater movement up the hierarchy into intermediate, managerial or professional occupations than was observed in the US, though note that the UK evidence used a birth cohort data set and so was based on a single cohort of individuals who were aged 23 in 1981. There is certainly room for more evidence on the longitudinal job histories of those who previously worked in the declining intermediate-level occupations.

- For those in low-level jobs, in particular in entry-level jobs, the decline in traditional intermediate-level occupations has potential implications for career progression from entry-level jobs. A lower number of intermediate-level jobs, or simply a change in the type of intermediate-level jobs, may mean that opportunities to advance one's career may be reduced compared to, for example, production jobs in earlier time where individuals could have developed their skills over time and progressed to foreman, supervisor and technician levels. Evidence of a falling likelihood that an individual who starts in a low-level job will progress up the jobs hierarchy was presented by Bukodi and Dex (2010) above. However, there does not appear to be any evidence in the literature that has examined the changing likelihood of progression from entry-level jobs due specifically to the polarisation of the labour market, and this is clearly an area where more research is needed.

What, then, are the policy recommendations resulting from this review? Possibly the most dangerous policy conclusion to draw would be to cut back on intermediate-level education. The possible argument for such a conclusion is clear – if there are growing numbers of low-wage jobs and declining intermediate jobs, then we do not need to continue with the policies of the previous decades that have tried to reduce the number of unqualified individuals in the workforce, and get more up to an intermediate level. This policy conclusion would be wrong for a number of reasons. First, it is certainly not the case that intermediate-level jobs are disappearing altogether. The job polarisation literature might show that the employment share of jobs classified as intermediate at the beginning of the period has fallen, but as discussed above, jobs can also move up and down the distribution, and new intermediate-level jobs can be created. Thus, while the *Working Futures* report of Wilson and Homenidou (2012) above showed that the number of intermediate jobs has fallen, there are still several million such jobs. Furthermore the fact that replacement demand is several times larger than net changes in demand (i.e. the need to replace workers who leave is greater than the contraction in the size of an occupation's workforce), means that there are still jobs available for those with intermediate-level qualifications.

Second, the analysis of mobility in Section 6(i) above revealed the importance of education for movement into higher occupation levels, if individuals are displaced from routine jobs. Thus, it is education that is going to help individuals, when their jobs are threatened by technological change. Finally, education and training have repeatedly been shown to be positively linked. Denying an individual an intermediate education in the immediate post-compulsory phase would likely deny them the opportunity of developing and reaching higher qualification levels later in life.

Therefore, the first policy prescription is that education and training remain important, and individuals, particularly young people, should be helped to achieve the best education outcomes possible, to give them the opportunity to reach intermediate jobs, and possibly beyond. Although some of the above analysis was re-assuring in terms of intermediate jobs continuing to exist, it is true that they are declining in number, and it is becoming more difficult to progress from entry- to intermediate level. Those who do make this progression are more likely to be better trained, and have higher level skills.

What sort of intermediate jobs should workers be trained for? While there is little quantitative evidence on this as mentioned above, anecdotally we can think of a range of jobs that do not require a university degree, but do require a certain level of competency and intermediate skills. Often, these involve previously high level tasks that have been made accessible to intermediate and technician staff. Obvious examples can be found in the health sector. Where previously diagnoses would have been carried out by professionally trained doctors and medical practioners, now nurses and paramedics can make diagnoses and affect treatment. In addition, a range of new intermediate technician jobs have emerged in hospitals, such as radiology technicians. It is noticeable that technology is important in such jobs. Thus, while technology has displaced human input in certain routine tasks, it can make other previously high levels tasks more accessible to intermediate level workers, where some human input is still required. Equally, technology can be added to manual tasks to increase the skill level required, for example for mechanics, plumbers and other building trades. Education and training will therefore remain important, to give individuals the skills to work in the new intermediate jobs.

More than training for particular jobs, vocational education and training needs to be general enough to prepare individuals to work across a particular sector or range of jobs, and to provide them with the fundamental understanding of the principles involved, so that they can continue to learn, develop, and react to future changes. This will be much more likely to help individuals be successful, rather than train them to do a specific task (that may or may not exist in the future). Much has been written about the need to change vocational education and training, and this is not the place to go through all the usual arguments. The recent *Wolf Report* (Wolf, 2011), is a good reference source to pursue these arguments.

As well as providing the vocational education and training needed, another area that could be improved is the provision of information about available provision. Rather than focus only on the academic route, and advise going to university to all young people whether it is the appropriate choice for them or not, more could be done to provide information about vocational learning such as apprenticeship, and to provide the encouragement to follow such a route.

The second main policy area starts with the assertion that increasing skills is not sufficient, if there are not enough jobs available for intermediate skilled workers. If all of the lowest quartile of education achievers suddenly increased their skills and qualifications levels, it would not be the case that they would all immediately work in intermediate-level rather than entry-level jobs. The number of jobs at each skill level is determined by the interaction of demand from firms and supply from individuals. As the supply of skilled labour changes, this equilibrium outcome will adjust, but demand from firms to fill low-level jobs will not immediately disappear, and a certain number of low-skill jobs will always exist. Qualifications, any qualifications, have perhaps been over-emphasised in terms of what is required to improve labour market outcomes for individuals. However, firms need to want to use this qualified labour. At the moment there is still a demand from firms for labour in too many low-skill jobs.[3] Thus, the availability of good jobs and progression routes to those jobs is needed to provide an incentive for individuals to learn. Creating circumstances where firms have an incentive to offer such jobs is challenging, when the low-wage, low-skill route may be currently working for firms and generating short-run profits. For example, increasing the minimum wage, making labour representation within workplaces easier to achieve, and promoting labour resource management and partnership techniques, would all help to level the playing field between those firms already following such a route, and those that seek to gain a competitive advantage via low labour costs. A regional approach to this would be beneficial for a number of reasons. First, it would reduce competition between local firms, so they would be working together to find solutions. In addition, they could react together to local labour shortages, and design training programmes that are needed to solve such shortages and provide the local skills needed. Finally, fixed costs of training and development, which might otherwise prevent the involvement of small firms, can be shared through a more collective approach. Whether such policies, which may benefit individuals through the provision of better jobs, are in the interests of the economy overall, taking into account short-term and long-term impacts on firms as well, is something to be researched and decided.

The final issue is what we still need to learn. As made clear at numerous points above, a key gap in the literature is studying job mobility and career progression, with a particular focus on progression from entry level to intermediate level, and how this has been affected by job polarisation. The requirement for such research is clearly longitudinal data, so that individuals can be followed over a significant period of time. The birth cohort data sets exist, though the evidence they produce is limited in the sense that each data set relates only to one particular cohort, who undertook their education and formative stages of their careers some time ago now, so that any results may not be generalisable to recent cohorts of young people. An alternative would be the New Earnings Survey/Annual Survey of Hours and Earnings panel, which has followed individuals of all ages over a long period of time. The key limitation of this data set is that it does not contain information on qualifications, which as we have seen above may have a key role to play in job mobility and progression. A final possibility is using a repeated cross-sectional data set such as the Labour Force Survey, and creating pseudo cohorts to track over time, whereby a sample

[3] There is also an argument to be made that the number of low-level jobs is driven by supply, rather than demand. The supply of labour to low-level jobs has been increased by welfare reforms, forcing more people off benefits and into work, as well as by the supply of labour replaced from intermediate-level jobs. Under this argument, reducing the supply of labour to low-skill jobs would reduce the number of such jobs being offered. Separating supply and demand effects is always difficult, and more work could be done here, though flat or falling wages at the bottom end, together with rising employment, would suggest supply effects rather than demand.

who are representative of each cohort are observed each year, though the individuals in that sample vary from year to year.

The other research area that would be useful would be to investigate which jobs are employing intermediate skilled workers, and how these jobs are changing over time. We know from the job polarisation literature that previously middle-level jobs have lost employment share, but we also know from the wage polarisation studies that wage growth remains strong in intermediate jobs, and that there are similar numbers of intermediate jobs now as 25 years ago, just different jobs. So what are these jobs and what prospects do they offer? Answering this will inform policy on skills development, as well as on firms' progression policies.

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