Productivity in the UK's low-wage industries

John Forth and Ana Rincon Aznar

This report assesses the productivity performance of low-wage sectors such as retail, social care and food processing and looks at international comparisons.

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Productivity in the UK's low-wage industries: a comparative cross-country analysis

John Forth and Ana Rincon Aznar

The UK's current productivity performance is weak – both by international standards and when compared with the period before the financial crisis (2007–2008). How do low-wage sectors perform within this overall picture? This report assesses the productivity performance of sectors such as retail, social care, and food processing in the UK against the performance of the same sectors in other countries. It also seeks to account for any cross-country productivity gaps by examining international differences in capital intensity and labour quality.

What you need to know

- The UK performs relatively strongly in some low-wage sectors, such as textile and clothing manufacture, and retail. The UK's productivity performance is relatively weak, however, in sectors such as agriculture, and arts, entertainment and recreation.
- Productivity weakness in the UK's low-wage sectors is typically attributable to differences in total factor productivity, followed by differences in labour quality. Differences in capital intensity tend to play a relatively minor role.
- Overall, sectors with a higher incidence of low pay tend to perform slightly better in international comparison than higher-paid sectors. However, there is a great deal of variety depending on the sector and comparator country.

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JRF is working with governments, businesses, communities, charities and individuals to solve UK poverty. *Productivity in the UK's low-wage industries: a comparative cross-country analysis* plays an important part in creating credible solutions so that more people find a route out of poverty through work – a key focus of our strategy to solve UK poverty.

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Contents

List of figures

List of tables

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Executive summary

Background and research objectives

This report compares the productivity performance of the UK's low-wage sectors, such as retail; social care; and food processing, with other countries in the EU and with the US. Productivity growth in some of the UK's low-wage sectors has been weak in recent years (Riley et al, 2015) and it has been suggested that the UK's 'productivity problem' is comparatively large in these sectors (Thomson et al, 2016). Nevertheless, there is no up-to-date, comprehensive analysis of the productivity performance of the UK's low-wage sectors.

The research had three objectives:

- to compare the *level* of labour productivity in the UK's low-wage sectors with the level of productivity in the equivalent sectors in other major economies
- to compare sectoral rates of *labour productivity growth* between the UK and other major economies over recent years
- to account for the cross-country productivity gaps by examining international differences in capital intensity, labour quality and total factor productivity (TFP).

The analysis uses data from the EUKLEMS database (Jäger, 2017; O'Mahony and Timmer, 2009) which provides sectoral productivity and growth accounts for a range of major economies over several years (see www.euklems.net). The analysis focuses on the 10 lowest-paid sectors in the UK, which all have at least one quarter of their employees earning less than two-thirds of the UK median wage. These sectors collectively account for 23% of the UK's total value-added and 38% of the UK's total hours worked. The productivity performance of these low-wage sectors in the UK is compared with that of the equivalent sectors in 10 other major economies, including France, Germany and the United States. The causes of any gaps are explored by focusing on the main drivers of increased productivity, such as physical capital, human capital, innovation, competition and market flexibility.

International comparisons of levels of productivity in low-wage industries

The UK performs relatively strongly in some low-wage sectors, such as textile and clothing manufacture, sale and repair of motor vehicles, and other service activities (which includes activities such as dry cleaning and hairdressing). The UK's performance is relatively weak, however, in low-wage sectors such as agriculture, forestry and fishing; administrative and business support services (which includes activities such as security, cleaning and call centres); residential care and social work; and arts, entertainment and recreation. In the remaining three low-wage sectors (food processing; retail and accommodation; and food service), the UK sits broadly in the middle of our comparator countries.

Overall, there is a relatively weak relationship between the extent of low pay in a sector and the sector's relative productivity performance: the UK's productivity problem is certainly not concentrated in low-wage sectors. However, if productivity levels in the low-wage part of the UK economy could be raised to match those found in other countries, it would go some way towards closing the overall productivity gap between the UK and some of its major competitors.

Our comparisons of productivity levels focused on levels of value-added per hour worked at industry level in 2015, and use purchasing power parity (PPP) indices to adjust for cross-country differences in price levels within each industry.

Production inputs and their contributions to relative productivity at industry level

To understand why UK productivity may lag behind other countries, the report provides comparisons of capital intensity, labour quality and TFP at industry level.

The estimates of relative capital intensity suggest that the UK performs rather poorly in food processing and textile and clothing manufacture, while the estimates of relative labour quality indicate particular weaknesses in food processing (again), sale and repair of motor vehicles, and accommodation and food services. The breakdowns suggest that the UK has relatively low levels of TFP in accommodation and food service, and arts, recreation and leisure.

The contributions of relative capital intensity, labour quality and TFP to the overall productivity gap vary considerably by low-wage sector and country. However, UK productivity performance weakness relative to the US, France or Germany is attributable primarily to differences in TFP, followed by differences in labour quality, with differences in capital intensity playing a more minor role.

The estimates of relative capital intensity and labour quality used are based on PPP-adjusted measures of the value of capital and labour inputs which have been updated from 1997 benchmark estimates provided by Inklaar and Timmer (2008). These are used to break down relative productivity levels in 2015 into the contributions from capital intensity and labour quality, with what is left taken as a measure of relative TFP.

International comparisons of productivity growth in low-wage industries

To examine the extent to which productivity levels in the UK's low-wage sectors have been catching up with (or falling behind) those found in other economies, the report also compares rates of growth in labour productivity by sector over the period 2001–2015.

The estimates show that UK productivity growth has been relatively strong over this period in food processing; textile and clothing manufacture; and accommodation and food services, with growth in TFP having been key to the UK's good record in the first two of these sectors. However, UK productivity growth has been relatively weak in agriculture and in arts, entertainment and leisure, and relative weakness in TFP growth has been a major factor here.

During 2011–2015, productivity growth in the UK's low-wage sector as a whole has been relatively healthy, keeping pace with that of Germany and France and exceeding the rate of growth in the US. This indicates that, in low-wage sectors overall, the UK's relative productivity gaps with these countries have not been increasing. However, the UK will need to substantially raise its level of productivity growth if the gaps in productivity levels for the low-wage sector are to be narrowed to any appreciable extent soon

Exploring the correlates of relative TFP gaps at sectoral level

Productivity levels in the UK's low-wage sectors could be raised by further investments in physical and human capital. However, how to improve TFP is less obvious. For this reason, the report seeks to identify factors which may explain variation in TFP levels within each industry sector across countries. It does so by looking for statistical relationships between each country's relative sectoral position on several productivity drivers and that country's relative sectoral position in terms of levels of TFP.

The analysis finds that countries tend to have a TFP lead over the UK within a particular sector (or alternatively, have a smaller lag) in cases where they:

- engage a relatively higher share of employees in job-related training

- have a higher share of employees subject to management practices such as performance related pay or continuous improvement
- have a higher share of employees using ICT
- have a lower share of employees on temporary contracts

or

- have less restrictive product market regulations in upstream industries.

The positive associations with the use of performance related pay and the use of ICT, and the negative associations with the use of temporary contracts and the level of product market regulations, are particularly robust as they remain significant in a multivariate analysis. None of these relationships are particularly strong in our sample. However, they point towards a set of factors which may possibly serve as a focus for future efforts to bring about improvements in the UK's relative TFP performance in low-wage sectors.

1 Introduction

At a fundamental level, a nation's living standards are determined by three things: the share of the population in work (employment), the value of goods and services produced by these workers (productivity) and how the economic rewards from producing these goods and services are shared among the population (the income distribution). In recent times, the UK economy has fared very well on the first of these benchmarks, with the proportion of people aged 16–64 who are in work currently standing at 75%, its highest level for approximately 40 years (ONS, 2017a) and well above average for the EU15 (Eurostat, 2017a). The UK is doing less well on the second and third benchmarks, however. The level of labour productivity remains below its pre-crisis level and sits below that seen in many other major economies (ONS, 2017b), while the degree of income inequality, though falling, remains one of the highest in the OECD (ONS, 2017c; OECD, 2017).

This report focuses on the issue of productivity, with specific attention given to the performance of the UK's low-wage sectors, such as retail; social care; and food processing. It is apparent that productivity growth within the UK's low-wage sectors has been weak in recent years (Riley et al, 2015) and it has been suggested that the UK's 'productivity problem' is particularly large in these sectors when viewed in comparative perspective (Thomson et al, 2016). There has been no conclusive analysis of the reasons for this poor productivity performance, although various factors such as low rates of innovation and a relative lack of skills (especially management skills) have been highlighted (Thomson et al, 2016; Askenazy and Forth, 2016; Bloom et al, 2012). With these factors in mind, our new research sought to deepen our understanding of the productivity performance of low-wage sectors in the UK. In this report we:

- first, examine the *level* of labour productivity in the UK's low-wage sectors in 2015 and compare the productivity performance of these sectors with the equivalent sectors in other major economies; this analysis shows the extent to which the UK's low-wage sectors have 'labour productivity gaps' compared with other countries
- second, examine rates of *growth* in labour productivity by sector over the period 2001–2015; this analysis shows the extent to which productivity levels in the UK's low-wage sectors have been catching up with (or falling behind) those found in other economies, and may thus give a broad indication of the prospects for future convergence
- third, seek to account for the cross-country productivity gaps by examining international differences in capital intensity, labour quality and total factor productivity in each sector, and by quantifying the contribution of these differences to the sectoral gaps in labour productivity between the UK and other economies.

Our analysis takes place at the industry level. As such, it seeks to provide a high-level overview of the productivity performance of the UK's low-wage sectors, using broad measures of factor inputs. Nevertheless, through the set of domestic and international comparisons outlined above, we aim to arrive at a comprehensive understanding of the productivity performance of low-wage sectors in the UK which complements more detailed, sectoral studies of low-wage work (eg Gautie and Schmitt, 2010).

2 Theory and existing evidence

Overview

- Efforts to increase productivity have an important role to play in raising aggregate living standards.
- However, at the whole economy level, the UK performs relatively poorly in international comparisons of productivity levels. Productivity growth in the UK has also been stagnating in recent years.
- There are some indications that the UK's productivity performance may be particularly weak in some low-wage sectors. However, more comparative evidence is needed to pinpoint where the gaps are largest.
- Such evidence should also seek to understand the causes of these gaps by focusing on the main drivers of increased productivity, such as physical capital, human capital, innovation, competition and market flexibility.

The importance of raising productivity in low-wage sectors

At the outset, it is important to briefly discuss the relationship between productivity, employment and living standards, as this helps us to understand the importance of raising productivity in all sectors of the economy – including low-wage sectors.

From an economic point of view, a reasonable measure of living standards would be the value of all goods and services *consumed* per person. This level of consumption is ultimately bounded by the value of the goods and services that the economy produces, since it is only by creating value in production that the economy generates income that can be used to pay for the goods and services that its population wants to consume. It then follows that an increase in the level of productivity – the amount of output produced by each unit of labour input – provides opportunities for increased levels of consumption, and thus improved living standards.[1]

Labour productivity may increase through different routes. One route is to increase either the quantity or quality of capital (through capital investment, as new technological knowledge is often embodied in capital equipment). The second is to increase the quality of labour (mainly through upskilling), while the third is to increase the efficiency with which those inputs are combined – an increase in so-called 'total factor productivity' (for example, through better management and other innovative investments not incorporated in the factors of production).

Upskilling may take place via education or in-work training. This route to productivity growth is relatively uncontroversial for the individual worker, since an increase in their skill level should raise their marginal product, and this should be reflected in wage increases.[2] Individual workers may not always experience such positive outcomes from capital investment, however, as capital may, in some cases, be used to substitute for labour. Such 'technological displacement' (eg of retail check-out operators by self-service checkouts), arising from a fall in the price of capital relative to labour, can lead to unemployment in the short term. However, at the aggregate level, the standard expectation is that cheaper capital will reduce the price of goods and services, thus raising real incomes and stimulating demand for new goods and services, providing employment opportunities for displaced workers.

Productivity improvements which come about through technological change may thus lead to job losses in specific sectors. However, these changes need not necessarily lead to a net loss of jobs in the economy. If there are sufficiently large positive spillovers to other sectors – either through income effects or inter-industry demand linkages – then the net effect can be positive for employment in the economy as a whole.

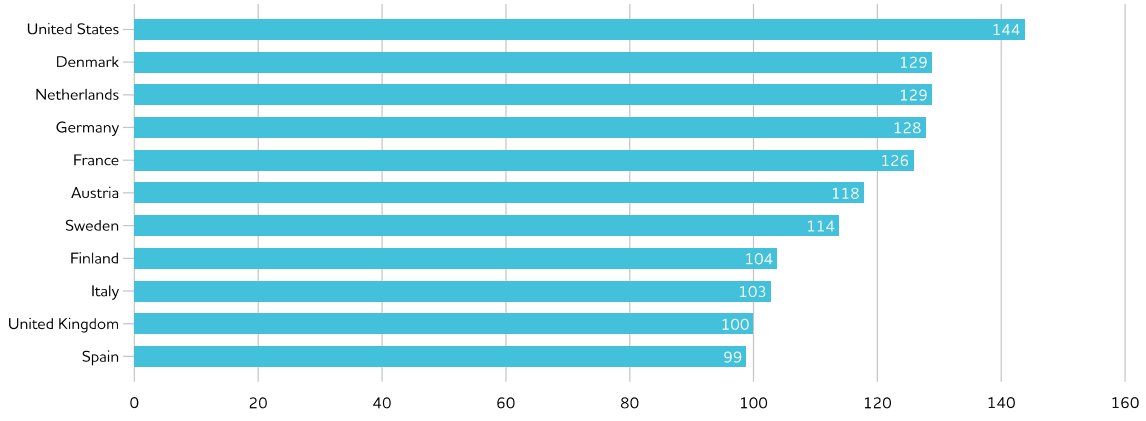
This is not to deny the suggestion that recent breakthroughs in artificial intelligence and robotics may have altered the dynamic, prompting a long-run decline in employment prospects (Brynjolfsson and McAfee, 2011). Indeed, recent work by Karabarbounis and Neiman (2014) has lent weight to this argument: reviewing an array of within- and cross-country evidence, they argue that the steep fall in the quality-adjusted equipment prices of information and communication technologies (ICT) relative to labour has prompted the recent reduction in labour's share of value added.[3] However, Autor and Salomons (2017) examine the relationship between productivity and employment at national and industry level over the past 35 years using the dataset we use in our later analyses (EUKLEMS). They find that, while employment has fallen within industries exhibiting strong productivity growth, the external (or spillover) effects of this productivity growth have been sufficient to generate modest gains in total employment at the aggregate level. Moreover, they find that productivity growth in services has generated larger positive spillovers than productivity growth in manufacturing. As service industries account for a disproportionate share of low pay, this suggests that boosting productivity in low-paying sectors – the focus of our report – could have particularly beneficial effects for overall employment growth. These combined effects can thus benefit overall living standards in the long run.

There remains considerable scope for heterogeneity. Autor and Salomons (2017) find that recent patterns of productivity growth have led to a re-allocation of employment away from intermediate-skill industries towards high- and low-skill industries, thus contributing indirectly to the polarisation of employment which has been a particular feature of the UK and US economies in recent years (see Goos et al, 2009, 2015; Eurofound, 2015). Consequently, the issue of income distribution remains a challenge under this broadly positive narrative. Our focus is on productivity, however, and below we consider how the UK has fared in this area in recent years.

International comparisons of UK productivity performance

Figure 1 shows comparative levels of value-added per hour worked for the UK and a range of other major economies in 2015. Values are for the whole economy and – as is standard in international comparisons of productivity – have been adjusted to account for international differences in price levels using estimates of purchasing power parity (PPP). The chart shows that the level of productivity for the UK is broadly on a par with that found in Spain or Italy. However, countries such as France and Germany generate around 30% more value-added per hour, while the US figure is over 40%. Official estimates (ONS, 2017c) focus on gross output rather than gross value-added. They show a very similar pattern, except that gap between the UK and US is notably smaller (around 30 percentage points) when productivity is measured using gross output.

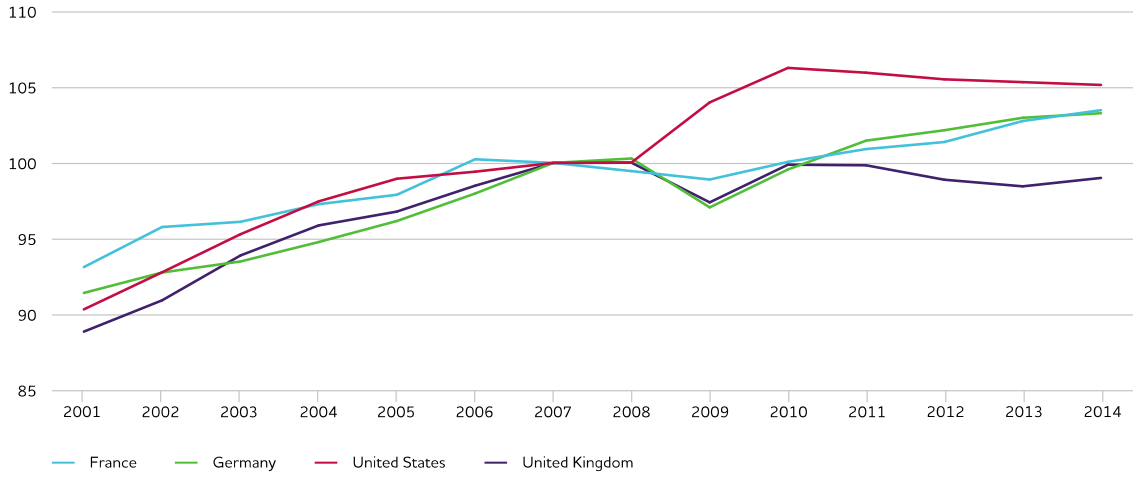
Figure 1: GVA per hour worked, adjusted for purchasing power parity, in selected major economies in 2015 (UK=100)



Source: EUKLEMS (gross value added; hours); OECD (purchasing power parities)

The UK's relatively poor productivity performance is longstanding, with data from Crafts (2012) and Broadberry and O'Mahony (2005) indicating that the United States' current productivity leadership over the UK dates back to the 1950s, and that productivity in Germany and France has exceeded that in the UK since the 1970s. However, the gap has not been constant over time (see Figure 2). UK productivity growth accelerated in relative terms during the 1990s and 2000s, aided by a rapid rate of growth in TFP (particularly in market services), ICT-capital deepening and increases in skill levels (see Van Reenen, 2013). The UK has fallen back since the mid-2000s, however, with its low rates of productivity growth since the financial crisis being termed the 'UK's productivity puzzle'. The major contributor to the UK's experience appears to have been a decline in TFP growth (see Goodridge et al, 2016). Capital shallowing (the fall in the capital-labour ratio) has also played a minor role, but changes in labour quality have contributed positively (Rincon-Aznar et al, 2015: 57–64). The implication is that productivity growth would have been even weaker in the UK in recent years had it not been for the continued upskilling of the workforce.

Figure 2: GVA per hour worked in selected major economies, 2001–2015 (2007=100)



Source: EUKLEMS

Existing evidence on the productivity performance of low-wage sectors

As one might expect, there is typically a positive association between productivity and wage levels at the industry level in the UK. This has been demonstrated empirically for the UK by Tuckett (2017), who shows a correlation of around 0.3 between output per worker and average wages in a panel of 24 industries over the period 2000–2016. It follows that low-wage industries such as retail, and accommodation and food services, are likely to be in the lower part of the productivity distribution.

As the incidence of low pay tends to be higher in the UK than in many other EU countries (Eurostat, 2017b), the issues of low wages and low productivity are often linked in public debate about the comparative UK's productivity performance. Thomson et al (2016: 12–13) provide some evidence to suggest that the productivity gap between the UK and other major EU economies may be particularly large in low-wage sectors. After combining output data for four broadly-defined low-wage sectors (agriculture, forestry and fishing; wholesale and retail; accommodation and food services; and administrative and support activities), they find that the UK is 20% less productive in these sectors than Germany and around 35% less productive than France. For the remaining (higher-wage) section of the economy the equivalent gaps are around 13% and 18% respectively. Thomson et al go on to show that the UK lags behind France in all four of their chosen low-wage sectors, and lags behind Germany in all

but one (accommodation and food services). However, their analysis does not take account of price differences across countries and does not look specifically at other prominent low-paying sectors such as food processing; textile and clothing manufacture; or social care.

Thomson et al survey a variety of possible reasons for the productivity gaps that they uncover but are unable to account for the differences in formal, quantitative terms. One of the few existing attempts to do so at a detailed sectoral level (Mason et al, 2008) finds that the UK's lag in productivity in low-wage sectors such as agriculture; retail; and accommodation and food services tends to stem from lower levels of capital intensity and TFP, rather than differences in labour quality. This accords to some extent with the findings of Dabla-Norris et al (2015: 15), who indicate that levels of TFP in the UK personal service sector sit towards the bottom of the distribution for advanced economies, whereas for higher-wage sectors such as finance and business services or telecommunications and electrical equipment, the UK's TFP levels tend to be well above average. Both sets of estimates pre-date the recent (2007–2008) financial crisis and so there is a clear need for more wide-ranging and up-to-date evidence.

Indeed, there is some suggestion that low-wage sectors may have improved their productivity performance relative to higher-wage sectors in recent years *within* the UK. McAfferty (2014: 13), for instance, shows that the largest declines in productivity between 2007 and 2010 were seen in relatively high-wage sectors such as finance, mining (particularly the oil sector), utilities and professional services.[4] Some low-wage sectors such as retail, and administrative and support services, actually posted small increases over the period. Data presented by the Low Pay Commission (2016: 26) shows that there can be considerable heterogeneity among low-wage sectors, however, with productivity in wholesale and retail having continued to rise over the period 2010–2016, while productivity in accommodation and food services has moved in the opposite direction.

Nevertheless, the most pertinent consideration for our purposes is whether these same sectors have performed differently in other major economies. In other words, are the UK's low-wage sectors catching up with those in other countries or falling further behind? The evidence is particularly sparse at a detailed industry level. Thomson et al (2016) present data on productivity growth in wholesale and retail, and accommodation and food services, over four decades. Looking at the period 2000–2009, one sees that productivity growth in UK wholesale and retail has been lower than that seen in Germany and the Netherlands, but broadly on a par with that seen in France. In the accommodation and food service sector, on the other hand, productivity growth in the UK has been slightly better than seen elsewhere, despite the recent dip mentioned above. Further analysis is needed to be able to fill out this picture for a broader range of sectors and countries.

What drives productivity?

To understand why the UK might lag behind other countries in terms of productivity – and how its low-wage sectors may be able to improve their productivity levels to those seen elsewhere – it is appropriate to consider the major drivers of productivity performance at industry level. The following discussion is organised under four broad headings: investment in physical capital; investment in human capital; innovation; competition and market flexibility.[5] Under each heading, we briefly summarise the links to productivity and review some of the evidence on how the UK's low-wage sectors perform on the various indicators.

At the outset, however, it is important to note that many low-wage industries form part of the service sector of the economy and the empirical evidence on the productivity performance of these sectors has historically been less extensive than for manufacturing. To some extent, this reflects greater challenges in the measurement of output, though the biggest challenges arguably pertain to industries outside the low- wage sector (eg finance, real estate and the public sector). Greater attention has been given to the productivity performance of service sectors in recent years (see, for example, O'Mahony, 2013) but specific discussion of low-wage services remains relatively limited, with greatest attention having been given to financial and business services and the measurement of government output.

Broadly speaking, there is an expectation of lower growth in service sectors than in manufacturing, because of the more limited scope for innovation and technical change (Baumol et al, 1985). However,

this argument applies more readily to personal and professional services than to the service sector as a whole. In retail, for example, the impact of investments in ICT have been profound.

Investment in physical capital

Businesses can raise productivity by investing in greater quantities of physical capital (e.g. machinery tools, equipment) – or by updating their physical capital to newer, more efficient models. In the restaurant sector, this might take the form of larger ovens or 'e-waiter' facilities; in the security sector it might take the form of electronic surveillance equipment. In either case, such investments would be expected to either raise output or reduce the level of labour input, thus raising the level of labour productivity.

Evidence on relative levels of capital intensity suggest that the UK's low-wage industries invest in less capital than is the case in some other European countries, but the pattern is not universal. For instance, Thomson et al (2016: 27) show that capital investment as a share of GVA is lower in the UK at a whole economy level than in Belgium, France, Germany and the Netherlands but, for the low-wage sector of the economy, a gap only exists with two of these countries (Germany and Belgium); capital investment in the UK's low-wage sector is broadly on a par with that seen in France and the Netherlands.

More detailed comparisons are generally lacking, but careful cross-country analysis of the retail sector suggests that greater investment in ICT in the US has played a substantial role in delivering superior rates of productivity growth than have been seen in the UK or Europe. Such investments have not only generated direct benefits (eg though better control of inventories), but have also brought indirect benefits by permitting innovation in retail formats and marketing (O'Mahony and Van Ark, 2007). Rates of capital investment may therefore explain the UK's low-wage productivity lag in some instances, but not others.

Investment in human capital

Higher levels of educational attainment and skills raise productivity directly by expanding an individual's economic capabilities – enabling them to accomplish more difficult tasks and to address more complex problems. But education and skills also raise productivity through indirect mechanisms – facilitating the diffusion of technology and making it easier for firms to absorb knowledge and ideas, which may enable a country to raise its average rate of productivity growth and catch up with the technological leaders

The sharp rise in the share of the UK population with graduate-level qualifications has been a notable feature of the UK economy in recent decades. International comparisons show that the supply of high-level skills is rising just as fast in many economies, though the graduate shares of employment in countries such as Germany or the Netherlands remain markedly smaller than in the UK or US (see Mason and Rincon-Aznar, 2015). In any case, it is arguably intermediate and lower-level skills that are more central to production and service delivery in low-wage sectors. The UK's position on intermediate skills may thus constitute a weak point, as the share of workers having such qualifications is low by international standards, and the UK's relative standing has dropped in recent times (UKCES, 2014). Cross-country evidence (Mason et al, 2014) has shown that the UK has the lowest share of upper secondary students engaged in vocational education and has only a modest proportion involved in apprenticeship or similar training programmes, compared with countries such as Denmark, Germany, France, the Netherlands and Sweden. Mason and Rincon-Aznar (2015) compare the mix of workforce qualifications in the UK with that in the US, France and Germany. They find that the UK's relatively large share of general education qualifications contrasts with the much greater emphasis on vocational education and training at these intermediate levels in both Germany and France. As in the UK, the emphasis in the US is on general skills development. While this is not necessarily a disadvantage in terms of economic performance, since general skills such as communication and mathematical skills are highly demanded by employers, this may be more applicable towards the upper end of the skills spectrum.

For low-wage sectors, Thomson et al (2016) show that the UK share of employees with secondary- or tertiary-level qualifications is lower than that found in the Netherlands, but above that found in France or Germany. Such indicators do not take account of skill usage, however, and so risk overstating the

contribution of labour quality to output if workers are not using their skills in full (so-called over-education). Wage-weighted labour quality indices are preferable in this respect. They show strong growth for the UK as a whole in the 2000s, including in service sectors. One consequence is that the UK has made up considerable ground on Germany; however, the UK appears to be doing little more than keeping pace with other major EU economies (see Kang et al, 2012).

Such indices typically focus on qualifications from general education, but investments in human capital can also arise through in-work training. A relatively high share of UK employees receive workplace training, but such training is often of shorter duration than in other EU countries, and so the UK tends to sit below other countries in terms of total hours of training – both for low-wage sectors and more generally (see Thomson et al, 2016: 30). Nevertheless, training investments as a share of GDP are relatively high in the UK (Kang et al, 2012), and this remains the case for both manufacturing and services, although more detailed sectoral estimates are lacking.

In recent years, debates around the UK's relative position in terms of skills has focused particularly on management skills. The quality of management skills is shown to be strongly linked to productivity in manufacturing, and international comparisons show that countries such as the US and Germany have a clear lead over the UK in terms of best practice in this sector (Bloom et al, 2012). There is no comprehensive information on the comparative level of management skills in low-wage sectors. However, a number of studies suggest that the UK lag in this area extends to the retail sector at the very least. In a comparative study of Britain and France, for example, Askenazy and Forth (2016) show that British retail workplaces tend to have less extensive use of productivity-enhancing practices such as team working and performance related pay, while Bloom et al (2012) show that US retail stores have substantially higher management scores than their UK counterparts. Management skills may thus be a particular weak point for the UK.

Innovation

The principal routes through which innovation can raise productivity are either through the development of new or improved products or services (product innovation), or through improvements in the processes that are used to create or deliver those products or services (process innovation). Such innovations may be the product of specific research and development (R&D) activities or – as is more typical in service sectors – they may come about through the acquisition of knowledge from outside the firm. Increased use of ICT plays a potentially significant role, as discussed above in relation to the retail sector.

The extent of product and process innovation tends to be lower in the service sectors than in manufacturing, and lower in sectors such as retail, and accommodation and food service, than it is in higher-value services such as finance and business services (Hooker and Achur, 2016). Looking across countries, it is difficult to determine the UK's position for low-wage sectors, as only a handful of other EU countries collect innovation statistics for a wide range of service industries. Denmark and the Netherlands are two such countries, however, and the UK typically matches or leads both countries in the share of 'innovative enterprises' across various low-wage sectors, including food processing; wholesale and retail; accommodation and food service; and administrative and support services (Eurostat, 2017c). Rates of innovation are thus not obviously an issue for the UK, although evidence is sparse.

Competition and market flexibility

Competition acts as a driver for productivity growth by creating incentives to innovate and by encouraging firms to seek efficiencies in production or service delivery. When more efficient firms grow faster than less efficient ones – or when more efficient entrants replace those less efficient – this also drives productivity growth by moving the industry or economy towards a more efficient allocation of resources.[6]

There is often a focus on the regulatory environment, since poorly regulated markets can make it more difficult for consumers to switch to more efficient producers (eg by restricting entry) or reduce the incentives to innovate (eg by allowing collusion over prices) (for evidence of the negative effects on productivity, see Nicoletti and Scarpetta, 2003). The UK does not obviously lag behind other countries in

terms of its regulatory environment. The rate of business start-ups is relatively high when compared with other EU sectors, both for the economy as a whole and also when one focuses in on low-wage sectors (Thomson et al, 2016: 25). The UK also typically appears towards the bottom of the distribution on economy-wide indicators of the level of product market regulation, alongside countries such as the Netherlands and the United States, and somewhat below other EU countries such as Germany, France, Italy and Sweden (Koske et al, 2015). One caveat, however, is that such regulatory indicators tend to focus on a specific range of sectors (utilities, transport and communications, professional services and retail). Retail is the only low-wage sector among these and, on this sub-indicator, the UK tends to be higher up – somewhere towards the middle (Koske et al, 26).[7]

A second caveat is that basic indicators of product market regulation consider only the first-order effects on the industries concerned, but empirical evidence is emerging of second-order effects when the output of industries such as energy and transport serves as the input for other businesses across the economy (see Bourlès et al, 2013). This inter-connectedness can be measured through indicators that link product market regulations with input-output data. Since the UK ranks among the least restrictive countries in terms of many of the first-order effects – and arguably because retail has fewer knock-on effects than other industries – the UK also rates favourably on these more sophisticated indicators of competitiveness (see Égert and Wanner, 2016). Product market regulation would therefore not appear to be a major concern for the UK and, indeed, compared with other countries, the UK ranks high in allocative efficiency (the extent to which resources are put to best use). Evidence at company level for the UK suggests that allocative efficiency in the UK market sector was the same or higher, after the financial crisis than before (Riley and Rosazza Bondibene, 2016), while an increase in allocative efficiency after the financial crisis was seen in many sectors of the UK economy.

Indicators of regulation such as those discussed above recognise the importance of flexibility in a broad set of input markets, but do not typically extend to labour markets. The standard expectation is that labour market regulations which constrain hiring and firing (so-called employment protection legislation or EPL) generally serve to lower productivity (for evidence, see Bassanini et al, 2009; Siebert and Rincon-Aznar, 2012). The UK again sits towards the bottom of the international distribution on such measures. However, there is also a recognition that high levels of job insecurity can also be counter-productive, and the relationship between labour market flexibility and economic performance may take the form of an inverted-U (for one exposition of the conceptual argument, see Streeck, 1987). Empirical evidence of the potential negative effects is provided by Roth (2013), and also by Zhou et al (2011) who show that firms with high shares of workers on temporary contracts are less innovative.

Minimum wages are one form of labour market regulation that are particularly pertinent for low-wage sectors, and recent evidence suggests that increased constraints can be beneficial for productivity at the margin (Riley and Rosazza-Bondibene, 2015; Rizov et al, 2016). Over the period 2010–2015, increases in the UK minimum wage were not exceptional compared with other EU economies such as France and the Netherlands, but more recently (2016–17) the UK minimum wage has risen at a faster rate (Eurofound, 2017a) and, indeed, the government has said that future increases in the minimum wage in the UK are part of a strategy to move away from a low-wage, low-productivity economy (DBIS, 2015).

Summary

The evidence presented in this chapter indicates that the UK lags behind a number of other major economies in terms of productivity levels. Previous research suggests that this broad picture of under-performance may be particularly acute in low-wage industries such as agriculture; wholesale and retail; and accommodation and food services. However, more detailed information is needed to: pinpoint the sectors in which the gaps are largest; understand the reasons for these gaps; understand whether (and why) they may be either shrinking or growing over time. Our research aims to provide evidence on each of these issues so that the UK's productivity problem in low-wage industries may be better understood and the relevant policy initiatives developed to address it.

3 Research objectives and data sources

Overview

- The research presented in the remainder of this report has three objectives. To:
- compare the *level* of labour productivity in the UK's low-wage sectors with the level of productivity in the equivalent sectors in other major economies
- compare sectoral rates of *labour productivity growth* between the UK and other major economies over recent years
- account for the cross-country productivity gaps by examining international differences in capital intensity, labour quality and total factor productivity.
- The analysis uses data from the EUKLEMS database, which provides sectoral productivity and growth accounts for a range of major economies over several years.
- The analysis focuses on the 10 lowest-paid sectors in the UK, each of which have at least one-quarter of their employees earning less than two-thirds of the UK median wage. These sectors collectively account for 23% of the UK's total value-added and 38% of the UK's total hours worked.
- The productivity performance of these low-wage sectors in the UK is compared with that of the equivalent sectors in 10 other major economies, including France, Germany and the United States.

Research objectives

We build on the issues discussed in Chapter 2 to provide a comparative analysis of productivity with three broad strands.

- First, we examine the *level* of labour productivity in the UK's low-wage sectors in 2015 and compare the productivity performance of these sectors with that of the equivalent sectors in other major economies. This analysis shows – at a detailed level – the extent to which the UK's low-wage sectors have 'labour productivity gaps' compared with other countries.
- Second, we examine rates of *growth* in labour productivity by sector over the period 2001– 2015. This analysis shows the extent to which productivity levels in the UK's low-wage sectors have been catching up with (or falling behind) those found in other economies, and thus gives a broad indication of the prospects for future convergence.
- Third, we seek to account for the cross-country productivity gaps by examining international differences in capital intensity, labour quality and total factor productivity (TFP) within each sector, and by quantifying the contribution of these differences to the sectoral gaps in labour productivity between the UK and other economies. As part of this analysis, we also seek to identify some of the possible causes of the sectoral TFP differentials between the UK and other major economies.

In all of the analyses, we measure labour productivity in terms of value-added per hour worked.

Data sources

The data used on value-added and labour and capital inputs at a detailed sectoral level for the UK and other major economies came from the 2017 edition of the EUKLEMS database (see Jäger, 2017). This database provides productivity and growth accounts for 17 countries (including the UK) over the period 1995–2015 (with estimates extending as far back as 1970). We focus on data for the period 2001–2015, giving us insights into the productivity performance of low-paying industries both before and after the 2007/8 financial crisis. Data is provided for a total of 34 industry sectors – see Appendix A –

however we focus our analyses on 31 industries, omitting real estate, activities of households as employers and activities of extra-territorial organisations.[8]

Productivity data is also available from Eurostat to a greater level of sectoral disaggregation (around 60 sectors, many of which equate to two-digit (division) level of NACE Rev 2.[9] However, the Eurostat data has the disadvantage that it does not contain some of the variables that are critical to any 'productivity accounting' exercise and which are present in EUKLEMS, namely estimates of capital services (rather than capital stocks) and labour quality (rather than simply raw number of hours worked or number of workers in employment). In addition, the Eurostat data is only available for 2007–2015. We do use this data, however, to measure basic productivity levels in two low-paying sectors not separately identified within the EUKLEMS industry classification (see below).

Choice of low-wage sectors

To select a set of UK low-wage sectors to serve as the focus for the analysis, we define a low-paid worker as one whose gross hourly wages are less than two-thirds of the median wage for all employees in the economy – a definition of low pay which is standard in the literature (see Mason and Salverda, 2010; Grimshaw, 2011). We use microdata from the 2015 Quarterly Labour Force Survey (QLFS) (ONS and NISRA, 2017) to measure the share of low-paid workers in each EUKLEMS industry sector in the UK; the full results of this analysis are presented in Appendix A.[10] Overall, 21% of employees in the UK are paid less than two-thirds of the whole-economy median wage (equating to around £7.20 an hour in 2015). However, the estimates in Appendix A show that these employees are clustered in industry sectors. We take the lowest-paid sectors in the EUKLEMS industry classification to be those in which at least 25% of all employees are low paid. These sectors are shown in Table 1.

Table 1: Lowest-paid sectors in EUKLEMS

NACE Rev. 2	Description	% low paid
Section A	Agriculture, forestry and fishing	38%
Divisions 10–12	Food processing	29%
Divisions 13–15	Manufacture of textiles and clothing	31%
Division 45	Sale and repair of motor vehicles and motorcycles	25%
Division 47	Retail trade (except of motor vehicles and motorcycles)	46%
Section I	Accommodation and food service activities	59%
Section R	Arts, entertainment and recreation	30%
Section S	Other service activities[11]	33%

Source: Labour Force Survey 2015

Comparing the list in Table 1 with the set of low-paying sectors identified by the Low Pay Commission (2016: 222–223) shows that the vast majority of the sectors highlighted by the LPC are captured in the list indicated above. The notable omissions are employment agencies, security and cleaning (all part of NACE Rev. 2 section N: administrative and support service activities), and those parts of NACE Rev. 2 section Q which relate to social care (divisions 87 and 88) rather than health (division 86). Our analysis of the QLFS shows that 29% of employees in section N are low paid, compared with just 9% in section M, while 31% of employees in divisions 87–88 are low paid, compared with just 8% in division 86. While these pockets of low pay cannot be separately identified in EUKLEMS, they are identifiable in the more detailed sectoral data made available by Eurostat and the US Bureau of Economic Analysis (BEA). We thus use Eurostat and BEA data to map productivity levels in section N and divisions 87–88, although we have not used this further disaggregation in the remainder of the analysis.

Our definition of low-paying sectors differs from that used by Thomson et al (2016), who focus on those NACE Rev. 2 sections in which the average (median) employee earns less than 80% of the whole-economy median, using data from ASHE.[12] However, cross-referencing to published data from the 2015

ASHE data on median gross hourly wages (ONS, 2015), we can see that, by focusing on the sectors identified above, we do not exclude any NACE Rev. 2 section or division in which the median wage is less than 80% of the whole-economy median.

We therefore take an inclusive approach, which uses the sectoral disaggregation available in the EUKLEMS and Eurostat data to give a more detailed and specific analysis of low-paying sectors than has been provided before. In particular, we are able to include all of the five sectors (food processing, retail, hotel accommodation, cleaning and call centres) highlighted in the recent comparative project on low-wage work funded by the Russell Sage Foundation (Gautié and Schmitt, 2010), even if the more specific of these (notably call centres – NACE Rev. 2 Class 82.20) are necessarily subsumed within larger groups. Together, the 10 low-paid sectors that we identify account for 23% of UK gross value added and 38% of UK hours worked in 2015 (see Table 2).

Table 2: Lowest-paid sectors, showing share of value-added and employment in 2015

NACE Rev. 2	Description	% low paid	Share of gross value added	Share of hours worked
Section A	Agriculture, forestry and fishing	38%	0.7%	1.7%
Divisions 10-12	Food processing	29%	1.6%	1.5%
Divisions 13–15	Manufacture of textiles and clothing	31%	0.4%	0.4%
Division 45	Sale and repair of motor vehicles	25%	2.0%	2.1%
Division 47	Retail trade (except of motor vehicles and motorcycles)	46%	5.6%	8.4%
Section I	Accommodation and food service activities	59%	3.0%	5.7%
Section N	Administrative and support service activities	29%	4.8%	8.2%
Divisions 87–88	Residential care and social work without accommodation	31%	2.0%	4.9%
Section R	Arts, entertainment and recreation	30%	1.4%	2.4%
Section S	Other service activities	33%	2.1%	2.4%
TOTAL			23.4%	37.7%

Sources: EUKLEMS (2017 edition) and Eurostat (tables: Nama_10_a64 and Nama_10_a64_e)

Note: Those sectors shaded grey use value-added and employment data from Eurostat

Choice of countries

As noted above, the EUKLEMS data provides productivity and growth accounts for a total of 17 countries. We focus our attention on the US and the larger economies of the EU-15. In this group, EUKLEMS provides data for Austria, Germany, Denmark, Spain, Finland, France, Italy, the Netherlands and Sweden, as well as for the UK. Among the remaining five members of the EU-15, neither Ireland, Greece nor Portugal are covered within the EUKLEMS growth accounts, while Belgium and Luxembourg have substantial amounts of missing data and are excluded from our analysis on that basis. We do not include the four accession countries covered by EUKLEMS (Czech Republic, Latvia, Slovakia and Slovenia) as these are not common reference points for the UK economy and we anticipate that specific issues relating to their accession to the EU in 2004 may affect comparability; Latvia and Slovakia also have significant missing data.

Appendix B shows that EUKLEMS data is available for each of our 11 chosen countries for the year 2001 onwards. Eurostat and BEA data for sections M and N and divisions 86 and 87–88 are added into our dataset for 2015.

4 International comparisons of productivity levels in low-wage industries

Overview

- This chapter provides cross-country comparisons of levels of labour productivity (measured as value-added per hour worked) at industry level. Purchasing power parity (PPP) indices are used to adjust for cross-country differences in price levels within each industry.
- The UK is found to perform relatively strongly in some low-wage sectors, such as textile and clothing manufacture (NACE Rev. 2 divisions 13-15), sale and repair of motor vehicles (division 45) and other service activities (section S).
- The UK's performance is relatively weak, however, in low-wage sectors such as agriculture (section A), administrative and support services (section N), residential care and social work (divisions 87-88) and arts, entertainment and recreation (section R).
- Overall, the UK's lower-wage sectors perform slightly better in international comparisons than its higher-wage sectors, but it is apparent that the UK's productivity problem spreads across low and high-wage sectors alike.

Introduction

This chapter presents data on the *level* of labour productivity (value-added per hour worked) in the UK's low-wage sectors in 2015, and compares the productivity performance of these sectors with that of the equivalent sectors in other major economies. The analysis thus shows the extent to which the UK's low-wage sectors have labour productivity gaps compared with other countries. The analysis also takes a step back from the individual low-wage sectors to examine the broad relationship between the incidence of low pay and the UK's relative productivity performance at a sectoral level.

Methodology

In our analysis, for each sector, we derive country-specific measures of labour productivity (value-added per hour worked) and compare these to the level of labour productivity for that sector in the UK. Ideally, for cross-country comparisons, one has access to ratios of output as well as ratios of inputs between two (or more) countries. In practice (including our case), one typically has access only to data on the total value of outputs and inputs, rather than actual quantities. Even if these values are provided in a common currency, they still need to be adjusted for differences in relative prices between countries before they can reliably be used to make comparisons of productivity levels.

This correction can be made by using price level indices (PLIs). A PLI above 1 indicates that a good or service has a higher price in country *c* than in the reference country (in our case, the UK), whereas a PLI below 1 indicates that it has a lower price. In cases where two countries use different currencies, the PLI is multiplied by the exchange rate to give a purchasing power parity index (PPP). The resulting PPPs specify the ratio of the price for a good or service between the two countries in local currency units (effectively estimating the exchange rate that would equalise the purchasing power of the two currencies). Adjusting the value of outputs and inputs using such PPP indices thus enables us to obtain a more accurate estimate of outputs and inputs for the purposes of our productivity comparisons.

With such PPPs in hand, comparative productivity levels (measured in terms of value-added per hour worked) can be estimated as follows:

$$LP = \frac{\left(\frac{VA_{i,c}}{PPP_{i,c}}\right)/HEMP_{i,c}}{VA_{i,UK}/HEMP_{i,UK}}$$

where $VA_{i,c}$ is the nominal value of value-added in sector *i* in country *c* (measured in national currency units), $PPP_{i,c}$ is the purchasing power parity index for sectoral output in country *c* compared with the UK, and $HEMP_{i,c}$ is the total number of hours worked in the sector in country *c*.

The PPPs used in our analysis are provided by Eurostat (Olislager and Konijn, 2016) and are the same as those used by the ONS in its recent high-level comparison of industry productivity (ONS, 2017d). Unlike the country-level PPPs that are developed from the expenditure side of GDP and published by the OECD among others, these PPPs are calculated from the production side. This allows for the calculation of industry-specific PPPs, which are of particular value since relative price levels are found to differ considerably between sectors (ONS, 2017d; Inklaar and Timmer, 2008: 16–17). The Eurostat PPPs are based on price data for 2014 and are provided for around 60 separate industry sectors.[13] In cases where an EUKLEMS industry sector spans a number of sectors in the Eurostat PPP database, we derive a PPP for the combined sector as the weighted average of the PPPs for the individual industries, using weights equal to the share of value-added in each of the constituent industries. The implicit price level indices that underlay the PPPs for our 31 industry sectors are shown in Appendix C.

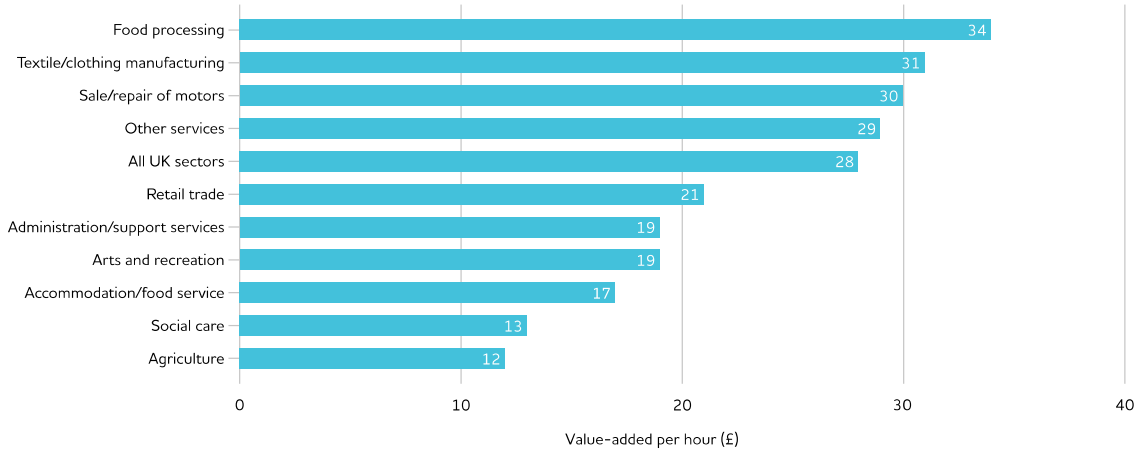
We compute values of relative productivity (LP) in each of our 10 chosen low-paying industries to show the UK's position, within that industry, relative to each of the 10 comparator countries in the sample. To obtain a broader indication of the UK's position in relation to the comparator countries, we then compute an aggregate measure of labour productivity for all low-paying industries by summing output and input values across all 10 industries (referring to this as labour productivity in 'the low-paying sector'). We repeat the process for the 'higher-paying sector' (obtained by summing across all 21 industries not classified as low-paying); we do this to assess whether any patterns relating to low-paying sectors are specific to that part of the economy or more generalised. Total economy estimates are derived in an equivalent way. It is reassuring to observe that, although the Eurostat PPPs allow for relative price differences across industries, whereas the OECD country-level PPPs do not, the two sets of PPPs provide a very similar picture of the UK's position relative to other countries when productivity estimates are computed for the economy as a whole.[14]

Finally in this section, one should note that there are some difficulties in measuring output (and thus productivity) in sectors where a substantial share of activity entails the provision of public services that are not traded on the open market. In the UK, almost half (48%) of the employees in social care (divisions 87–88) work in the public sector; the share is around one-third in arts, entertainment and recreation (34%) and other services (32%) (it is less than 10% in the remaining seven low-paid sectors). There may thus be some measurement error in the estimates for these sectors, though we take the published estimates at face value.

Results

At the outset, it is perhaps helpful to indicate the absolute levels of labour productivity within each of the 10 chosen low-wage sectors, and to compare these with the level of labour productivity in the UK economy as a whole. These estimates are provided in Figure 3, which shows that six of the 10 industries have levels of labour productivity which are substantially below the average for all sectors in the UK. Value-added per hour is particularly low in agriculture (NACE Rev. 2 section A); accommodation and food service (section I); and residential and social care (divisions 87–88). Only food processing (divisions 10-12) has a level of productivity that is appreciably above average for the UK.[15]

Figure 3: Value-added per hour in low-wage sectors in the UK, 2015



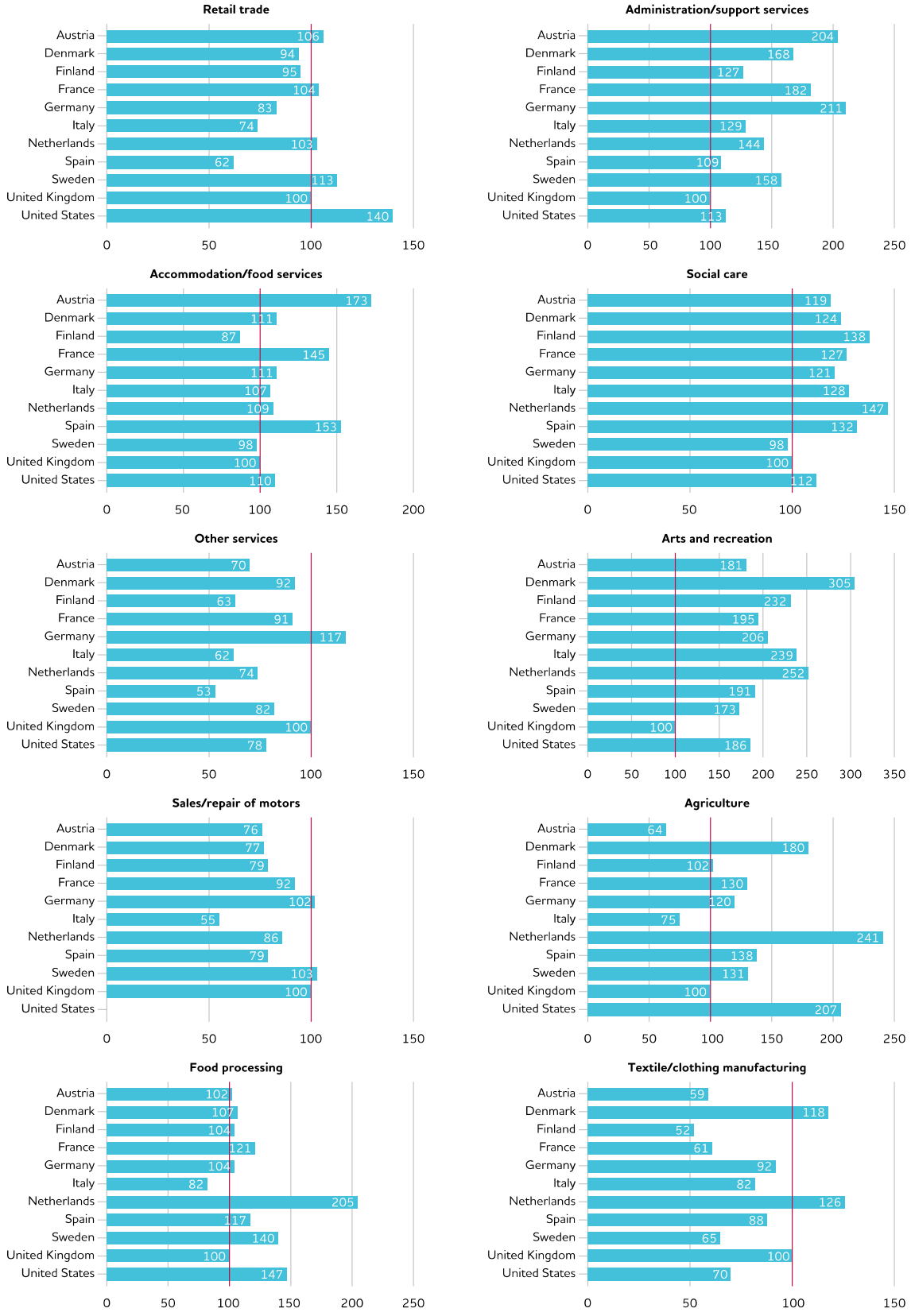
Source: EUKLEMS

The broadly positive relationship between productivity and wages at the industry level is replicated in all of the countries in our sample. As noted in *Choice of low-wage sectors* in Chapter 3, within the UK, the 10 low-wage sectors together account for 38% of total hours worked, but only 23% of total value-added. The shares of value-added and hours worked differ somewhat across the 10 other countries but the pattern is similar, with the combined low-wage sector accounting for a lower share of value-added than its labour inputs would suggest and the higher-wage sector accounting for a correspondingly higher share. This is not surprising, since wages ought to reflect workers' marginal product. Our prime interest, however, is not in the relative productivity of lower- and higher-wage sectors *within* each country, but in the relative productivity of these sectors when comparing *across* countries. In other words, do the UK's low-paying industries lag behind those in other countries to a greater extent than the UK's higher-paying industries?

Relative productivity levels for low-paying industries

Figure 4 shows how the level of labour productivity in each of the 10 low-wage sectors varies across the countries in our sample, after setting the UK as the reference point (UK=100). The underlying calculations use PPP-adjusted value-added, as discussed earlier in the chapter, and the sectors accounting for the largest numbers of hours worked in the UK (retail, administrative and support services etc) appear first.

Figure 4: Relative productivity levels in 2015 (UK=100), by low-paying industry



Source: EUKLEMS

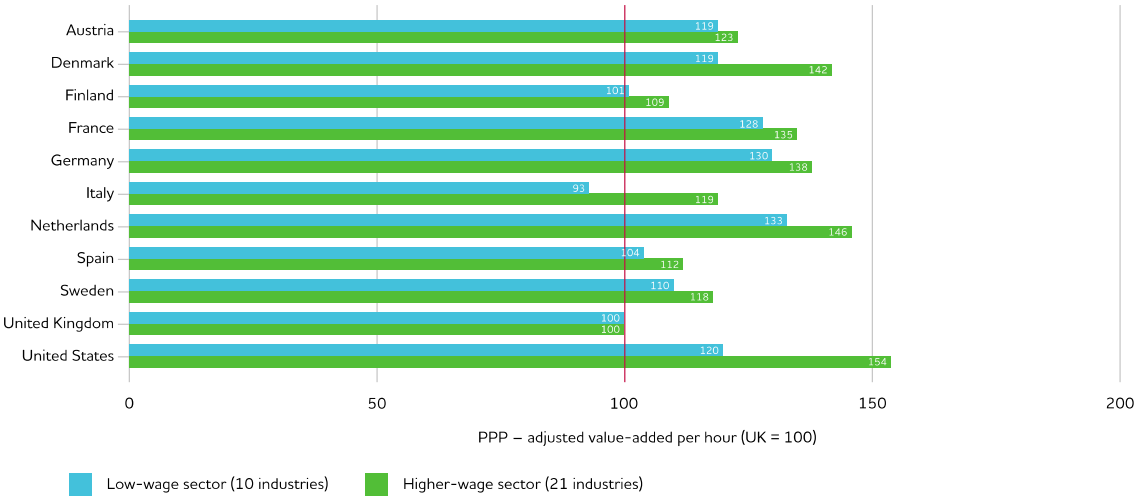
The charts show that, among these 10 sectors, the UK's relative position tends to be lowest in agriculture (NACE Rev. 2 section A); administrative and support services (section N); social care (divisions 87-88); and arts, entertainment and recreation (section R). The UK's productivity performance in arts, entertainment and recreation is particularly poor, although there are examples in other sectors where the UK lags substantially behind the productivity leader (eg agriculture with respect to the Netherlands and the US, though some of the differences in respect of agriculture are likely to originate from differences in natural resources). In contrast, the UK has a productivity lead over several countries in textile and clothing manufacture (divisions 13–15); sale and repair of motor vehicles (division 45); and other service activities (section S). Even in these sectors there are individual countries that outperform the UK (eg the Netherlands in textile and clothing manufacture and Germany in other service activities) but the UK is found to outperform several other countries in these specific industries.

A comparison of low-paying and higher-paying industries

Looking at the UK's performance with respect to specific countries, Figure 4 shows that the UK lags behind Germany in eight of the 10 low-wage sectors, behind France in seven of the 10 and behind the US in seven of the nine sectors for which the US is observed.[16] This suggests that broad country-level factors may be at work, affecting low-wage and higher-wage sectors alike.

To examine the extent to which the UK's relative productivity performance differs between low-wage and higher-wage sectors, we group the 10 low-wage sectors together and compare the UK's relative productivity performance for this aggregated sector (LW) with the combined performance of all higher-wage sectors (HW). The results are shown in Figure 5.

Figure 5: Relative labour productivity in 2015 (UK=100), by broad sector



Source: EUKLEMS

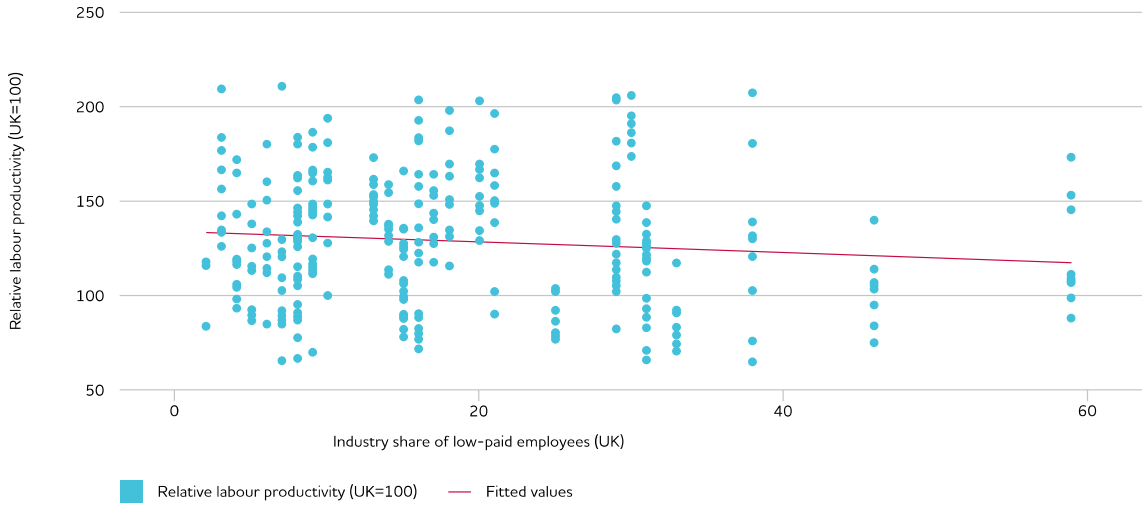
Focusing first on the low-wage sector, the figure shows that the overall level of productivity for the aggregate low-paying sector is around 30% higher in Germany, France and the Netherlands than it is in the UK, and around 20% higher in the US. The UK does not sit at the bottom of the rankings, however. Productivity in the UK's low-wage sector is on a par with Finland and Spain, and the aggregated sector has a small productivity lead over Italy.

Nevertheless, it is apparent from Figure 5 that, for each of the 10 countries against which the UK is compared, the UK's lag is smaller for the low-wage sector than it is for the higher-wage sector. The difference is relatively small in most cases (8 percentage points in the case of Germany and 7 percentage points in the case of France); it is largest in the case of the US, which has a particularly large productivity lead over the UK in the high-wage sector. Overall, however, the chart suggests that the UK's relative position is slightly better, on aggregate, among the low-wage sector of the economy than it is among the higher-wage sector.

This analysis presents a somewhat different picture to that provided by Thomson et al (2016), whose analysis indicated that the UK's relative productivity performance was worse in low-wage sectors than in high-wage sectors. However, Thomson et al's (2016) analysis did not take account of relative prices in the calculation of productivity levels and – more importantly – adopted a narrower definition of low-wage industries, including only sections A, G, I, N and R. The exclusion of section S seems particularly important, as it is a large sector in which the UK performs relatively well. If we adopt the same industry categorisation as Thomson et al, section S moves out of the low-paying sector, along with divisions 13–15, and this contributes to an apparent worsening of the relative position of low-paying and higher-paying industries. Under this narrower definition of low-wage industries, the UK lag is higher in low-wage industries than in high-wage industries for eight of the 10 countries; the exceptions are Spain and Italy, where the UK lag remains larger for the high-wage sector.

To examine the relationship between the extent of low pay and the productivity gap more fully, we turn to the full sample of 31 industries. With this industry-level sample, we can examine the correlation between the extent of low pay in each UK industry sector and the size of the productivity gap between that industry and its counterparts in other countries. Figure 6 shows the overall correlation using a scatterplot. Each point on the chart plots the extent of low pay in a given industry in the UK (x axis) against the productivity gap between the UK and a given comparator country for that industry (y axis). It is apparent from the fitted line that there is a weakly negative relationship overall: we obtain a correlation coefficient of -0.11 which is statistically significant at the 10% level.[17]

Figure 6: Scatterplot of relative productivity (UK=100) by share of low-paid employees (measured in UK), by industry sector



Source: EUKLEMS

In summary, we find that there is a weakly negative relationship between the extent of low pay in a UK industry sector and the size of the productivity gap between that industry and its counterparts in other countries. In other words, the UK's productivity lag at sector level tends to decrease slightly with the incidence of low pay. The relationship is not strong, however, and the broad conclusion is that the UK's productivity problem spreads across the industry pay distribution, rather than being concentrated within either low-paying or higher-paying industries.

The contribution of the low-paying sector to the overall productivity gap

To conclude the chapter, we return to our broader definition of low-wage sectors and compute the contribution made in aggregate by these 10 sectors to the overall productivity gap between the UK and other countries. This allows us to assess the extent to which the gap between the UK and a productivity

leader, such as the US, would be reduced if productivity levels in the UK's low-paying sector could be raised to the levels found in the comparator country. The results are shown in Table 3, focusing on those countries with the largest productivity advantage over the UK at the whole economy level.

Here we see, for example, that the comparatively low rate of productivity in the UK's low-paying sector when compared with the US accounts for just over one-tenth (12%) of the UK's overall productivity gap with the US. In other words, if the level of productivity in the UK's low paying sector could be raised to that found in the equivalent sector in the US (everything else being equal), then the overall UK–US productivity gap would be reduced from 46 percentage points to 40 percentage points. This gain is relatively small because the US's principal lead over the UK is in higher-paying sectors (see Figure 5). The larger proportionate gains come in the comparisons with the Netherlands, Germany and France. Raising the level of productivity in the UK's low paying sector to that found in the low-paying sector in France, for example, would reduce the UK-France productivity gap by almost one quarter (23%).

Table 3: Impact of equalising the level of productivity in the UK's low-paying sector to that found in comparator countries

	Total productivity gap before equalisation (ppts)[18]	Total productivity gap after equalisation (ppts)	Reduction (%)
US	+46	+40	12%
Netherlands	+41	+32	21%
Germany	+39	+31	21%
Denmark	+38	+33	14%
France	+32	+25	23%

Summary

The overall picture, then, is one in which the level of productivity in the UK's low-paying sector lags behind that found in the equivalent sector in a number of economies, including Germany, France, the Netherlands and the United States. In each of these economies, the low-wage sector outperforms the UK in productivity terms by between 20% and 30%, depending on the country. Looking within the low-paying sector, there are several specific industries where the lags are particularly large: arts, entertainment and recreation is particularly notable, but the UK lag is also relatively large in agriculture; administrative and support services; and social care. However, there are also some low-wage sectors where the UK is performing relatively well, including textile and clothing manufacture; sale and repair of motor vehicles; and other service activities.

In aggregate, there is a relatively weak relationship between the extent of low pay in a sector and its relative productivity performance: the UK's productivity problem is certainly not concentrated in low-wage sectors. However, if productivity levels in the low-wage part of the UK economy could be raised to match those found in other countries, this would go some way towards closing the overall productivity gap between the UK and some of its major competitors.

5 Production inputs and their contributions to relative productivity at industry level

Overview

- This chapter provides cross-country comparisons of capital intensity and labour quality at industry level. These comparisons are based on PPP-adjusted measures of the value of capital and labour inputs which have been updated for this project.
- The estimates suggest that the UK has relatively low levels of capital intensity in NACE food processing, and textile and clothing manufacture, while the UK has relatively low levels of labour quality in food processing (again), sale and repair of motor vehicles, and accommodation and food services.
- The comparative levels of these production inputs are then used to break down the relative labour productivity gaps shown in Chapter 4 into the parts that can be attributed to capital intensity, labour quality and a residual which is termed 'total factor productivity'. These breakdowns suggest that the UK has relatively low levels of TFP in accommodation and food services, and arts, entertainment and recreation.
- The contributions of relative capital intensity, labour quality and TFP to the overall productivity gap vary considerably by sector and country. However, when we focus on the UK's productivity performance relative to the US, France or Germany, we typically find that UK weakness is attributable primarily to differences in TFP, followed by differences in labour quality, with differences in capital intensity playing a more minor role.

Introduction

To understand why labour productivity in specific UK industries may lag behind that of other countries, we look at the relative levels of the two main inputs to production: capital and labour. Working on a per hour basis, we estimate relative levels of capital intensity and labour quality within each sector, again adjusting for relative price differences between countries.

We then employ the method of productivity levels accounting outlined by Inklaar and Timmer (2008) to estimate the extent to which these relative levels of capital intensity and labour quality can explain relative differences in levels of labour productivity at the sectoral level between the UK and our chosen comparator countries. That part of the productivity gap which cannot be attributed to differences in capital intensity or labour quality is termed total factor productivity, which is taken as an indicator of differences in the efficiency of the production processes between the two countries (though by virtue of being a residual, is effectively a measure of what is unexplained).[19]

Methodology

To ascertain the relative level of labour and capital inputs, one needs to measure the flow of productive services that is delivered to the production process, per hour, from each of the two types of input. On the labour side, one has the advantage that there is a market transaction which puts a valuation on the productive services provided by workers by setting a price (the wage).[20] When labour markets are broadly competitive, workers of higher productivity are rewarded with higher wages. Accordingly, comparative indices of labour quality can be constructed by taking a reference group of workers (say young men with low-level skills) and weighting the share of hours supplied by other types of worker by their wage relative to this reference group. A country in which a greater share of hours is supplied by higher-skilled workers, or in which the ratio of high-skilled to low-skilled wages is greater, will then have

a higher measure of relative labour quality per hour.[21] Since wages are only measured for employees, the labour inputs of self-employed workers are incorporated into the framework by assuming that the average hourly compensation of a self-employed worker equals that of a wage earner.

On the capital side, differences arise because producers usually own capital goods, and so one needs to value the implicit transaction that takes place when capital services are drawn from this capital stock during a period. This is done by estimating the user cost – the price that an owner would have to pay for the use of the asset. Under competitive conditions, it is assumed that user costs take the same value as the rent that the owner of a good would obtain from renting out the asset. These rental prices are, in turn, estimated using information on the return to capital, on how rapidly assets depreciate due to ageing, and on revaluation due to a change in the price of an asset of a given age. Heterogeneity in asset types is accommodated at the industry level by aggregating across different categories of asset, each of which has their own user cost.[22]

Once one has obtained measures of labour and capital services in each industry and country, relative measures of capital intensity and labour quality are derived in a similar way to relative levels of labour productivity (see Chapter 4): that is, after taking account of cross-country differences in prices. The index of labour services is thus derived using a PPP based on relative wages, while the index of capital services is derived using a PPP based on the relative price of capital services between the two countries. Specifically, the indicator of relative capital intensity for industry *i* in country *c* is derived as:

$$CAP\_QPH = \frac{\left(\frac{CAP_{i,c}}{PPP\_CAP_{i,c}}\right)/HEMP_{i,c}}{CAP_{i,UK}/HEMP_{i,UK}}$$

where *CAP* is a measure of capital services and *PPP_CAP* reflects the relative price of capital services in industry *i* in country *c* when compared with the UK.

Similarly, the indicator of relative labour quality is derived as:

$$LAB\_QPH = \frac{\left(\frac{LAB_{i,c}}{PPP\_LAB_{i,c}}\right)/HEMP_{i,c}}{LAB_{i,UK}/HEMP_{i,UK}}$$

where *LAB* is a measure of labour services and *PPP_LAB* reflects relative labour prices (wages) in industry *i* in country *c* when compared with the UK.

While the EUKLEMS database provides estimates of labour and capital compensation for 2015, which may proxy for estimates of labour and capital services, it does not provide accompanying PPPs for labour and capital services; nor are such PPPs available from Eurostat. However, measures of relative capital intensity (*CAP_QPH*) and relative labour quality (*LAB_QPH*) have previously been calculated by Inklaar and Timmer (2008) for each of our EUKLEMS industries in each of our 11 chosen countries for a benchmark year (1997). We thus take the industry and country-specific values of *CAP_QPH* and *LAB_QPH* computed by Inklaar and Timmer for this benchmark year and bring these up to date using the volume indices of labour services and capital services from the 2017 edition of EUKLEMS. These industry and country-specific volume indices measure the growth in the volume and quality of labour and capital services over time. Consequently, by uprating the value of *CAP_QPH* or *LAB_QPH* for each industry-by-country pair with the relevant volume index for that industry-by-country pair, we expect to arrive at up-to-date measures of relative capital intensity and labour quality that reflect the situation within each industry-by-country pair in 2015. The relative position of the UK within each industry can then be identified.[23]

Once we have estimates for *CAP_QPH* and *LAB_QPH* for a given industry, relative levels of labour productivity between two countries for that industry can be broken down as follows (Inklaar and Timmer, 2008: 12):

$$\ln LP = w_L \ln LAB\_QPH + w_K \ln CAP\_QPH + \ln TFP$$

where *LP* is as defined in *Methodology* in Chapter 4, w_L is the share of labour compensation in value-added averaged over the two countries, and w_K is the share of capital compensation in value-added averaged over the two countries. With this decomposition, we are then able to arrive at an industry-specific estimate for relative TFP between the two countries via subtraction.

It should be noted, however, that the breakdown relies on a variety of assumptions, including constant returns to scale, competitive markets and technical and allocative efficiency, alongside the assumption that the input measures outlined above adequately reflect differences in input quality between countries. (An important caveat in respect of input quality concerns the agriculture sector, since differences in natural resources between countries - such as land quality - are not captured within the measure of capital. Accordingly, any such differences will contribute to relative differences in TFP).

Some care should thus be used when interpreting the results. Nevertheless, the methodology is well rooted in neoclassical economic theory and has been used extensively to assess recent drivers of industry productivity differentials across countries (O'Mahony and Timmer, 2009). While there are alternative perspectives (eg Nelson and Winter, 1982), our view is that the approach serves to provide a broad mapping of the comparative performance of difference sectors.

Results

The following three sections present our estimates for relative capital intensity, relative labour quality and relative TFP, with the UK set as the reference country within each industry. We focus primarily on our chosen low-wage sectors. However, we also look beyond these sectors to examine whether the UK's relative position differs in higher-wage sectors of the economy.

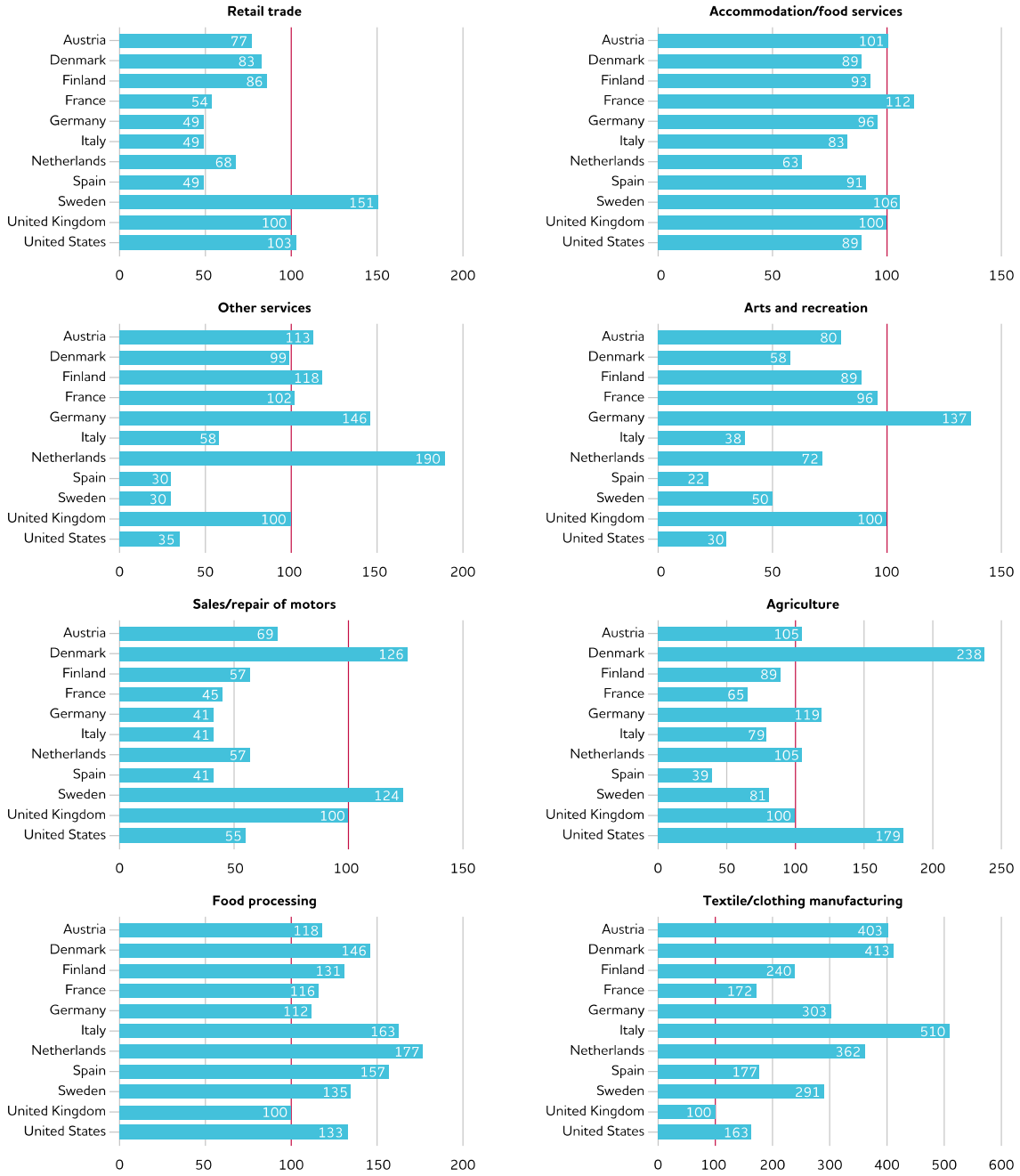
Data limitations (discussed in Chapter 3) mean that we are unable to calculate separate estimates for administrative and support services (NACE Rev. 2 section N) or social care (divisions 87–88). Our low-wage sector thus comprises eight industries, with sections M–N and section Q classified as higher paying. Estimates of relative capital intensity, labour quality and TFP at the whole economy level are provided for information in Appendix D.

Relative capital intensity

The estimates of relative capital intensity are presented in Figure 7, with those sectors that account for the largest numbers of hours worked in the UK again appearing first. The graphs suggest that the UK has relatively high levels of capital intensity in sale and repair of motor vehicles (NACE Rev. 2 division 45), retail trade (division 47) and arts, entertainment and leisure (section R). The UK is also broadly on a par with other countries in accommodation and food service (section I). However, the UK has relatively low levels of capital intensity in food processing (NACE Rev. 2 divisions 10–12) and textile and clothing manufacture (divisions 13–15.[24] The UK's performance in agriculture (section A) and other service activities (section S) varies considerably depending on the comparator country.

When we look more broadly at relative levels of capital intensity across our full sample of industries, we find the UK tends to perform better, in relative terms, in low-wage sectors than in higher-wage sectors. Across the eight low-wage sectors and all 10 comparator countries, the UK has an average (mean) lag of 18 percentage points, whereas across the 21 higher-wage sectors, it has an average lag of 69 percentage points. The overall correlation between the UK's relative capital intensity and the share of low-wage employees is -0.15, which is statistically significant at the 5% level. The UK's low-wage sectors could thus do better in terms of relative capital intensity, but the overall gap with other countries tends to be larger in higher-wage sectors.

Figure 7: Relative capital intensity per hour, 2015 (UK=100), by industry sector



Source: EUKLEMS

Relative labour quality

The corresponding estimates of relative labour quality are presented in Figure 8. These estimates suggest that the UK has relatively high levels of labour quality in agriculture (NACE Rev. 2 section A) and performs reasonably well in other service activities (section S). Elsewhere, however, the UK tends to perform less well. The UK tends not to be too distant from other countries in retail (division 47) and accommodation and food service (section I) and arts, entertainment and recreation (section R). However, notable gaps exist in textile and clothing manufacture (divisions 13–15) and sale and repair of motor vehicles (division 45).

The UK tends to sit broadly in the middle of our chosen set of countries in terms of relative labour quality at the whole economy level (see Appendix D), and so this raises the question of whether the UK's performance in terms of relative labour quality may be worse in low-wage sectors than in higher-wage

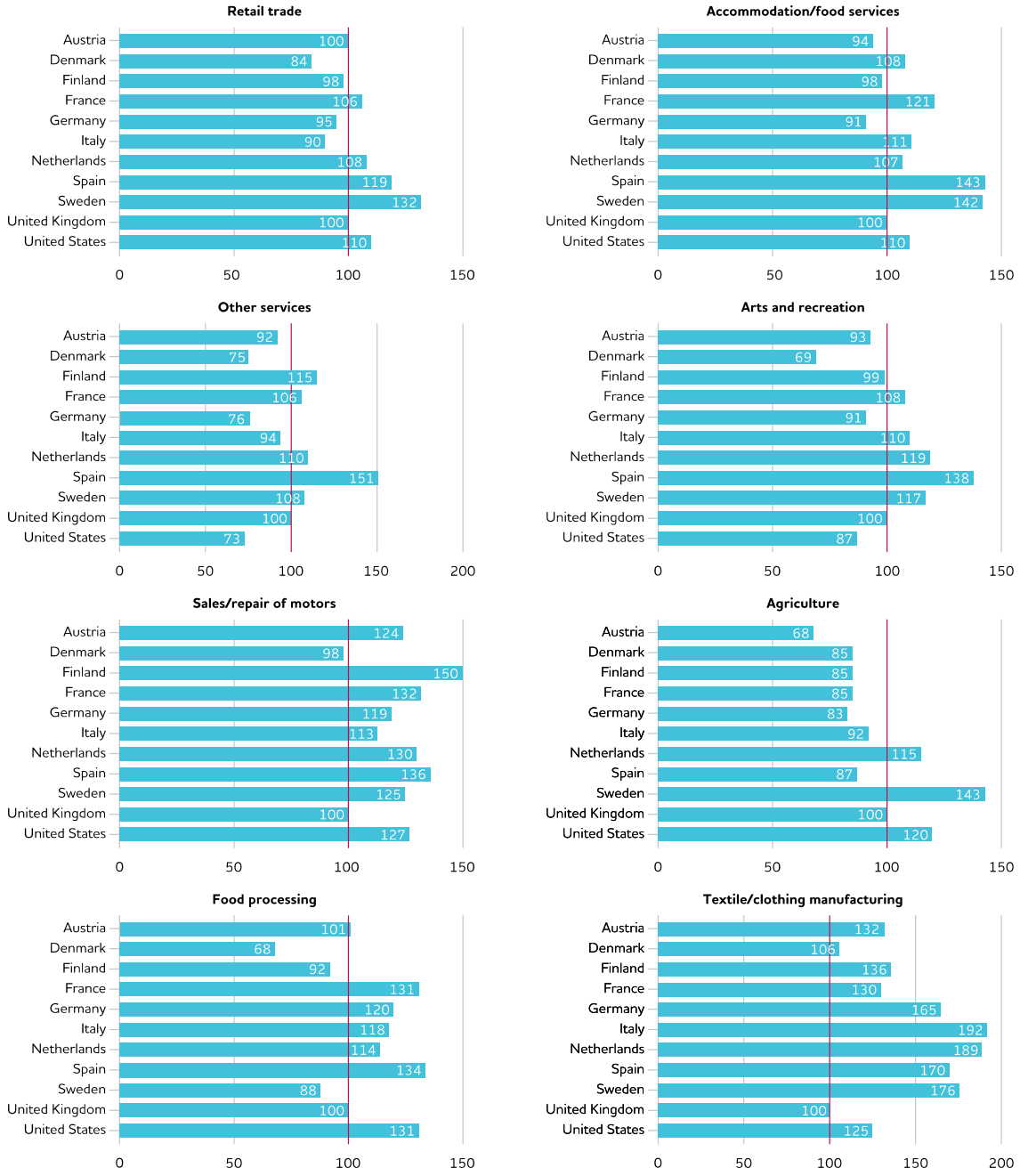
sectors. Our estimates point in this direction, but the differences are very small. Across the eight low-wage sectors and all 10 comparator countries, the UK has an average (mean) lag of 13 percentage points in relative labour quality, whereas across the 21 higher-wage sectors, it has an average lag of 11 percentage points.[25] The overall correlation between the UK's relative labour quality and the share of low-wage employees is almost zero (r=0.04; p=0.48). Again, therefore, the UK's low-wage sectors could do better in terms of relative labour quality. But they do not perform any worse, on average, than the UK's higher-wage sectors.

Relative levels of TFP

Having obtained relative measures of labour productivity, capital intensity and labour quality, we can now estimate relative TFP for each industry sector. These estimates are presented in Figure 9. They suggest that the UK has relatively low levels of TFP in accommodation and food service (NACE Rev. 2 Section I) and arts, entertainment and recreation (section R). Some countries have gaps in food processing (divisions 10-12), retail (division 47) and other service activities (section S), but the UK performs relatively well in textile and clothing manufacture (divisions 13–15) and sale and repair of motor vehicles (division 45).[26]

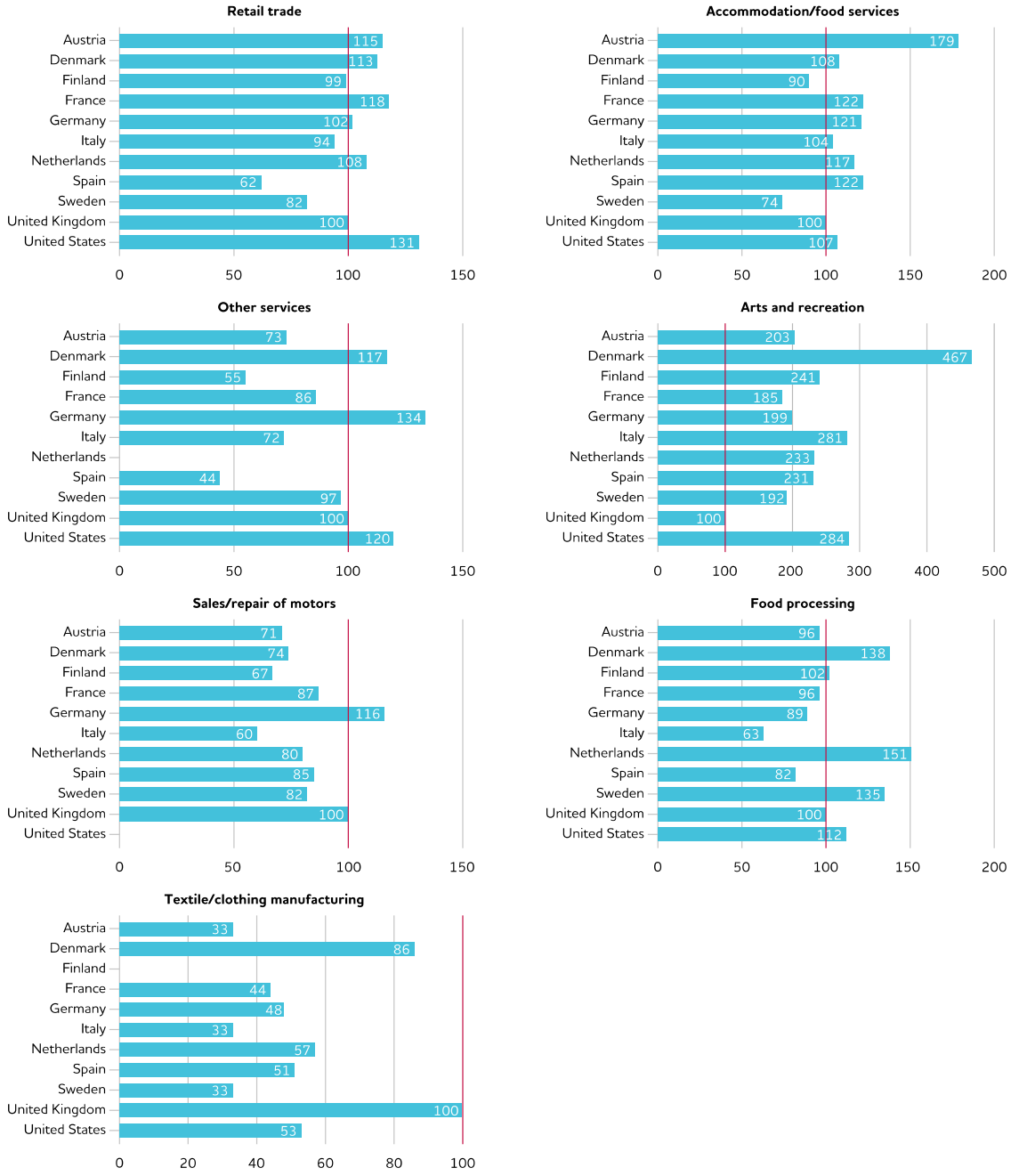
Across the eight low-wage sectors and all 10 comparator countries, the UK has an average (mean) lag of 15 percentage points in relative TFP, whereas across the 21 higher-wage sectors, it has an average lag of 23 percentage points, suggesting that the UK does slightly better in terms of relative TFP within lower-wage sectors. The overall correlation between the UK's relative labour quality and the share of low-wage employees is again close to zero however (r=-0.07; p=0.30). The overall indication is then similar to that for relative labour quality, with the UK's low-wage sectors able to do better compared with other countries in terms of relative TFP, but not performing any worse, on average, than the UK's higher-wage sectors.

Figure 8: Relative labour quality per hour, 2015 (UK=100), by industry sector



Source: EUKLEMS

Figure 9: Relative TFP, 2015 (UK=100), by industry sector



Source: EUKLEMS

Note: Agriculture is omitted because of missing data

Breaking down relative productivity levels

To show how the relative levels of capital intensity, labour quality and TFP contribute to make up the relative productivity gaps shown in Chapter 4,

Table 4 breaks down the gaps in productivity between the UK and its three largest competitors (France, Germany and the US) for each of the low-wage sectors (with the exception of agriculture – see above).[27]

The first row of the table shows, for example, that, in divisions 10–12 (food processing), the level of productivity in Germany exceeded that of UK by 4 percentage points (a relative productivity level of 104, with Ln(LP)=0.04). Labour quality in this sector in Germany exceeded that in the UK and, all other things equal, would have given Germany a productivity lead of 13 percentage points, to which a greater level of capital intensity would have added a further 3 percentage points. One can then infer that the UK had a relative TFP lead over Germany of 12 percentage points, bringing the overall lead for Germany back to 4 percentage points.

Looking down the table, it is clear that the contributions of relative capital intensity, labour quality and TFP to the overall productivity gap vary considerably by sector and country. However, looking across all the sectors, one typically finds that any UK weakness is attributable primarily to differences in TFP, followed by differences in labour quality, with differences in capital intensity playing a more minor role. Three industry-by-country comparisons serve to illustrate this general point.

- In division 47 (retail), the UK lags behind the US in terms of relative productivity by 40 percentage points (a gap of 34 log points). A very minor share of this overall gap (only 1 log point) is attributable to differences in capital intensity, with a larger share (6 log points) due to differences in labour quality. This leaves most of the gap (27 log points) unexplained, and thus attributable to relative levels of TFP.
- In section I (accommodation and food service), the UK lags behind France in terms of relative productivity by 45 percentage points (a gap of 37 log points). Again, a minor share of this overall gap (only 3 log points) is attributable to differences in capital intensity. A much larger share (15 log points) is due to differences in labour quality, leaving a similar share (20 log points) attributable to relative levels of TFP.
- In section S (other service activities), the UK lags behind Germany in terms of relative productivity by 17 percentage points (a gap of 16 log points). Capital intensity plays some role here, contributing 8 log points. However, the gap primarily arises because of higher levels of TFP in Germany. In this case, the productivity gap would be much larger if it were not for relatively high levels of labour quality in the UK.

Table 4: Break down of relative levels of labour productivity, 2015, by country (UK=100) and low-wage industry

Country	NACE Rev. 2	Relative productivity (UK=100)	Ln(LP)	*Contributions from (percentage points):*		
				Relative capital intensity	Relative labour quality	Relative TFP
Germany	10–12	104	0.04	0.03	0.13	-0.12
France	10–12	121	0.19	0.05	0.18	-0.04
US	10–12	147	0.39	0.12	0.15	0.11
Germany	13–15	92	-0.09	0.26	0.38	-0.73
France	13–15	61	-0.50	0.11	0.21	-0.82
US	13–15	70	-0.35	0.10	0.17	-0.63
Germany	45	102	0.02	-0.26	0.12	0.15
France	45	92	-0.09	-0.17	0.22	-0.14
US	45					
Germany	47	83	-0.18	-0.16	-0.04	0.02
France	47	104	0.03	-0.17	0.04	0.17
US	47	140	0.34	0.01	0.06	0.27
Germany	I	111	0.11	-0.01	-0.08	0.19
France	I	145	0.37	0.03	0.15	0.20
US	I	110	0.10	-0.04	0.07	0.07
Germany	R	206	0.72	0.10	-0.06	0.69
France	R	195	0.67	-0.01	0.06	0.62
US	R	186	0.62	-0.32	-0.10	1.04
Germany	S	117	0.16	0.08	-0.22	0.29
France	S	91	-0.10	0.00	0.05	-0.15
US	S	78	-0.24	-0.17	-0.26	0.19

Source: EUKLEMS

Summary

This chapter has provided cross-country comparisons of capital intensity, labour quality and TFP at industry level. The estimates of relative capital intensity and labour quality are based on PPP-adjusted measures of the value of capital and labour inputs which have been updated from benchmark estimates provided by Inklaar and Timmer (2008). These updated estimates have then been used to break down relative productivity levels in 2015 into the contributions from capital intensity and labour quality, leaving a residual which is taken as a measure of relative TFP.

The estimates of relative capital intensity suggest that the UK performs rather poorly in food processing (NACE Rev. 2 divisions 10–12) and textile and clothing manufacture (Divisions 13–15), while the estimates of relative labour quality indicate particular weaknesses in food processing (NACE Rev. 2 divisions 13–15), sale and repair of motor vehicles (division 45) and accommodation and food service (section I). The breakdowns suggest that the UK has relatively low levels of TFP in accommodation and food service, and arts, entertainment and recreation (section R).

The contributions of relative capital intensity, labour quality and TFP to the overall productivity gap vary considerably by sector and country. However, when we focus on the UK's productivity performance relative to the US, France or Germany, we typically find that UK weakness is attributable primarily to differences in TFP, followed by differences in labour quality, with differences in capital intensity playing a more minor role.

6 International comparisons of productivity growth in low-wage industries

Overview

- This chapter provides cross-country comparisons of rates of *growth* in labour productivity by sector over the period 2001–2015. This analysis shows the extent to which productivity levels in the UK's low-wage sectors have been catching up with (or falling behind) those found in other economies, and may thus give a broad indication of the prospects for future convergence.
- UK productivity growth has been relatively strong over this period in food processing; textile and clothing manufacture; and accommodation and food service. Growth in TFP has been key to the UK's good record in the first two of these sectors.
- UK productivity growth has been relatively weak in agriculture and arts, and entertainment and leisure, largely because TFP growth has been relatively weak in these sectors.
- In the most recent period (2011–2015), productivity growth in the UK's low-wage sector as a whole has been relatively healthy, keeping pace with that seen in Germany and France and exceeding the rate of growth seen in the US. This indicates that, in low-wage sectors, the UK's relative productivity gap with these countries has not been increasing recently. However, the UK will need to substantially raise its level of productivity growth if the gaps in productivity levels for the low-wage sector are to be closed in the future.

Introduction

Having examined the level of labour productivity in the UK's low-wage sectors in 2015 and compared the productivity performance of these sectors with the equivalent sectors in other major economies, the analysis now moves on to examine rates of growth in labour productivity by sector over the period 2001–2015. This analysis shows the extent to which productivity levels in the UK's low-wage sectors have been catching up with (or falling behind) those found in other economies, and may thus give a broad indication of the prospects for future convergence.

Methodology

Sectoral comparisons of relative rates of productivity growth between two countries proceed in a similar way to that outlined in respect of productivity levels in Chapters 4 and 5. Our comparisons of productivity growth rates thus focus on rates of growth in value-added per hour at sectoral level. We compute average annual growth rates at sector level, by country, for the period 2001–2015. We then divide the period into three parts, to give further insights into the UK's relative performance over this time. Specifically, we separate the period before the onset of the financial crisis (2001–2007) from the period of the crisis itself (2008–2010) and the period thereafter (2011–2015).

In computing the growth rate of value-added per hour, we use country and industry-specific output price deflators to adjust for price inflation within each country (to arrive at implicit volume indices for changes in output and inputs). Once sectoral rates of productivity growth have been computed, we then use a growth accounting framework (Jorgenson et al, 1987) to break down overall labour productivity growth into the contributions from: changes in capital intensity per hour, changes in labour quality and changes in total factor productivity. Again, as in Chapter 5, the measure of total factor productivity growth is calculated by subtracting the growth of the primary inputs (weighted by their respective shares in nominal

value-added) from the growth of value-added. For a single country, growth in value-added per person between *t1* and *t2* within industry *j* is thus broken down as follows:

$$ln\frac{V^{VA}_{cjt_2}}{H_{cjt_2}} - ln\frac{V^{VA}_{cjt_1}}{H_{cjt_1}} = w_L\left(ln\frac{V^{L}_{cjt_2}}{H_{cjt_2}} - ln\frac{V^{L}_{cjt_1}}{H_{cjt_1}}\right) + w_K\left(ln\frac{V^{K}_{cjt_2}}{H_{cjt_2}} - ln\frac{V^{K}_{cjt_1}}{H_{cj1}}\right) + \left(\ln TFP_{cjt_2} - \ln TFP_{cjt_1}\right)$$

where *V* indicates the use of implicit volume indices for value-added (VA), labour (L) and capital (K), *H* is total hours worked, and w_L is the share of labour compensation in value-added, averaged over *t1* and *t2* (and equivalently for w_k).

To compute the index of labour input (V^L) that feeds into the expression above, changes in the hours worked by various types of workers are weighted by their compensation rates, and as we assume that workers are paid their marginal productivities, skills with a higher remuneration will have a larger influence on the labour quality index (see M*ethodology* in Chapter 5). If the proportions of each labour type in the workforce change, this will have an impact on the growth of labour inputs, beyond any change in the number of hours or workers. A shift of hours worked by less qualified workers to more qualified workers, for example, will be reflected in a positive contribution of labour quality to growth.

To compute the index of capital (V^K), we use a capital services measure, for which the different stocks of capital assets are aggregated using a measure of their rental price as weights (again, see M*ethodology* in Chapter 5). Here, changes in the index of capital services over time will be affected by changes in the relative shares of different asset types and by changes in their rental prices.

Measures of the contributions from ICT assets and more traditional-type of assets (non-ICT assets) are computed separately within the EUKLEMS growth accounting framework and so, in this chapter, it is straightforward to identify the separate contributions of ICT and non-ICT capital to productivity growth (whereas, in Chapter 5, we relied upon a single term for capital which combined both asset types). Those wishing to compare across the two chapters can simply sum the contributions of ICT and non-ICT capital to obtain the total contribution from capital here.

One limitation when compared with the analysis in Chapter 5, however, is that growth accounts are not typically available for the sub-divisions of section G (wholesale and retail). Accordingly, we treat the whole of section G as low-paid.

Results

Taking all the sectors in our whole-economy sample together, labour productivity in the UK – measured as value-added per hour – grew at a rate of around 1 percentage point per year between 2001 and 2015.[28] Productivity growth was strong in the first half of the 2000s (1.05 percentage points per year, 2001–2007), but then went into reverse during the crisis (-0.21 percentage points per year, 2008–2010) before stabilising in subsequent years (0.54 ppts per year, 2011–2015). Overall, productivity in the UK grew at a similar rate to Austria, Germany and Denmark, and around one-third faster than France, but at only two-thirds the rate seen in Sweden. The UK's performance was weakened by relatively low rates of capital deepening in each period and a stagnation of TFP growth since the onset of the financial crisis.

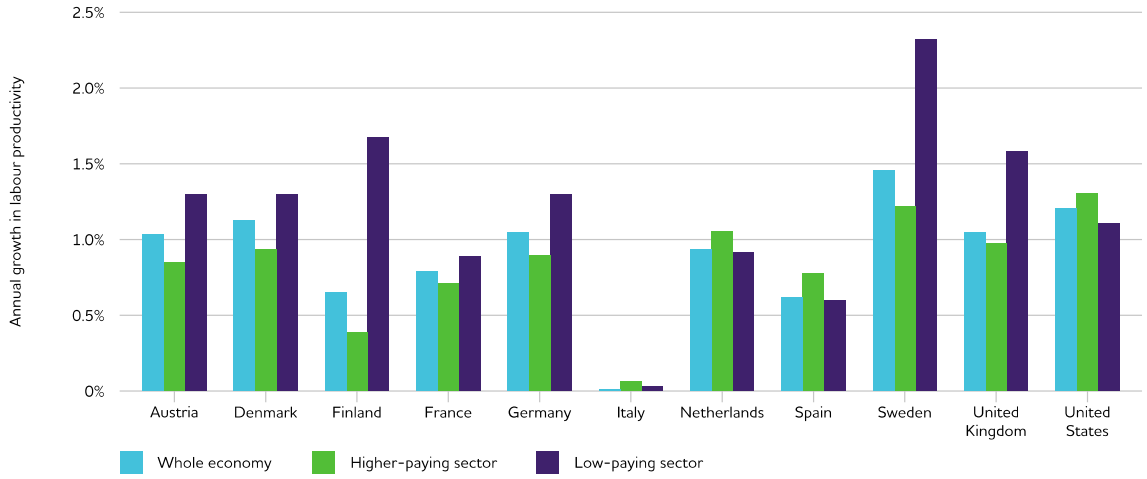
Figure 10 shows how this relative productivity performance differed for the low-paying sector. Comparing growth rates in the low-paying sector across countries, we see that productivity in the UK's low-paying sector grew faster than it did in most other countries over the period 2001–2015, including Germany, Denmark, France, the Netherlands and the US, though Sweden was the top performer. Productivity growth was not constant over this 15-year spell, however. The UK performed better than France and the US because its low-paid sector posted stronger growth both in the years before the financial crisis (2001–2007) and in the years after (2011–2015). It performed better than Germany because productivity growth fell less in the UK during the crisis years (see Figure 11).

The growth accounting methodology allows us to identify the contributions made to this growth in productivity by changes in capital intensity, labour quality and TFP. From Table 5 one can see that, in the

low-paying sector of the economy, the UK had a strong contribution from increases in capital intensity, whereas the contributions from labour quality and TFP growth were comparatively less remarkable. Capital deepening accounted for around half of the UK's average growth of 1.6 percentage points a year. Similar contributions from capital were seen in Sweden and the US, but the contributions were somewhat weaker in France and Germany. Interestingly, all four countries posted a stronger capital contribution than the UK in the higher-paying sector, adding to the perception that capital deepening was a relative strength for the UK's low-paying sector over this period (even though levels of capital intensity remain weak – see Chapter 5).

Returning to Figure 10, we see that productivity growth in the UK's low-paying sector was slightly faster over the whole period than in the higher-paying sector. In other words, the productivity gap between higher-paying and low-paying sectors *within* the UK closed a little between 2001 and 2015. The same occurred in several other countries, including Germany, Denmark, Finland and Sweden, though not in the Netherlands or the US. In the UK, this process of 'catching up' came about despite a deeper slowdown in low-paying sectors during the crisis years (2008–2010); before the crisis (2001–2007), productivity growth had been around one percentage point faster in the low-paying sector than in the higher-paying sector and this pattern was restored in the period 2011–2015. The causes were faster rates of capital deepening and faster growth in TFP, rather than improvements in labour quality (which made a greater contribution in the higher-paying sector).

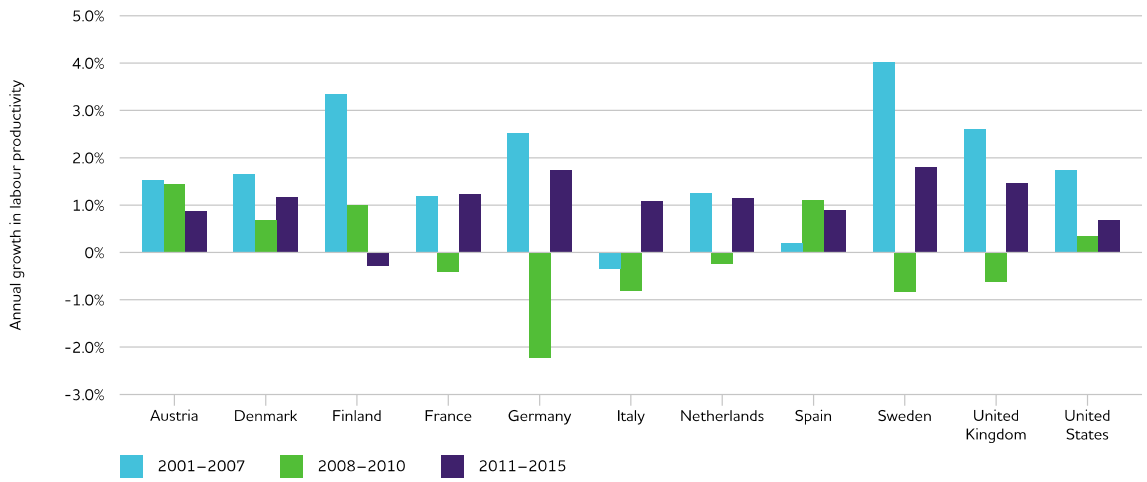
Figure 10: Annual growth in labour productivity, by sector, 2001–2015



Source: EUKLEMS

Note: Whole economy estimates exclude NACE Rev. 2 sections K, L, T and U.

Figure 11: Annual growth in labour productivity in the low-paying sector, by time period, 2001–2015



Source: EUKLEMS

Productivity growth within individual sectors

Naturally, one can expect heterogeneity within the low-paid sector. Average rates of productivity growth for the period 2001–2015 are shown for each of the eight low-paying industries in Figure 12.[29]
In summary, we find that:

- in agriculture (section A), productivity growth in the UK has been slower than in most other comparison countries over the past 15 years
- in food processing (divisions 10–12), productivity growth in the UK has been relatively healthy. In particular, productivity growth in this sector in the UK has been on an upward trend compared with countries such as Germany, France and the US
- in textile manufacture (divisions 13–15), productivity growth in the UK has again been relatively healthy. This adds to – and no doubt partly explains – the relatively favourable position of the UK in respect of productivity levels for this sector (see Figure 4)
- in wholesale and retail (section G), growth in the UK has been behind that of Germany, but above that of France, and broadly on a par with that seen in the US
- in accommodation and food service (section I), the flat productivity growth seen in the UK has broadly mirrored that seen in countries such as Germany, France and the US, but is favourable when compared with the substantial reversals seen in countries such as Spain, Italy, the Netherlands and Sweden
- in arts, entertainment and recreation (section R), the UK has seen declining productivity on a par with Germany and the Netherlands, with this group of countries falling behind France and (notably) the US.

Table 6 shows the UK's productivity performance in our low-paying industries compared with other countries, after splitting the period in two (2001–2007 and 2008–2015) and breaking down growth in each period into the part attributable to growth in labour quality, growth in capital intensity (with separate terms for ICT and non-ICT capital) and growth in TFP.

The UK's comparatively good record in food processing, and textile and clothing manufacture, appears to be down to improvements in TFP (efficiency). It's relatively poor record in agriculture appears to be due to superior growth in TFP in France, and in Germany in the early period, and greater levels of capital

deepening in the US, while its relatively poor record in arts, entertainment and recreation appears to be due to declines in TFP which have not been seen elsewhere.

Summary

This chapter has provided cross-country comparisons of rates of growth in labour productivity by sector over the period 2001–2015. This has shown the extent to which productivity levels in the UK's low-wage sectors have been catching up with (or falling behind) those found in other economies.
The estimates showed that UK productivity growth has been relatively strong over this period in food processing (NACE Rev. 2 divisions 10–12), textile and clothing manufacture (divisions 13–15) and accommodation and food service (section I), with growth in TFP having been key to the UK's good record in the first two of these three sectors. However, UK productivity growth has been relatively weak in agriculture (section A) and arts, entertainment and leisure (section R) and, here, relative weakness in TFP growth has been a major factor.

In the most recent period (2011–2015), productivity growth in the UK's low-wage sector as a whole has been relatively healthy, keeping pace with that seen in Germany and France and exceeding the rate of growth seen in the US. This indicates that, in low-wage sectors, the UK's relative productivity gaps with these countries have not been increasing of late. However, the UK will need to substantially raise its level of productivity growth if the gaps in productivity levels for the low-wage sector (seen in Chapter 4) are to be narrowed to any appreciable extent in the near future.

Table 5: Sources of labour productivity growth, by sector, 2001–2015

	Total economy				Higher-paying sector				Low-paying sector			
	Growth in LP (%)	Contributions due to:			Growth in LP (%)	Contributions due to:			Growth in LP (%)	Contributions due to:		
		Capital intensity	Labour quality	TFP		Capital intensity	Labour quality	TFP		Capital intensity	Labour quality	TFP
Austria	1.04	0.81	0.17	0.06	0.85	0.86	0.12	-0.13	1.30	0.61	0.29	0.40
Germany	1.05	0.57	0.15	0.33	0.90	0.62	0.14	0.14	1.30	0.46	0.19	0.66
Denmark	1.13	0.76	0.45	-0.07	0.94	0.69	0.42	-0.17	1.30	0.24	0.31	0.76
Spain	0.62	1.14	0.30	-0.82	0.78	1.22	0.36	-0.81	0.60	0.65	0.09	-0.13
Finland	0.65	0.58	0.19	-0.12	0.39	1.15	0.19	-0.95	1.68	-0.07	0.16	1.59
France	0.79	0.69	0.37	-0.28	0.71	0.83	0.34	-0.45	0.89	0.33	0.45	0.11
Italy	0.01	0.59	0.18	-0.76	0.06	0.60	0.21	-0.75	0.03	0.31	0.05	-0.33
Netherlands	0.94	0.60	0.25	0.09	1.06	0.63	0.29	0.14	0.92	0.24	0.07	0.61
Sweden	1.46	1.17	0.95	-0.66	1.22	1.12	1.05	-0.95	2.33	0.77	0.28	1.27
UK	1.05	0.40	0.38	0.26	0.96	0.30	0.42	0.24	1.59	0.86	0.25	0.48
US	1.21	0.88	0.26	0.07	1.31	0.98	0.30	0.03	1.11	0.79	0.13	0.18

Source: EUKLEMS

Contributions are in percentage points.

Note: Whole economy excludes NACE Rev.2 sections K, L, T and U.

Figure 12: Average annual rates of labour productivity growth (value-added per hour), 2001–2015, by low-paying industry and country

Source: UKELMS

Table 6: Breakdown of labour productivity growth, 2001–2015, by country and low-wage industry

Country	NACE Rev. 2	Growth in LP (%)	*Contributions from (percentage points):*			
			ICT capital	Non-ICT capital	Labour quality	TFP
Germany	A	0.57	0.03	0.32	0.51	-0.28
France	A	2.81	0.00	0.00	0.37	2.45
UK	A	1.18	0.01	0.25	0.65	0.27
US	A	2.65	0.02	1.53	0.20	0.91
Germany	10–12	-0.69	0.06	0.23	0.17	-1.15
France	10–12	0.98	0.08	0.11	0.50	0.29
UK	10–12	1.84	0.09	0.44	0.31	1.00
US	10–12	0.51	0.07	0.94	0.18	-0.68
Germany	13–15	2.14	0.10	0.33	0.17	1.53
France	13–15	3.63	0.22	0.66	0.80	1.95
UK	13–15	3.13	0.07	0.05	0.84	2.17
US	13–15	1.95	0.11	0.47	1.41	-0.03
Germany	G	2.48	0.27	0.20	0.16	1.84
France	G	0.67	0.11	0.28	0.37	-0.09
UK	G	1.98	0.21	0.66	0.23	0.87
US	G	1.72	0.36	0.48	0.16	0.73
Germany	I	-0.54	0.03	0.00	0.27	-0.84
France	I	-0.34	0.01	0.17	0.19	-0.71
UK	I	0.14	0.06	0.11	0.17	-0.19
US	I	-0.07	0.06	0.08	0.10	-0.31
Germany	R	-0.56	0.40	0.02	0.17	-1.15
France	R	0.34	0.08	0.12	-0.18	0.31
UK	R	-0.95	0.16	0.86	0.24	-2.20
US	R	0.89	0.09	0.20	0.22	0.39
Germany	S	0.03	0.16	0.29	0.14	-0.56
France	S	1.31	0.25	0.21	1.83	-0.97
UK	S	0.18	0.20	0.14	0.02	-0.18
US	S	-1.08	0.11	0.31	-0.12	-1.38

Source: EUKLEMS

7 Exploring the correlates of relative TFP gaps at sectoral level

Overview

- This chapter seeks to identify factors which may explain cross-country variation in TFP levels within each sector (as shown in Chapter 5). It looks for statistical relationships between each country's relative sectoral position on a number of productivity drivers and that country's relative sectoral position in terms of levels of TFP.
- The analysis finds that countries tend to have a TFP lead over the UK in a particular sector (or alternatively, have a smaller lag) in cases where they: have a higher share of employees subject to management practices such as performance related pay; have a higher share of employees using ICT; have a lower share of employees on temporary contracts; or have less restrictive product market regulations.
- None of these relationships are particularly strong in our sample. However, they point towards a set of factors which may possibly serve as a focus for efforts to bring about improvements the UK's relative TFP performance in low-wage sectors.

Introduction

One of the main findings from our comparative analysis of productivity levels in Chapter 5 was that, in cases where the UK lags behind other countries in levels of productivity for low-wage sectors, that lag is often due to lower levels of TFP. In other words, it is not primarily explained by measured levels of capital or measured levels of labour quality.

The level of TFP is computed as a residual in the levels accounting methodology and so it is not possible to explore the reasons for any TFP gaps without bringing further explanatory variables into the analysis. We do so in this chapter by using available measures of a variety of known productivity drivers, as discussed in Chapter 2. Where it is possible to obtain metrics for these drivers, which include factors such as managerial skill, innovation and product/labour market flexibility, we can look for a statistical relationship between each country's position relative to the UK) on the factor in question and that country's relative position in terms of levels of TFP. Where statistically significant relationships are found, this will point towards factors which may possibly serve as a focus for efforts to bring about improvements the UK's relative TFP performance in low-wage sectors.

Methodology

A standard approach to understanding relative levels of TFP might be to undertake econometric analysis of the relationship between production outputs and inputs, regressing value-added on measures of capital and labour inputs and augmenting this regression with additional variables which are intended to explain some of the residual variance (likely candidates were discussed in Chapter 2, such as the incidence of workforce training, the prevalence of specific management practices or the level of regulation). Regressions may be undertaken in levels or growth rates (see for example, Rincon-Aznar et al, 2015). However, such analyses typically have access to long panels of data. Our sample covers only 15 years, and is further curtailed by the limited availability of complementary data. For instance, data on workforce training and workforce characteristics are readily available on a consistent industry basis only for the period 2008–2015. Measures of product and labour market regulation are available, but change little over such a short period. Data on management practices are available only for specific time points, thus limiting their use in panel analyses. We thus take a different, more descriptive approach, in which we seek to identify factors which help to explain cross-country variation in TFP levels within each sector in 2015.[30]

The list of explanatory variables that we employ in our analyses is as follows:

- *employer-provided training:* the share of employees engaging in education and training in the last four weeks (source: EU-LFS)
- *management practices:* the shares of employees who are subject to specific management practices such as team working or performance related pay (source: European Working Conditions Survey (EWCS))
- *innovation:* R&D expenditure as a share of gross output in the industry (in current prices) (source: OECD's ANBERD database)
- *labour market regulation:* the levels of Employment Protection Legislation (EPL) concerning permanent and temporary contracts (source: OECD)
- *employment characteristics:* the share of employees with a permanent vs temporary contract and the share of employees working full-time vs part-time (self-report) (source: EU-LFS)
- *product market regulation:* the impact of product market regulation on downstream industries (source: the OECD REGIMPACT indicator (Egert and Wanner, 2016)).

The analysis takes the sector-specific measures of relative TFP in 2015 (from Chapter 5) as its focus. TFP is measured here in log points relative to the UK, such that values above 0 indicate that the country in question has a higher level of TFP than the UK within the given sector, and values below 0 indicate that the country has a lower level of TFP than the UK. Each of the variables listed above are defined in an equivalent way. In the case of employer-provided training, for example, we identify the share of employees that receive training within a particular industry-by-country cell, and then express each country's value relative to that of the UK (again in log points) within each of our 31 industry sectors. We then regress the relative measure of TFP on the relative score on the factor in question, with sector fixed effects necessarily factored out. If variations in the factor in question (rates of training, in this example) play some part in explaining TFP gaps between the UK and other countries at sectoral level, we would expect those countries with higher sectoral prevalence of training than the UK to also have a higher sectoral level of TFP than the UK and, conversely, we would expect those countries with a lower prevalence of training to lag behind the UK in terms of TFP.

Our analysis begins with bivariate regressions, in which relative TFP is regressed on each factor in turn. This allows us to include the broadest range of indicators – some of which are only available for a limited range of sectors or may be collinear. A multivariate analysis is then used with a more limited set of factors to explore the extent to which these bivariate associations are independent of one another.

Our estimates use data from a single year (2015) and so there can be no causal interpretation. Instead, we are examining cross-sectional correlations. However, where such correlations are apparent, they may point towards factors that are relevant in explaining the UK's TFP gaps in low-wage sectors and which are thus worthy of further investigation.

Results

A summary of the results of our bivariate regressions is provided in Table 7. The table shows the size and statistical significance of the coefficient on each 'factor' (p-values), along with a standardised coefficient to ease comparison between the factors in this bivariate setting. For the low-wage sectors, the results are presented under a robust regression approach, which is designed to restrict the influence of outliers. Each variable is discussed in turn within the sub-sections which follow the table. The results of our multivariate analysis are then presented to provide confirmation of the relative importance of those variables which the bivariate analysis suggests are the most important.

Table 7: Results of bivariate regressions of relative TFP on relative factor scores, 2015

			All sectors		Low-wage sectors
	Obs.	OLS	Standardised coefficients	Obs.	Robust regression
% Workers in training	251	0.141** (0.011)	0.159	61	0.138 (0.258)
Management practices score	254	0.236* (0.07)	0.114	61	0.411 (0.108)
Components:					
% employees in semi-autonomous teams	254	0.009 (0.818)	0.015	61	0.098 (0.314)
% employees involved in process improvement	254	0.106* (0.051)	0.123	60	-0.236 (0.277)
% of employees with performance related pay	254	0.085* (0.069)	0.114	60	0.385*** (0.000)
% employees with 50%+ use of ICT	254	0.226*** (0.000)	0.250	61	0.265*** (0.009)
% of employees for whom pace of work is driven by targets	254	-0.005 (0.922)	-0.006	60	-0.007 (0.937)
R&D intensity lag t-4 (all sectors)	190	-0.061*** (0.006)	-0.198	59	-0.184*** (0.000)
R&D intensity lag t-4 (production sectors only)	117	0.097** (0.015)	0.224	–	–
Employment protection legislation (regular contracts)	10	-0.043 (0.788)	-0.097	–	–
Employment protection legislation (temporary contracts)	10	-0.041 (0.587)	-0.195	–	–
% Temporary workers	245	-0.188 *** (0.008)	-0.169	61	-0.359** (0.027)
% Part-time workers	272	0.107* (0.060)	0.114	67	0.233 (0.178)
Product Market Regulation (country-specific weights)	255	-0.138** (0.011)	-0.159	61	-0.225 (0.181)
Product market regulation (US weights)	246	-0.129*** (0.008)	-0.169	61	-0.481*** (0.007)

Note: P-values in brackets. *** p<0.01, ** p<0.05, * p<0.1

Employer-provided training

Our first investigation focuses on the role of workplace-based skill acquisition through employer-provided training. In several recent studies, workforce training has been shown to have a positive association with productivity growth over and above the measured effects of labour quality measured in the conventional way by means of the returns to qualifications, age and gender. Specifically, in a growth accounting analysis, O'Mahony (2012) estimated that training investments expanded the contribution of increasing labour quality to productivity growth in the UK over the period 2001–2007 by around one fifth. Mason et al's (2014) econometric analysis also indicated that the positive impact of higher-level

certified skills on productivity is reinforced by uncertified skills developed through employer investments in job-related training.

A measure of employer-provided training is provided within the EU-LFS, which indicates the share of employees who have engaged in education and training in the four weeks before their survey interview. One limitation, however, is that the EU-LFS estimates are only available at NACE section level (one-digit industry). We can therefore obtain estimates for a maximum of 17 industries across our 10 comparator countries. We match these onto our more disaggregated measures of relative TFP, which are available for 31 sectors, with the most obvious penalty coming in manufacturing, where the EUKLEMS provides a considerably more detailed sectoral disaggregation than NACE section level.

Drawing from the EU-LFS, we find that the only countries where the share of the workforce receiving training is smaller than in the UK are Germany, Italy, and Spain. In the case of Germany, this may be explained by the fact that employer-based training is usually combined with classroom-based training. Apprenticeship training, which is usually combines employment-based training with part-time attendance in vocational education classes or workshops, remains strong in Germany and covers a range of occupations (Mason and Rincon-Aznar, 2015).

When we regress the relative TFP gap for each industry on the relative training measure for that industry, we find a positive relationship (coefficient of 0.14) between the relative training measure and relative TFP which is statistically significant at the 5% level. The standardised coefficient of 0.16 indicates that an increase of one standard deviation on the relative training score is associated with an increase of one sixth of a standard deviation in the relative TFP gap (though of course a causal link cannot be identified).

When we restrict the sample to low-wage sectors only, we find no substantive alteration in the size of the coefficient, but the standard error is larger in this smaller sample and the association is no longer statistically significant at the 10% level. Nevertheless, there is evidence to suggest that variations in the rate of workforce training may be one factor in explaining relative levels of TFP.

Management practices

There is growing evidence of the importance of management practices in explaining productivity differences across firms and countries. In some parts of the literature (eg Bloom et al, 2012, 2016), the focus is on practices relating to monitoring, target setting, performance incentives and the use of ICT. Elsewhere (eg Black and Lynch, 2005; Huselid, 1995) greater attention is given to forms of work organisation such as self-managed teams and to the involvement of employees in changes to work processes. Although there is limited existing quantitative evidence of how such practices compare across countries for specific low-wage sectors, there is evidence that, in the retail sector at least, the UK may be lagging behind other major economies such as France and the US (Askenazy and Forth, 2016; Bloom et al, 2012).

To derive a relative measure of 'management practice' for each industry-by-country cell in our sample, we use data from the European Working Conditions Survey (EWCS) (Eurofound, 2017b). Sample sizes for each country in the EWCS are modest (1,000–2,000 workers per wave, depending on the country) but there is a reasonably strong degree of consistency in the questionnaires over time, and so we combine data from the 2010 and 2015 waves of the survey to get reasonable sample sizes for most country-by-industry pairs.[31]

Taking our cue from the management practices literature cited above, we used the data to identify the prevalence of five specific practices:

- *semi-autonomous team working:* the employee works in a group or team that has common tasks and can plan its work, and in which the team members themselves decide on the division of tasks
- *employee involvement in process improvement:* the employee is involved in improving the work organisation or work processes of their department or organisation
- *use of ICT:* the employee spends at least half of their time working with computers, laptops or smartphones

- *performance related pay:* the employee's earnings include payments based on their individual performance (eg piece rates or merit pay), payments based on the performance of their team or department (eg a team bonus), or payments based on the organisation's overall performance (eg a profit sharing scheme)
- *target-driven work processes:* the employee's pace of work is dependent on numerical production targets or performance targets.

We identify whether each employee in the survey reports that they are using the practice in their work and code this with a set of five binary (0,1) variables. We then sum these five variables to give a summated score which counts the number of practices that the employee is using (ranging from a minimum of zero to a maximum of five). The mean of this score is then computed across all employees in each industry-by-country pair to provide an overall management score, which we take as a measure of the prevalence of productivity-enhancing management practices within the sector/country.

It is apparent that the UK's low-wage sector has less extensive use of our chosen management practices than some 'productivity leaders' such as Denmark and the Netherlands, but a higher score than another 'leader', Germany.

When we regress the relative TFP gap for each industry on the relative management score for that industry, we find a positive relationship between the relative management score and relative TFP which is statistically significant at the 10% level (coefficient of 0.236). The standardised coefficient of 0.11 indicates that an increase of one standard deviation on the relative management score is associated with an increase of one-tenth of a standard deviation in the relative TFP gap.

When we restrict the sample to low-wage sectors only, we find that the size of the coefficient increases, but it is just outside the bounds of statistical significance at the 10% level.

To understand the relationship between management practices and TFP in more detail, we examine the association between relative levels of TFP and each of the five individual management practices that make up the overall management score. Our aim is to identify whether some of these practices are more closely associated with relative TFP than others.

We first express the incidence of each practice relative to the UK in each industry (repeating the approach taken in respect of the overall management score). We then replace the overall management score with these five individual relative scores in turn. Here we find that having leads in the extent of process improvement and in performance related pay and in the use of ICT are each positively associated with having a TFP lead over the UK at industry level. The other management practices are not significantly associated with relative TFP. When we restrict the analysis to our sample of low-wage sectors, the use of performance related pay and the use of ICT remain positively and significantly associated with relative TFP.

This evidence is broadly in line with the literature cited above, which would suggest that variations in the incidence of management practices can go some way towards explaining productivity differences across countries.

Innovation

Innovation may raise productivity either through the development of new or improved products or services (*product innovation*), or through improvements in the processes that are used to create or deliver those products or services (*process innovation*). Such innovations may be the product of research and development (R&D) activities or they may come about through the acquisition of knowledge from outside the firm. Most previous cross-national research has focused on the role of R&D (eg Griffith et al, 2004) and, certainly, measures of R&D expenditure tend to be more readily available than other indicators for a wide range of industries: only a handful of other EU countries collect a wider set of innovation statistics for a range of service industries.

Our measure of R&D intensity is the ratio of R&D expenditures over an industry's gross output (all in current prices). Rather than using a contemporaneous measure of R&D intensity we employ a lagged

measure of R&D effort (lagged by four years). In doing so we follow the literature that finds that the effect of R&D on firms' productivity is more likely to materialise within a longer time of at least five years, as it takes some time to convert R&D projects into new products and services. See Ugur et al (2016) for a recent review of empirical evidence of the relationship between R&D and productivity across firms and industries.

Compared with the UK, in 2015 we find that only Italy and Spain have a lower ratio of R&D expenditures to output, on average, across industries. As expected, the United States is the country in our sample where R&D represents a particularly large proportion of output (more than 2% in our sample of industries).

When we regress the relative TFP gap for each industry on the lagged measure of R&D intensity, we find a statistically significant negative relationship between the two variables. In other words, those countries with a larger TFP gap to the UK tend to be less intensive investors in R&D. This is not in line with expectations. However, we have noted above that our measure of R&D is somewhat partial, being likely to capture a higher share of innovation activity in manufacturing than in services. Notably, when we restrict our sample to production industries (mainly manufacturing, but also includes utilities and construction), we find the anticipated positive (and statistically significant) relationship between R&D and relative TFP.

The standardised coefficient of 0.22 indicates that an increase of one standard deviation in R&D intensity is associated with an increase of one-fifth of a standard deviation in the relative TFP gap within manufacturing. Unfortunately, with only two low-wage sectors in manufacturing, it is not practical to repeat the analysis in the low-wage sector. Other measures of innovation are needed to enable us to examine the relationship between innovation and TFP across manufacturing and services. However, the limited evidence available here suggests that innovation may contribute in some way towards explaining relative levels of TFP when suitable measures are available.

Labour market regulation and workforce characteristics

The standard expectation is that labour market regulations which constrain hiring and firing (so-called employment protection legislation or EPL) generally serve to lower productivity. Bassanini et al (2009) provide evidence for the OECD, while Siebert and Rincon-Aznar (2012) provide evidence using EULEMS. However, some argue that high levels of job insecurity (such as might arise from low levels of EPL) can also be counter-productive, impairing organisational trust and hampering innovation (see Streeck, 1987; Roth, 2013; and Zhou et al, 2011).

Our indicator of employment protection legislation is drawn from the OECD database.[32] The OECD indicators of employment protection legislation measure the procedures and costs involved in dismissing individuals or groups of workers and the procedures involved in hiring workers on fixed-term or temporary work agency contracts. We find that, for the latest year available (2013), the employment protection legislation in the UK is less restrictive that in any of the other European countries covered here. In our sample, only the US has a level of EPL that is below the UK. This finding applies both for the regulations affecting open-ended contracts as well as temporary contracts.

With no industry variation in the EPL measure (as these laws apply to all sectors of activity), it is only possible to examine the association at country level between each of the two EPL indices and the average (mean) TFP gap to the UK. When we do this, we find a negative relationship, suggesting that higher levels of EPL are associated with lower levels of TFP, but the association is not statistically significant and any inferences must be extremely speculative given the limitations of our data in this area. Nevertheless, it is well known that countries with high EPL tend to have relatively high shares of temporary work (since employers seek to avoid offering permanent contracts which are difficult to terminate) and, in a separate regression we find relative TFP gaps to be smaller in industry-by-country cells with relatively high shares of temporary work. These combined results thus suggest that a higher incidence of permanent contracts can be pro-productive (perhaps helping to foster innovation, for example) but that productivity disadvantages may possibly arise from regulations that overly restrict the choices of labour market actors in this arena.

Product market regulation

Poorly regulated product markets can make it more difficult for consumers to switch to more efficient producers (eg by restricting entry) or reduce the incentives to innovate (eg by allowing collusion over prices). Nicoletti and Scarpetta (2003) provide evidence of the direct negative effects of more stringent product market regulation on productivity growth within the OECD. Most low-wage industries do not have high levels of product market regulation, but productivity in these sectors may nonetheless be affected by the regulation of upstream industries (eg energy, transport), whose goods and services serve as intermediate inputs for low-wage sectors. Bourlès et al (2013) provide evidence of such second-order effects of upstream regulation on downstream industries. Their study uses the regulation impact indicators developed at the OECD, which measure the knock-on effects of heavily regulated sectors across the wider economy.[33] Here we use a `narrow' definition of the regulation impact indicator, which measures the degree of regulation over the energy, transport and telecommunications sectors (Égert and Wanner, 2016); it excludes regulation in the professional services and retail sectors, as data in these sectors is usually available less often. We first use a version of the indicator that uses country-specific input output coefficients. Then we use a second version, where input-output coefficients for the US (the country with less stringent regulation) are instead used for all countries. This aims to minimise endogeneity problems associated with the use of country-specific weights as higher weights may be reflecting a more competition-friendly regulation.

The level of the regulation impact indicator in the UK is lower than that in the other European countries, largely because the degree of product market regulation in the energy, transport and telecommunications sectors is relatively low in the UK. Other sectors in the UK are thus less affected by restrictions to competition in these product markets than might be the case in other countries where those sectors are more heavily regulated.

When we regress the relative TFP gap for each industry on the OECD measure of the impact of product market regulation within the industry, we find a modest negative relationship between the two variables which is statistically significant at the 1% level. The standardised coefficient of -0.16 (or -0.17 when using the second version of the RI indicator) suggests that a decrease of one standard deviation on the relative measure of regulation impact is associated with an increase of one sixth of a standard deviation in the relative TFP gap.

When we restrict the sample to low-wage sectors only, we find that the size of the coefficient on the first indicator roughly doubles but is rendered non-significant by the smaller sample. With the second indicator (which aims to minimise endogeneity problems), the coefficient increases four-fold upon moving to the low-wage sample and remains statistically significant at the 1% level, despite the smaller sample size. Countries in which the downstream impact of product market regulation is relatively low thus tend to have larger TFP gaps relative to the UK than countries in which the impact of regulation is relatively high.

A combined analysis

The standardised coefficients in Table allow one to compare the relative strength of the association between each factor and relative levels of TFP when entered separately in bivariate regressions. However, those regressions do not necessarily indicate the independent associations between TFP and each factor, since the factors themselves are typically correlated with one another. For example, part of the positive association between training and TFP may, in fact, be attributable to a positive association between training and the use of ICT (say). To address this issue, we run a multivariate analysis in which we enter a number of factors alongside one another.

Such an analysis must be treated with some caution, as it is not possible to enter all the factors presented in Table 7 simultaneously. The EPL indicator, for example, is not observed at industry level, and we have seen that the R&D indicator can only be effectively used in production industries. The sample of low-wage industries is also particularly small for a multivariate analysis. However, we can run multivariate regressions which includes all of the factors that show a statistically significant association with relative TFP in the bivariate analysis, with the exception of R&D.

The results of this multivariate analysis are presented Table 8. It can be seen from the table that many of the statistically significant bivariate associations remain so under a multivariate analysis. Specifically, the use of performance related pay and the extensive use of ICT both remain positively associated with relative TFP in the 'All sectors' sample, while the use of temporary contracts and higher levels of product market regulation retain their statistically significant negative associations. The coefficients associated with performance related pay and the extent of product market regulation are also statistically significant in the smaller sample of low-wage sectors, suggesting that these factors may be particularly important and worthy of further attention, though the coefficient on the use of ICT is also close to statistical significance at the 10% level. The coefficients on the variables for training, process involvement and part-time work, in contrast, all reduce in size within the multivariate analysis and are no longer statistically significant, even in the larger sample of all sectors, indicating that these factors do not have an independent association with relative TFP levels once other sectoral characteristics have been controlled for.

Table 8: Results of multivariate regressions of relative TFP on selected relative factor scores, 2015

	All sectors		Low-wage
	OLS	Standardised coefficients	Robust regression
% Workers in training	-0.0288 (0.642	-0.032	0.0275 (0.839)
Process involvement	-0.0148 (0.844)	-0.017	-0.240 (0.300)
Performance related pay	0.113** (0.047)	0.153	0.421*** (0.000)
Use of ICT	0.227*** (0.004)	0.253	0.269 (0.115)
% Temporary workers	-0.167** (0.024)	-0.148	0.0384 (0.803)
% Part-time workers	0.045 (0.524)	0.045	0.129 (0.524)
Product market regulation	-0.127*** (0.028)	-0.160	-0.364* (0.073)
Constant	0.379*** (0.000)		0.402 (0.139)
Observations	*235*		*60*
R-squared	*0.143*		*0.408*

Note: P-values in brackets. *** p<0.01, ** p<0.05, * p<0.1

This version of the product market regulation uses US weights, to minimise endogeneity issues.

Summary

The analyses of productivity levels in Chapters 4 and 5 shows that productivity levels in the UK's low-wage sectors lag behind those of a number of other countries, and that a chief contributor to these lags are relatively low levels of TFP in the UK. In this chapter, we have investigated the extent to which these TFP gaps may be related to each country's relative sectoral position on a number of drivers of productivity that were not explicitly considered in the levels accounting exercise presented in Chapter 5.

The bivariate analysis indicated that countries tend to have a TFP lead over the UK within a particular sector (or alternatively, to have a smaller lag) in cases where they: engage a relatively higher share of employees in job-related training; have a higher share of employees subject to management practices such as performance related pay or continuous improvement; have a higher share of employees using ICT; have a lower share of employees on temporary contracts; or have less restrictive product market regulations in upstream industries. When these indicators are entered together in a multivariate regression, the positive associations between TFP and the use of performance related pay and the use of ICT remain, as do the negative associations with the use of temporary contracts and the degree of product market regulation.

None of these relationships are particularly strong in our sample and some of them are rendered statistically non-significant in the small sample of low-wage industries. One must also recognise the inherent limitations of a cross-sectional analysis based on only one year. However, collectively, the analyses presented here point towards a set of factors which may possibly serve as a focus for efforts to bring about improvements the UK's relative TFP performance in low-wage sectors in the future.

8 Summary and conclusions

Introduction

Efforts to increase productivity have an important role to play in raising aggregate living standards since, by creating greater added value in production, the economy generates additional income that can be used to pay for the goods and services that its population wants to consume. However, at the whole economy level, the UK performs relatively poorly in international comparisons of productivity levels and this has been true for several decades. Productivity growth in the UK has also been stagnating in recent years.

It has been suggested that the UK's 'productivity problem' is comparatively particularly large in low-wage sectors (Thomson et al, 2016). Nevertheless, a comprehensive analysis of the productivity performance of the UK's low-wage sectors has been lacking. The research presented in this report therefore had three objectives:

- to compare the *level* of labour productivity in the UK's low-wage sectors with the level of productivity in the equivalent sectors in other major economies
- to compare sectoral rates of *labour productivity growth* between the UK and other major economies over recent years
- to account for the cross-country productivity gaps by examining international differences in capital intensity, labour quality and total factor productivity, which measures differences in efficiency and technological change.

The analysis used data from the EUKLEMS database (Jäger, 2017; O'Mahony and Timmer, 2009), which provides sectoral productivity and growth accounts for a range of major economies over a number of years. The analysis focused on the 10 lowest paid sectors in the UK, which are listed below in descending order of size (total hours worked), along with their NACE Rev. 2 classifications:

- retail (NACE Rev. 2 division 47)
- administrative and support services (section N)
- accommodation and food services (section I)
- social care (divisions 87–88)
- other service activities (section S)
- arts, entertainment and recreation (section R)
- sale and repair of motor vehicles (division 45)
- agriculture (section A)
- food processing (divisions 10–12)
- textiles and clothing manufacture (divisions 13–15)

Each of these sectors have at least one-quarter of their employees earning less than two-thirds of the UK median wage. They collectively account for 23% of the UK's total value-added and 38% of the UK's total hours worked.

The productivity performance of these low-wage sectors in the UK was compared with that of the equivalent sectors in 10 other major economies, including France, Germany and the United States, and potential causes for the cross-country gaps in sectoral productivity performance were explored, focusing on the main drivers of increased productivity, such as physical capital, human capital, innovation, competition and market flexibility.

How do levels of productivity in the UK's low-wage industries compare internationally?

Our cross-country comparisons of levels of labour productivity focus on levels of value-added per hour worked at industry level in 2015, and use purchasing power parity (PPP) indices to adjust for cross-country differences in price levels in each industry. When the UK's low-wage sectors are compared with those in other countries on the basis of PPP-adjusted value-added per hour, the UK is found to perform relatively strongly in some low-wage sectors, such as textile and clothing manufacture; sale and repair of motor vehicles; and other service activities (which includes activities such as dry-cleaning and hairdressing). The UK's performance is relatively weak, however, in low-wage sectors such as agriculture, forestry and fishing; administrative and business support services (which includes activities such as security; cleaning and call centres); residential care and social work; and arts, entertainment and recreation. In the remaining three low-wage sectors (food processing; retail and accommodation; and food service), the UK sits broadly in the middle of our comparator countries.

A broader analysis showed that the UK's productivity problem is certainly not concentrated in low-wage sectors. However, if productivity levels in the low-wage part of the UK economy could be raised to match those found in other countries, our analysis shows that this would go some way towards closing the overall productivity gap between the UK and some of its major competitors.

How does productivity growth in the UK's low-wage industries compare with that seen in other countries?

In the most recent period (2011–2015), productivity growth in the UK's low-wage sector as a whole has been relatively healthy, keeping pace with that seen in Germany and France and exceeding the rate of growth seen in the US. UK productivity growth has been particularly strong in food processing (NACE Rev. 2 divisions 10–12), textile and clothing manufacture (divisions 13–15) and accommodation and food services (section I), with growth in total factor productivity (TFP) making relatively strong contributions.

This indicates that, mainly in low-wage sectors, the UK's relative productivity gaps with these countries have not been increasing of late. However, the UK will need to substantially raise its level of productivity growth if the gaps in productivity levels for the low-wage sector are to be narrowed to any appreciable extent in the near future. This is particularly so in sectors such as agriculture, and arts and recreation, where the gap between the UK and other countries has been widening.

What might explain the productivity gaps at sectoral level?

A common means of understanding productivity differences is to use the method of 'productivity accounting' to break down relative productivity levels into the contributions from capital intensity (the quality of capital services entering production per hour worked), labour quality (the quality of labour services per hour worked) and total factor productivity (a residual, which may be thought of as a measure of efficiency, determined for example by the quality of management as well as by other intangible factors).

Our results indicate that, in terms of relative capital intensity, the UK performs rather poorly in sectors such as food processing, and textile and clothing manufacture, while levels of labour quality are a particular weakness in sectors such as wholesale and retail of motor vehicles, and accommodation and food service. However, when we focus on the UK's productivity performance relative to the US, France or Germany across a range of low-wage sectors, we find that UK weakness is attributable primarily to differences in TFP, followed by differences in labour quality, with differences in capital intensity playing a more minor role.

Productivity levels in the UK's low-wage sectors may be raised by further investments in physical and human capital. However, it is less obvious how improvements in TFP may be brought about. To inform

this issue, we examined the statistical relationships between the UK's relative sectoral position in terms of TFP levels and its relative position on several productivity drivers such as innovation, competition, management practice and market flexibility.

In bivariate analyses, we found that that, in our sample of 10 countries, those which tended to have a TFP lead over the UK within a particular sector (or alternatively, had a smaller lag) were those that: engaged a relatively higher share of employees in job-related training; had a higher share of employees subject to management practices such as performance related pay or continuous improvement; had a higher share of employees using ICT; had a lower share of employees on temporary contracts; and had less restrictive product market regulations. The positive associations with the use of performance related pay and the use of ICT were robust to being entered alongside other factors in a multivariate analysis, as were the negative associations with the use of temporary contracts and the degree of product market regulation. This suggests that these factors may be particularly important drivers of productivity at the industry level, alongside the differences in capital intensity and labour quality discussed above.

Naturally, one must be cautious in over-interpreting the results of a cross-sectional analysis based on only one year. However, our analyses go further than other previous research (eg Thomson et al, 2016) in both quantifying and explaining differences in TFP at a sectoral level among low-wage industries. As such, they point towards a set of factors which may serve as a focus for future efforts to bring about improvements the UK's relative TFP performance in low-wage sectors.

Conclusion

In conclusion, there are three main points that emerge from the research:

- The UK's productivity performance varies considerably across low-wage industries, with some sectors performing relatively strongly when compared with the equivalent sectors in other major economies, while the productivity performance of other low-wage sectors is relatively weak. Looking more broadly, it is apparent that the UK's productivity problem spreads across low- and high-wage sectors alike.
- Productivity growth in the UK's low-wage sector as a whole has been relatively healthy in recent years, keeping pace with that seen in a number of other major economies. However, the UK will need to substantially raise its level of productivity growth if the gaps in productivity levels for the low-wage sector (and indeed, for the economy as a whole) are to be narrowed to any appreciable extent in the near future.
- Raising levels of labour quality and capital intensity in low-wage sectors can play a part in closing these gaps. However, the UK's weakness lies at least as much in closing the TFP gaps with other countries and so close attention must also be given to management practices and the organisation of work in low-wage industries.

We have been able to arrive at these conclusions – and the large number of detailed findings presented throughout the report – through careful quantitative analysis of a unique and comprehensive dataset (EUKLEMS). These data have enabled us to adopt a cross-country comparative perspective, which has enabled us to benchmark productivity levels (and growth rates) in the UK's low-wage sectors against those in a several other major economies, thereby arriving at valuable new insights into the strengths and weaknesses of these sectors. The results of such analyses must be interpreted judiciously, since comparing the outputs and inputs of broad industry sectors across countries has significant methodological challenges. However, notwithstanding this, our findings represent a significant addition to the current evidence base on the productivity performance of low-wage sectors in the UK.

The research thus contributes to discussions about the UK's productivity performance, with particular relevance for debates about the extent to which a lack of investment and innovation is holding back productivity in low-wage sectors (JRF, 2017). More broadly, the research also contributes to continuing debates about living standards and in-work poverty in the UK, identifying several focus points for efforts to improve prosperity. Finally, we hope that the research will also serve as a stimulus for further work at the micro-level which seeks to further understand the origins of the UK's weaknesses in labour quality and capital intensity in certain sectors, and which further explores the salience of issues such as work organisation and regulation in driving productivity in low-wage sectors.

Notes

1. One can, in fact, go further to say that higher consumption will follow from higher productivity (supply will create its own demand) (Say's law).

2. Notwithstanding concerns that an imbalance of power in the employment relationship may sometimes prevent this from happening.

3. See Autor et al (2017), however, for an alternative explanation for the recent fall in the labour share, which focuses more on reallocation between firms than on capital-labour substitution within firms.

4. Finance and the oil and gas sector account for about 35% of the overall UK TFP growth gap since the financial crisis (Goodridge et al, 2016).

5. Compare with Syverson (2011); OECD (2015); Camus (2007).

6. Though, in markets of a fixed size, heightened competition can reduce a firm's incentives to make productivity-enhancing investments.

7. Specific studies of this sector have shown that regulations to restrict the opening of large retail stores restricted productivity growth in the sector in the late 1990s and early 2000s (Haskel and Sadun, 2012).

8. Real estate is omitted because a substantial amount of output for this industry is imputed rent on owner-occupied dwellings. Activities of households as employers and activities of extra-territorial organisations are omitted because of the incompleteness of many data series for these sectors.

9. NACE Rev. 2 is the current iteration of the EU statistical classification of activities. The current (2007) edition of the UK's Standard Industrial Classification (SIC(2007)) is identical to NACE Rev. 2 down to, and including, the four-digit (class) level.

   The industry breakdown is provided in the column headed A*64 at http://www.oecd.org/sti/ind/3max.pdf

10. We use QLFS data for 2015 to match the end period of our EUKLEMS series. The Annual Survey of Hours and Earnings (ASHE) is generally preferred as a source of earnings data for the UK, however the ASHE microdata was not accessible for this project. While the two sources do not provide an identical picture of earnings, previous comparative analysis (Ormerod and Ritchie, 2006, 2007) has suggested that they provide comparable estimates for similar individuals.

11. This sector includes activities such as dry cleaning, hairdressing and the repair of household goods.

12. 1 In practical terms, this would mean, in 2015, that at least half of the employees in the industry sector earned less than £9.42.

13. The Eurostat PPPs are preferred to the historic sectoral PPPs contained within the 1997 Groningen Growth Development Centre (GGDC) productivity database because of their more recent vintage.

14. Results available on request.

15. Across all UK industries in the sample, the 25th percentile of the productivity distribution is £24 an hour whereas the 75th percentile is £37 an hour.

16. The EUKLEMS data does not provide estimates for division 45 for the US.

17. The scatterplot excludes industries with outlying values of relative productivity beyond the 5th and 95th percentile of the sample distribution. In the full sample, the correlation remains weakly negative but is on the borderline of statistical significance (p=0.11) under robust regression (designed to limit the influence of outliers).

18. These figures may not match those in Figure as the calculations underlying Table omit Sections L, T and U and are built up from the industry level using Eurostat PPPs.

19. Naturally, it may also reflect measurement errors or omissions, if the measures of capital or labour inputs only partly capture their real contributions to output. This is a key feature of the growing literature on intangible assets (see Corrado et al, 2005).

20. The wage is taken from the producer's perspective, ie total labour cost.

21. In EUKLEMS, hours shares and wage rates are computed for 18 labour types, representing the cross-classification of three qualification groups, three age groups and a male/female split.

22. EUKLEMS uses eight asset types: transport machinery; ICT equipment; other machinery and equipment; cultivated assets; residential structures; other buildings and structures; computer software and databases; and research and development. Land is not included.

23. For further information on the derivation of the benchmark measures, see Inklaar and Timmer (2008); for further information on the derivation of the indices charting the growth in the volume of labour and capital services over time, see Jäger (2017). For further information on the measurement of capital and labour inputs for productivity purposes, see OECD (2001, 2009).

24. The UK has seen a particularly rapid decline in capital intensity in this sector.

25. These means take no account of the size of each industry.

26. No estimates are provided for section A (agriculture) because of missing data on capital's share of value-added in this sector for the UK in 2015.

27. A full set of results covering all 10 countries is available on request.

28. Estimates may differ from those show in Figure since our whole-economy sample omits NACE Rev. 2 sections K, L, T and U.

29. Note that missing data in the growth accounts for sale and repair of motor vehicles (division 45) and retail (division 47) means that we instead present data for the whole of the wholesale and retail sector (section G, ie divisions 45–47).

30. Exploratory panel analyses using those variables which could be measured annually over the period 2008–2015 yielded few statistically significant results.

31. On average, the pooled EWCS provides around 50 observations per industry-by-country cell (a mean of 75 and a median of 40).

32. http://www.oecd.org/els/emp/oecdindicatorsofemploymentprotection.htm

33. The indicator is computed using the degree of regulation in a number of non-manufacturing sectors, together with input-output coefficients denoting the total intermediate inputs from the regulated sectors to other sectors.

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Glossary of terms

Capital compensation	That part of value-added that is not paid out as labour compensation and which therefore can be taken as a measure of the compensation due to capital.
Capital intensity	The amount (or value) of capital inputs per unit of labour input.
Growth accounting	A mechanism for breaking down the sources of growth in productivity into the contributions from increases in capital intensity, labour quality and total factor productivity.
Intangible capital investment	Investment in knowledge creation. Includes expenditure on human capital, such as education and training, scientific research and innovative property, business expenditures for product market development, as well as economic and organisational competencies such as productivity-enhancing management practices.
Labour compensation	Total employer costs paid out to workers.
Labour productivity	The amount (or value) of output produced per unit of labour input.
Labour quality	The quality of each unit of labour input. Sometimes referred to as a measure of skill intensity but can also capture other productivity-enhancing characteristics of the workforce (eg experience).
Levels accounting	A mechanism for breaking down differences in the level of output or labour productivity into the contributions from differences in capital intensity, labour quality and total factor productivity.
Productivity	The amount (or value) of output produced from a given set of inputs.
Purchasing power parity index	The rate of currency conversion that equalises the purchasing power of different currencies by eliminating the differences in price levels between countries.
Total factor productivity	Captures variations in output (over time or space) that are not explained by shifts or differences in observable inputs. Usually taken as a measure of the efficiency inputs are combined with to produce outputs.

List of abbreviations

BEA	US Bureau of Economic Analysis
EPL	Employment protection legislation
EUKLEMS	A database containing time series of growth and productivity accounts at industry level for a range of EU countries and the United States (see KLEMS below).
EWCS	European Working Conditions Survey
GDP	Gross domestic product
GVA	Gross value added
ICT	Information and communication technology
KLEMS	Refers to the broad categories of intermediate inputs that are consumed by industries in their production of goods and services (K = capital, L = labour, E = energy, M = materials, S = purchased services)
OECD	Organisation for Economic Cooperation and Development
ONS	Office for National Statistics
PLI	Price level index
PPP	Purchasing power parity index
QLFS	Quarterly Labour Force Survey
R&D	Research and development
TFP	Total factor productivity

Appendix A: Identification of low-paying industry sectors in EUKLEMS

The EUKLEMS database provides data for 34 industry sectors. For each sector, Table A1 shows the percentage of employees with gross hourly wages below two-thirds of the economy-wide median wage. Estimates are obtained from the 2015 Quarterly Labour Force Survey using data for employees (INECAC05=1) with gross hourly wages in the range 0<wage<100. The economy-wide median is estimated as £10.76 per hour using these data. Low-paid employees were thus earning £7.17 per hour or less.

Table A1

EUKLEMS industry code	NACE Rev. 2) Section or division	Industry description	Low-paid employees (%)
1	A	Agriculture, forestry and fishing	38%
2	B	Mining and quarrying	2%
3	10–12	Food products, beverages and tobacco	29%
4	13–15	Textiles, wearing apparel, leather and related products	31%
5	16–18	Wood and paper products; printing and reproduction of recorded media	18%
6	19	Coke and refined petroleum products	7%
7	20–21	Chemicals and chemical products	8%
8	22–23	Rubber and plastics products, and other non-metallic mineral products	20%
9	24–25	Basic metals and fabricated metal products, except machinery and equipment	14%
10	26–27	Electrical and optical equipment	10%
11	28	Machinery and equipment not elsewhere classified	13%
12	29–30	Transport equipment	9%
13	31–33	Other manufacturing; repair and installation of machinery and equipment	15%
14	D–E	Electricity, gas and water supply	6%
15	F	Construction	15%
16	45	Wholesale and retail trade and repair of motor vehicles and motorcycles	25%
17	46	Wholesale trade, except of motor vehicles and motorcycles	21%
18	47	Retail trade, except of motor vehicles and motorcycles	46%
19	49–52	Transport and storage	16%
20	53	Postal and courier activities	16%
21	I	Accommodation and food service activities	59%

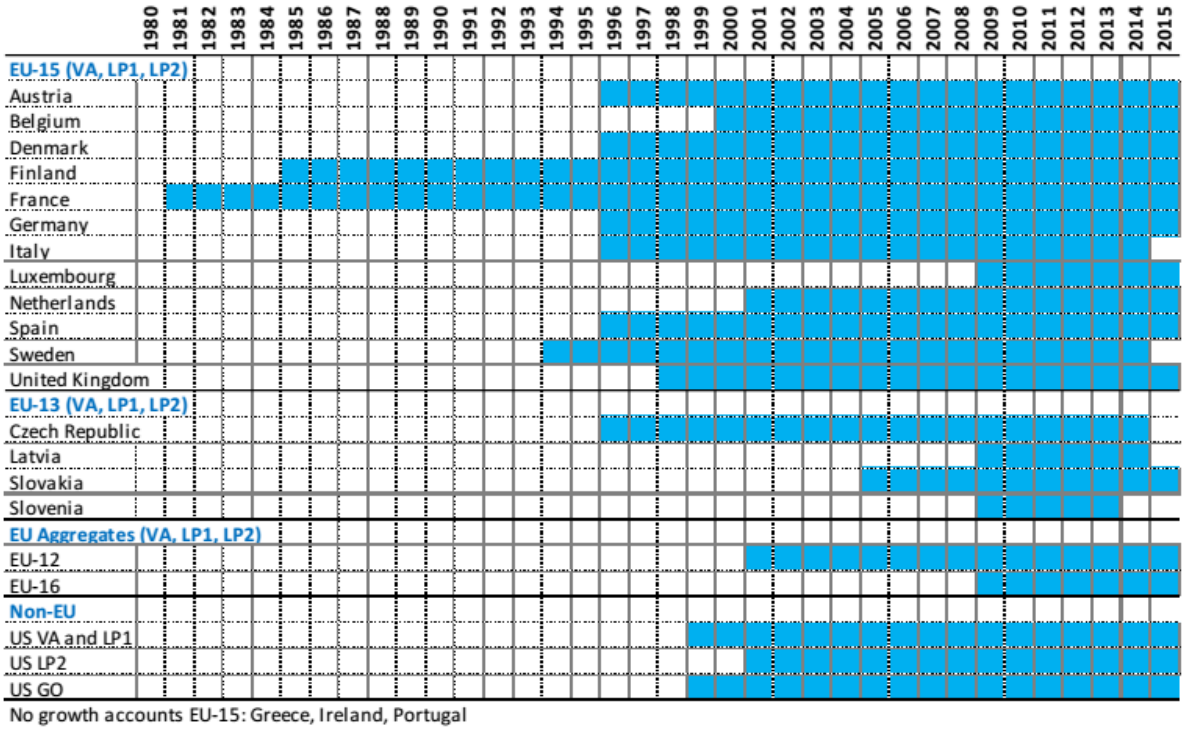
EUKLEMS industry code	NACE Rev. 2) Section or division	Industry description	Low-paid employees (%)
22	58–60	Publishing, audio-visual and broadcasting activities	7%
23	61	Telecommunications	3%
24	62–63	IT and other information services	8%
25	K	Financial and insurance activities	4%
26	L	Real estate activities	13%
27	M–N	Professional, scientific, technical, administrative and support service activities	17%
28	O	Public administration and defence; compulsory social security	5%
29	P	Education	17%
30	Q	Health and social work	19%
31	R	Arts, entertainment and recreation	30%
32	S	Other service activities	33%
33	T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	37%
34	U	Activities of extraterritorial organizations and bodies	2%

Source: 2015 Quarterly Labour Force Survey

Appendix B: EUKLEMS country coverage

Table B1 shows the extent of data provided in the EUKLEMS database for each country. Our analysis requires data on gross value added and capital and labour inputs (indicated by the letters VA in the table). These data are available for the UK from 1998 onwards.

Table B1



No growth accounts EU-15: Greece, Ireland, Portugal

No growth accounts EU-13: Bulgaria, Croatia, Cyprus, Estonia, Hungary, Lithuania, Malta, Poland, Romania

Note: VA=value added, LP1= value added per hour worked, LP2= value added per person employed, GO=gross output

Table 1: Growth accounting approaches of the EU KLEMS release

EU KLEMS Approaches: Contributions to…		
1) LP2: Value Added / Person Employed	VA/EMP	Minimum approach
2) LP1: Value Added / Hour worked	VA/H_EMP	⇕
3) Value Added and KL Inputs	VA	
4) Gross Output and KLEMS Inputs (only US)	GO	Maximum approach

Source: Jaeger, K. (2017) EU KLEMS Growth and productivity accounts 2017 release, statistical module.

Appendix C: Price level indices for EUKLEMS sectors

Table C1 shows the price level indices (PLIs) that underlay the PPPs used in our calculations of relative productivity levels. The PLIs are taken directly from Olislager and Konijn (2016) or, in some cases, are weighted aggregates of the PLIs specified by Olislager and Konijn for lower-level sectors. In all cases, we have rebased the PLI on the UK (such that UK=1).

Table C1: Price level indices for EUKLEMS sectors (UK=1)

NACE Rev.2	Austria	Denmark	Finland	France	Germany	Italy	Netherlands	Spain	Sweden	UK
A	0.95	0.99	1.13	1.10	0.90	1.17	0.81	0.82	1.09	1.00
B	0.91	0.99	0.99	1.06	0.81	0.81	0.91	0.74	1.24	1.00
10–12	0.98	0.90	0.99	0.89	0.76	0.90	0.78	0.73	0.94	1.00
13–15	1.50	0.92	1.28	1.19	1.02	0.86	0.85	0.66	1.37	1.00
16–18	0.89	1.11	0.79	0.91	0.78	0.84	0.88	0.72	0.88	1.00
19	0.99	1.17	1.04	0.88	0.79	0.73	0.84	0.70	1.04	1.00
20–21	1.03	0.75	1.24	1.20	0.97	0.95	0.98	0.91	0.99	1.00
22–23	1.07	1.24	1.10	1.13	0.90	0.71	0.88	0.71	1.25	1.00
24–25	1.11	1.26	0.98	1.07	0.84	0.68	1.00	0.64	1.15	1.00
26–27	1.04	1.15	1.24	1.02	0.82	0.76	1.83	0.71	1.35	1.00
28	1.00	1.09	1.10	0.91	0.94	0.76	1.18	0.73	1.08	1.00
29–30	0.88	1.02	1.18	0.95	1.05	0.86	0.99	0.71	1.08	1.00
31–33	1.21	1.41	1.15	1.01	0.95	0.90	1.05	0.80	1.29	1.00
D–E	0.92	1.21	0.89	0.88	1.00	1.00	0.95	0.93	1.07	1.00
F	1.07	1.30	1.27	1.15	1.19	0.77	1.01	0.67	1.55	1.00
45	1.12	1.53	1.14	1.05	1.06	1.00	1.10	0.94	1.17	1.00
46	1.06	1.25	1.12	1.04	0.98	1.04	1.04	0.92	1.19	1.00
47	0.99	1.24	1.07	0.97	0.97	1.00	0.97	0.89	1.12	1.00
49–52	0.70	1.07	0.81	0.63	0.67	0.53	0.80	0.61	0.91	1.00
53	0.82	1.79	1.35	1.05	0.82	1.11	1.04	0.83	1.87	1.00
I	0.90	1.29	1.15	1.00	0.80	0.94	1.02	0.80	1.27	1.00
58–60	0.96	1.43	1.27	1.02	1.00	1.00	1.09	0.95	1.22	1.00
61	0.80	0.88	0.71	0.81	0.85	0.98	0.97	1.04	0.78	1.00
62–63	0.80	1.07	0.98	0.82	0.75	0.76	0.88	0.68	1.03	1.00
K	0.80	1.07	0.98	0.82	0.75	0.76	0.88	0.69	1.04	1.00
L	0.54	0.90	0.87	0.73	0.59	0.59	0.76	0.58	0.68	1.00
M	0.80	1.07	0.98	0.82	0.75	0.76	0.88	0.69	1.04	1.00
N	0.80	1.07	0.98	0.82	0.75	0.76	0.88	0.69	1.04	1.00
O	1.02	1.22	1.08	0.96	0.91	0.91	1.02	0.77	1.29	1.00

NACE Rev.2	Austria	Denmark	Finland	France	Germany	Italy	Netherlands	Spain	Sweden	UK
P	1.13	1.13	1.02	0.83	0.83	0.71	0.89	0.66	1.45	1.00
86	0.82	0.89	1.00	0.75	0.70	0.88	0.78	0.81	1.34	1.00
87–88	1.12	1.68	1.24	1.22	1.01	0.90	1.22	1.08	1.93	1.00
R	0.90	0.77	0.62	0.73	0.88	0.55	0.56	0.54	0.83	1.00
S	0.98	1.27	1.13	0.88	0.85	0.83	0.93	0.75	1.30	1.00

Appendix D: Relative capital intensity, labour quality and TFP at the whole economy level

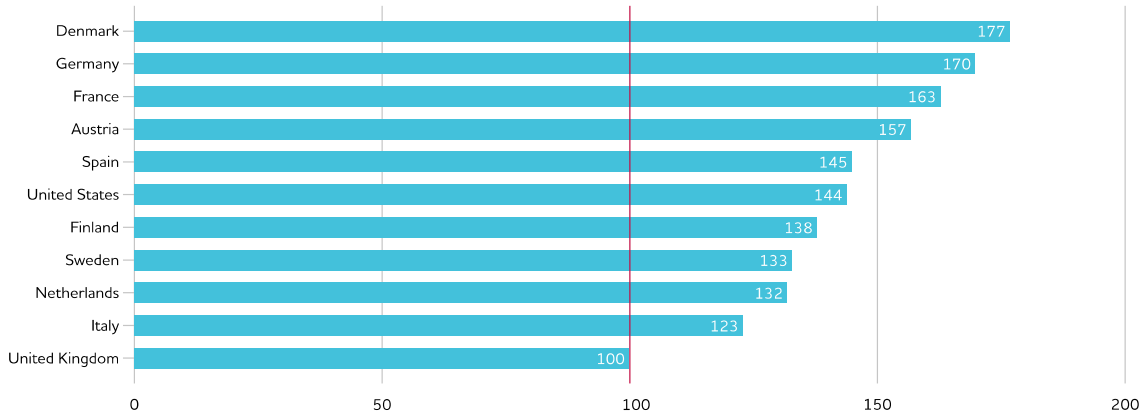
As part of our breakdown of relative levels of labour productivity in Chapter 5, we also produce estimates of relative capital intensity, labour quality and TFP at the whole economy level. These estimates are provided below for information.

These updated estimates tend to reflect the broad rankings shown for the year 2005 by Inklaar and Timmer (2008: Figures 7.3, 7.9 and 7.11). Notable differences are as follows:

- *relative capital intensity:* France and Spain have both gained ground on the leading countries, whereas Sweden has moved back in the rankings
- *relative labour quality:* The UK has moved ahead of Germany in our update (which may be due to Germany not having expanded its higher education to the same extent as the UK over the intervening period); Spain and Sweden have both improved their position relative to other countries
- *relative TFP:* Italy has moved ahead of the UK in our update, while Sweden has fallen substantially behind.

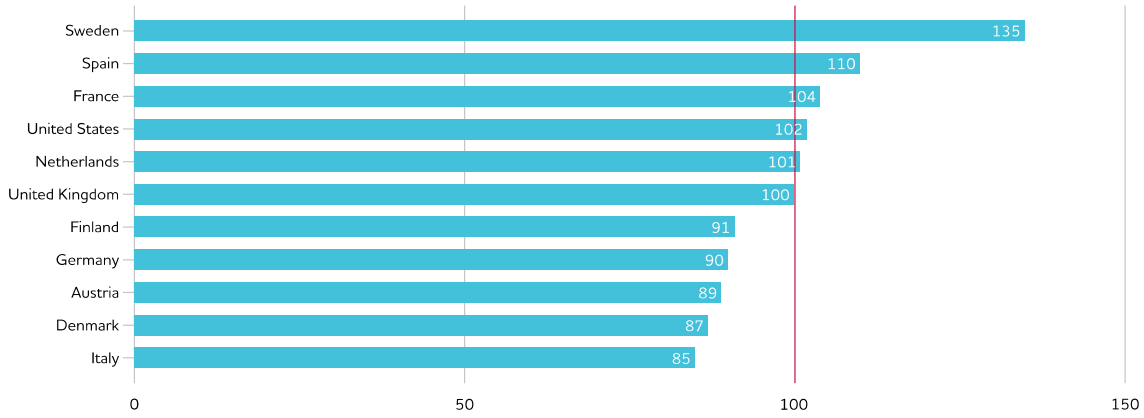
To provide further points of reference, Figure D4 indicates levels of capital stock per hour for each country (to compare against the estimates of the relative intensity of capital services in Figure D1), while Figure D5 indicates wage-weighted qualification shares for each country (to compare against the estimates of the relative quality of labour services in Figure D.2). While we would not necessarily expect the ranking of countries to be identical across each pair of measures for the reasons outlined in *Methodology* in Chapter 5, it is reassuring to note that the rankings are, in fact, broadly similar between Figure D1 and Figure D4, and between Figure D2 and Figure D5. The notable exceptions are Spain in respect of capital intensity and Finland in the case of labour quality. These comparisons suggest that the relative capital intensity estimates for Spain and the relative labour quality estimates for Finland should be treated with caution.

Figure D1: Relative capital intensity per hour worked, whole economy, 2015 (UK=100)



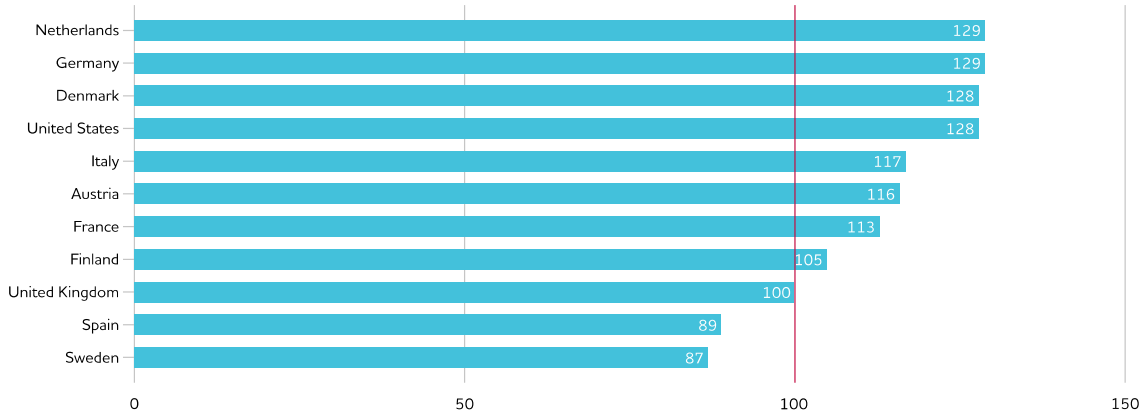
Source: EUKLEMS

Figure D2: Relative labour quality per hour worked, whole economy, 2015 (UK=100)



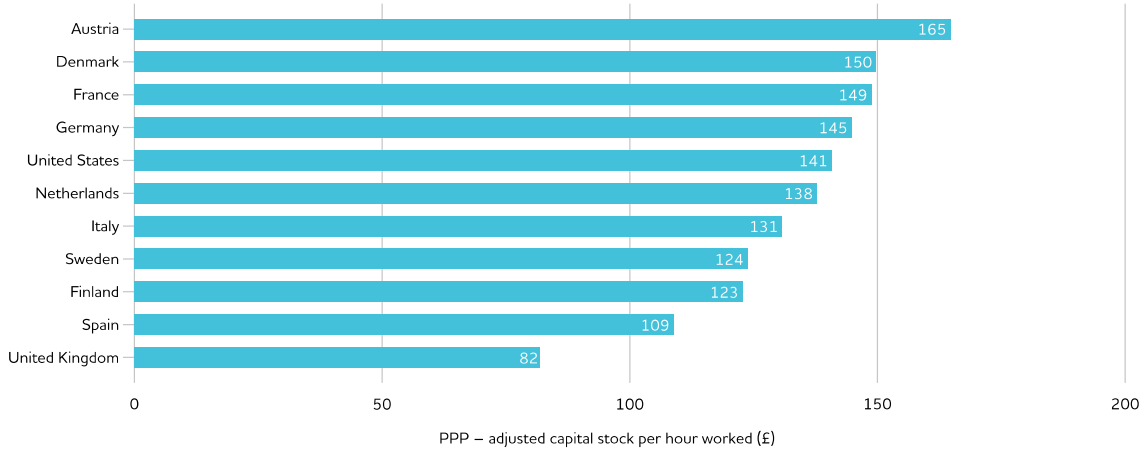
Source: EUKLEMS

Figure D3: Relative TFP, whole economy, 2015 (UK=100)



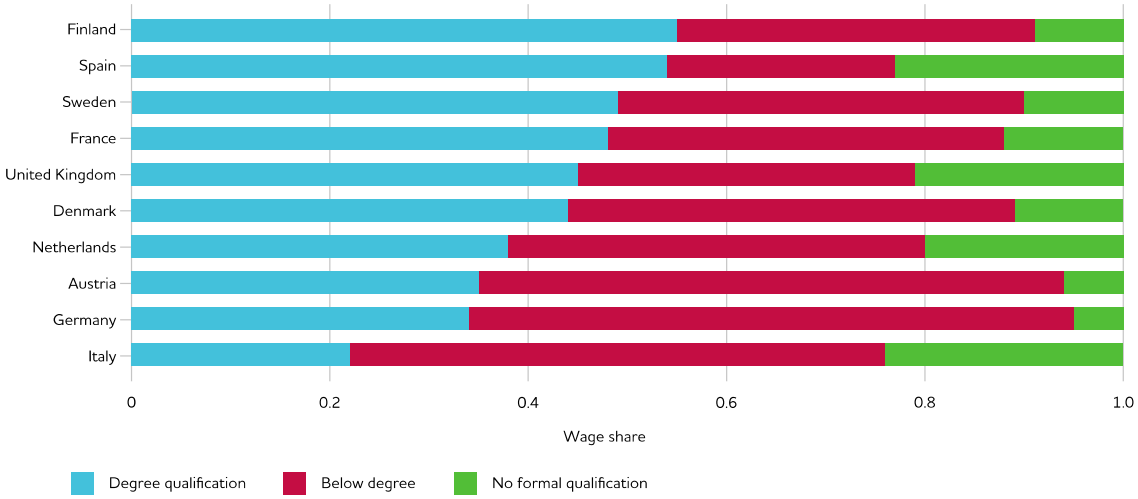
Source: EUKLEMS

Figure D4: Capital–labour ratio, whole economy, 2015



Source: EUKLEMS

Figure D5: Wage-weighted qualification shares, whole economy, 2015



Data not available for US

Source: EUKLEMS

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