4. What drives regional productivity gaps across the UK and how can these be closed?[1]

Key points

- Regional productivity gaps are large, with average output per job around 40% above the UK average in London, but about 16% below the national average in Yorkshire and the Humber.
- The gap between the best- and worst-performing local enterprise partnerships (LEPs) in England has widened over time, with productivity in the highest-ranking LEP being 2.1 times more than in the least productive LEP in 2017, compared to 1.8 in 2002.
- While differences in the composition of industrial activity can explain some regional productivity differences, "horizontal" issues such as skills, connectivity and innovation appear more significant in general.
- Using a cross-sectional regression analysis, we find that places that are better connected physically and have access to skilled workers tend to be associated with higher productivity levels.
- These findings suggest that both policymakers and businesses need to focus on upskilling workers, particularly in areas where there are skills gaps, such as self-management and leadership skills as well as digital capabilities.
- Investing to improve the quality and capacity of local infrastructure could help boost the connectivity of a place (and consequently its productivity based on our analysis). LEPs could work in collaboration to strengthen intra-region connectivity and access to economic hubs, for instance drawing on the experience of the Oxford-Cambridge arc, which is supported by four LEPs in the region.
- The economic prize for getting this right could be significant. If areas that are currently performing below the UK average can close 50% of this productivity gap, it could boost GDP by £83 billion in these areas, equivalent to an increase of nearly 4% in total UK GDP.

Introduction

As our analysis in the previous section shows, UK productivity levels continue to lag behind other advanced economies such as France, Germany, Sweden and the US. This reflects slower productivity growth since the financial crisis (see Figure 3.1 in the previous section), but also long-term structural challenges facing the UK economy related to factors like infrastructure and skills.

In this article we apply a regional lens to the 'productivity puzzle' by examining disparities in regional productivity and the causes and drivers of these differences. As our analysis shows, the issue for many parts of the UK is less about how to catch up with other countries than about how to catch up with cities and regions much closer to home. Questions of devolution and decentralisation have risen up the agenda in recent years, with local cities and regions now having greater capacity and autonomy to respond to local needs and challenges.

We also show the potential further gains that could be achieved from 'levelling-up' productivity across areas.

The discussion in the rest of the article is structured as follows:

- Section 4.1 How does productivity vary across different parts of the UK?
- Section 4.2 The causes and drivers of varying regional performance across the UK
- Section 4.3 How can the UK boost productivity in regions that lag behind?
- Section 4.4 The potential prize from closing the regional productivity gap

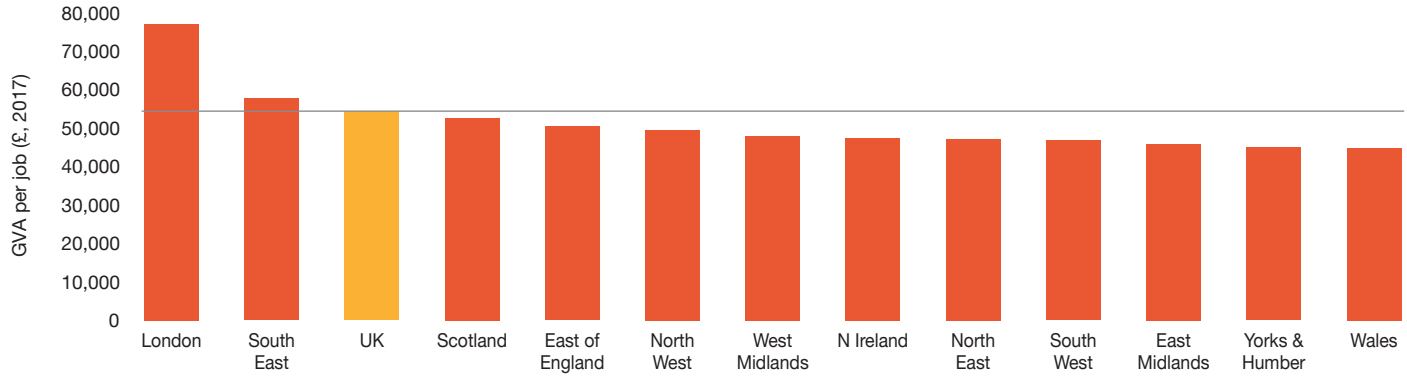
Details of our regression analysis of the possible drivers of local productivity differences are provided in a technical annex.

> "Halving the regional productivity gap could increase UK GDP by £83bn.

Jing Teow
Senior Economist, PwC

1 This article was written by Jing Teow and Natasha Reilly.

Figure 4.1 – Productivity (GVA per job) by NUTS 1 region, 2017



Sources: ONS, PwC analysis

4.1 – How does productivity vary across different parts of the UK?

Figure 4.1 shows variation in productivity performance at the NUTS1 level[2]. The region with the highest level of productivity is London, where productivity is around 40% above the UK average, while the region with the lowest level of productivity is Wales, where productivity is 18% below the national average.

UK average productivity is skewed by the high performance of London, which accounts for 17% of the workforce and had average GVA per job of around £77,000 in 2017 (the latest year for which data are available at the regional and LEP level).

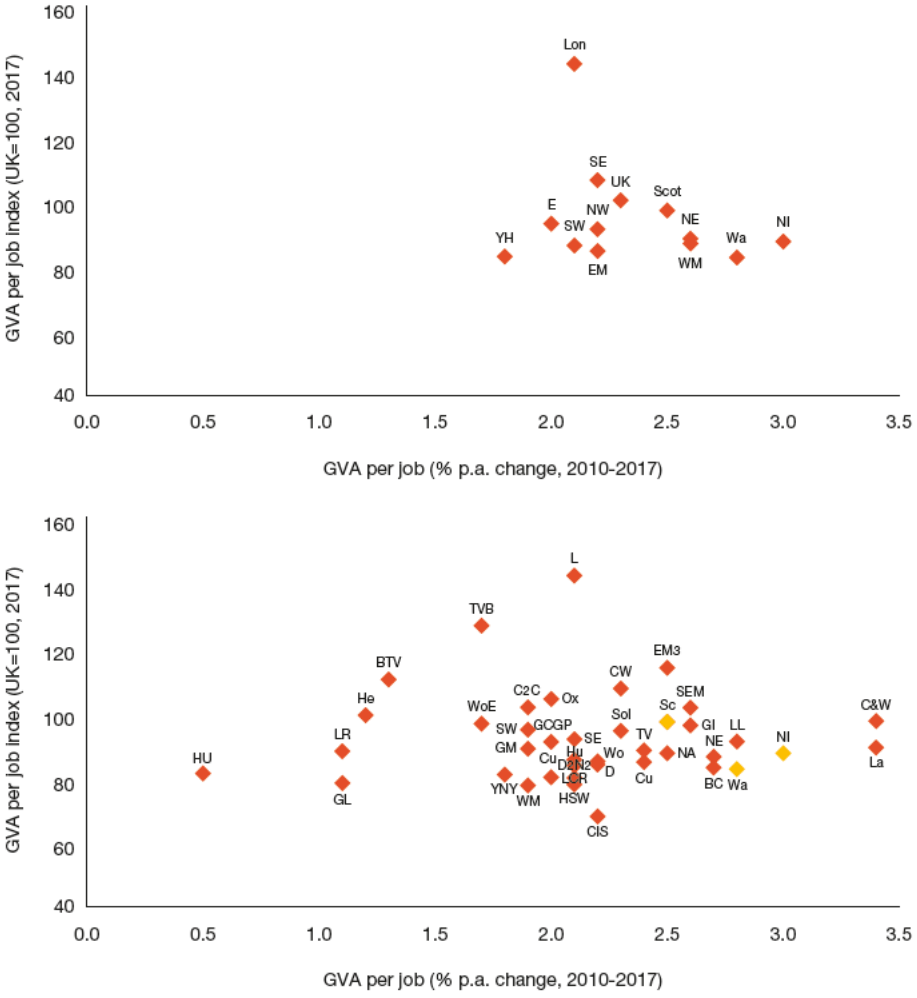
As a result, the majority of English regions sit below average UK productivity as do Wales and Northern Ireland. Scottish GVA per job is also slightly below the UK average level, despite being higher than all English regions except London and the South East.

2 When discussing regional productivity, the standard measure that has been used in this article is GVA per filled job from the regional/sub regional productivity data estimated by ONS. The NUTS1 and LEP data presented is from the most recent year of available data, 2017.

This variation in productivity becomes more distinct when considering more geographically granular areas[3], which we compare at the local enterprise partnership (LEP) level for England[4]. Figure 4.2 shows a larger dispersion in productivity performance, reflecting the diversity in the characteristics of LEPs as well as individual countries (Wales, Scotland and Northern Ireland are included as observations in the bottom panel of Figure 4.2).

Figure 4.3 presents these local productivity estimates as a heatmap to make the regional differences more clearly visible: five of the eight LEPs with above average productivity are located in London or the South East region. A number of these LEPs are located along the M3 and M4 corridor towards the west of London, an area that encompasses tech clusters that are relatively prosperous such as Oxford[5] and Swindon. The next best performing LEP in the country after London is Thames Valley Berkshire, where Reading, its biggest city, is home to tech multinationals such as Oracle, Cisco, Microsoft and Huawei.

Figure 4.2 – GVA per job, and annual growth rates at the NUTS1 and LEP level, 2017



Sources: ONS, PwC analysis

3 The speech 'Is all economics Local?' by Andy Haldane investigates this in more detail. https://www.bankofengland.co.uk/-/media/boe/files/speech/2019/is-all-economics-local-speech-by-andy-haldane

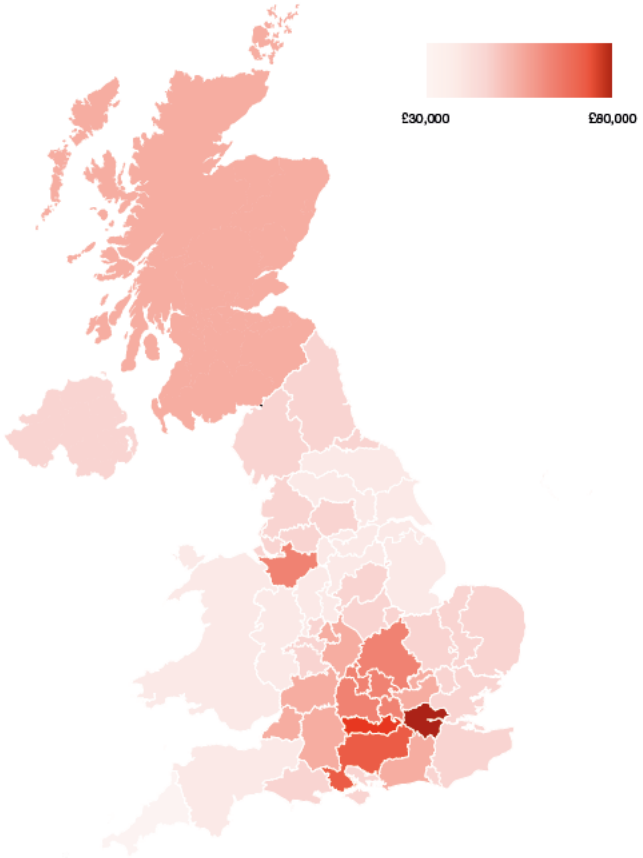
4 We also include observations for Wales, Scotland and Northern Ireland as single regions, given that LEPs only cover England.

5 It is notable here that Oxford has consistently come top of our Good Growth for Cities index in recent years, followed by Reading. This index covers a broader range of indicators beyond income and jobs, including health, housing, transport, environment, income distribution and skills. See our 2019 report for more details: PwC, Good Growth for Cities, November 2019.

The South West lags behind the South East in productivity and is home to the lowest-performing LEP – Cornwall and Isles of Scilly – which has productivity levels more than 30% below the UK average. There is also significant variation in productivity growth across LEPs. A number of LEPs, such as Lancashire and Coventry and Warwickshire have seen rapid improvements in productivity, while LEPs like Humber have struggled to improve their productivity in recent years.

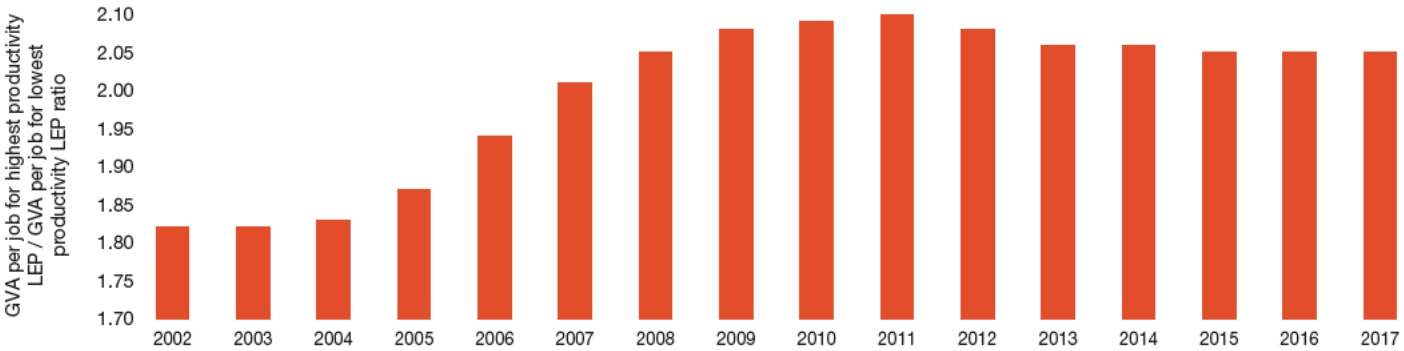
This disparity in productivity at a regional level has also risen over time (see Figure 4.4). In 2002, a London worker was 1.8 times more productive (as measured by average GVA per job) than a worker in Cornwall; by 2011 that gap had grown to 2.1 times and remained around that level up to 2017.

Figure 4.3 – Heatmap of UK productivity based on output per job for LEPs in England as well as Scotland, Wales and Northern Ireland (2017)[6]



Sources: ONS, PwC analysis

Figure 4.4 – Ratio between the highest- and lower-productivity LEP based on nominal GVA per filled job, 2002-2017



Source: ONS

6 There are 38 local enterprise partnerships (LEPs) in England. We present these alongside the data for the other three nations of the UK (Wales, Northern Ireland and Scotland).

4.2 – The causes and drivers of varying regional performance across the UK

In this section, we explore a number of possible causes and drivers of regional productivity gaps across the UK. We consider the following factors:

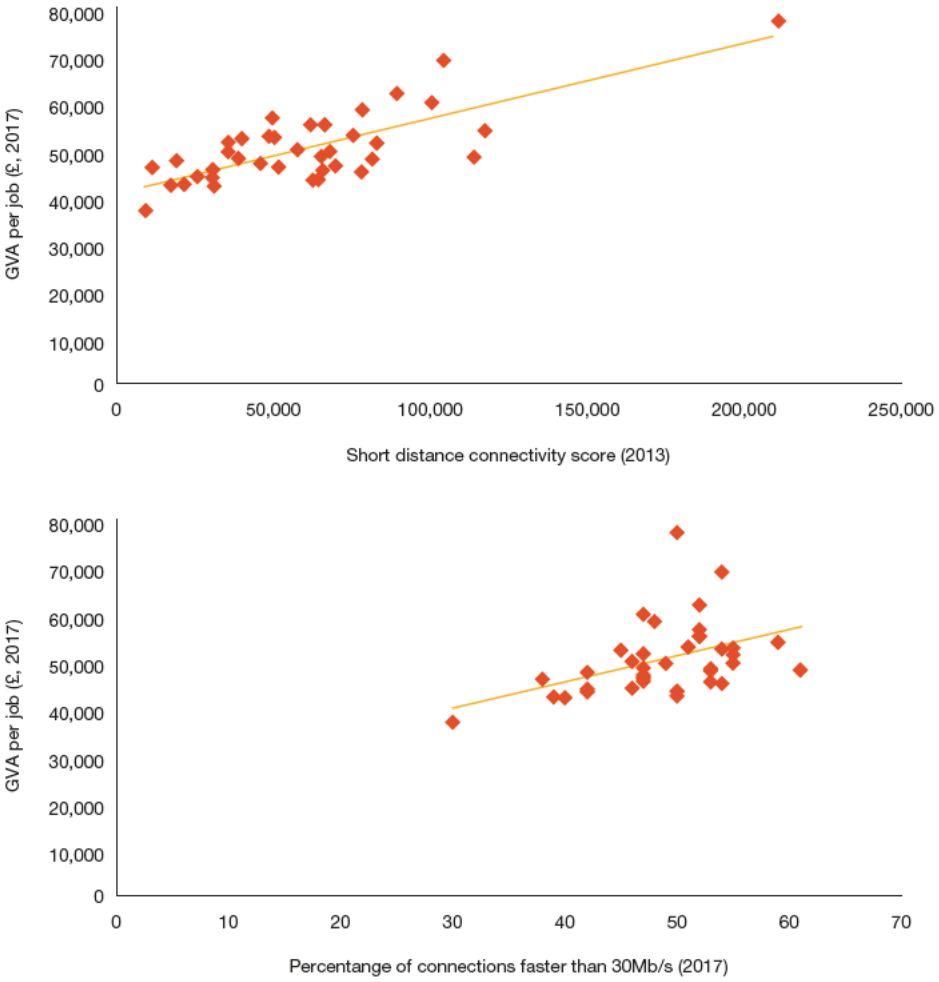
- physical and digital connectivity;
- the skills of the workplace population;
- business size;
- business investment and innovation; and
- industrial structure.

Better connected regions tend to also have higher productivity

At the heart of the case for greater connectivity is the idea of economies of agglomeration, which means that the co-location of firms and people facilitates opportunities for collaboration, competition and innovation, and so increases productivity. Venables (2007)[7] demonstrates that improvements in transport links can help support agglomeration, and that agglomeration effects can be intensified without necessarily increasing the physical concentration of firms and workers, but through improving transport connectivity. A study on the US by Leduc and Wilson (2012)[8] established that each $1 spent on highways in the US increased state annual output by $2.

By reducing the physical or virtual distances between firms, businesses are better able to collaborate with suppliers, access bigger and more diverse labour pools, and compete in bigger markets with other firms. For people, better connectivity means improved wellbeing by reducing commuting times, but also access to job and training opportunities in locations they may not have been able to reach before, thus improving matching between vacancies and jobseekers.

Figure 4.5 – GVA per job (2017) vs short-distance connectivity (2013) and GVA per job (2017) vs digital connectivity (2017) at the LEP level



Sources: ONS, PwC analysis

To examine the relationship between connectivity and productivity, we consider two measures of connectivity (as shown in Figure 4.5):

- A short-distance connectivity 'score', which PwC has calculated based on an area's access to the economic mass of other regions[9]. Specifically, this measures the level of connectivity between the geographical centre of a region and the boundary of other regions in the UK.
- The proportion of fixed broadband connections faster than 30 Mb/s, using data sourced from Ofcom[10].

7 Venables, A., Evaluating Urban Transport Improvements: Cost-Benefit Analysis in the Presence of Agglomeration and Income Taxation, Journal of Transport Economics and Policy, 41, Issue 2, p. 173-188, 2007.
8 Leduc, S. and Wilson, D., Roads to Prosperity or Bridges to Nowhere? Theory and Evidence on The Impact of Public Infrastructure Investment, National Bureau of Economic Research Working Paper 18042, May 2012.
9 This measure of connectivity was developed by PwC in collaboration with Prof. Steve Gibbons at LSE to understand how well-connected areas are to other economic hubs in the UK. The higher the score, the greater the access to economic mass and the shorter distance over which businesses must travel to get the kind of access they need to supply chains, labour markets etc.
10 Ofcom, Connected Nations, 2017.

Differences in skill levels across regions show a strong correlation with the variation in productivity

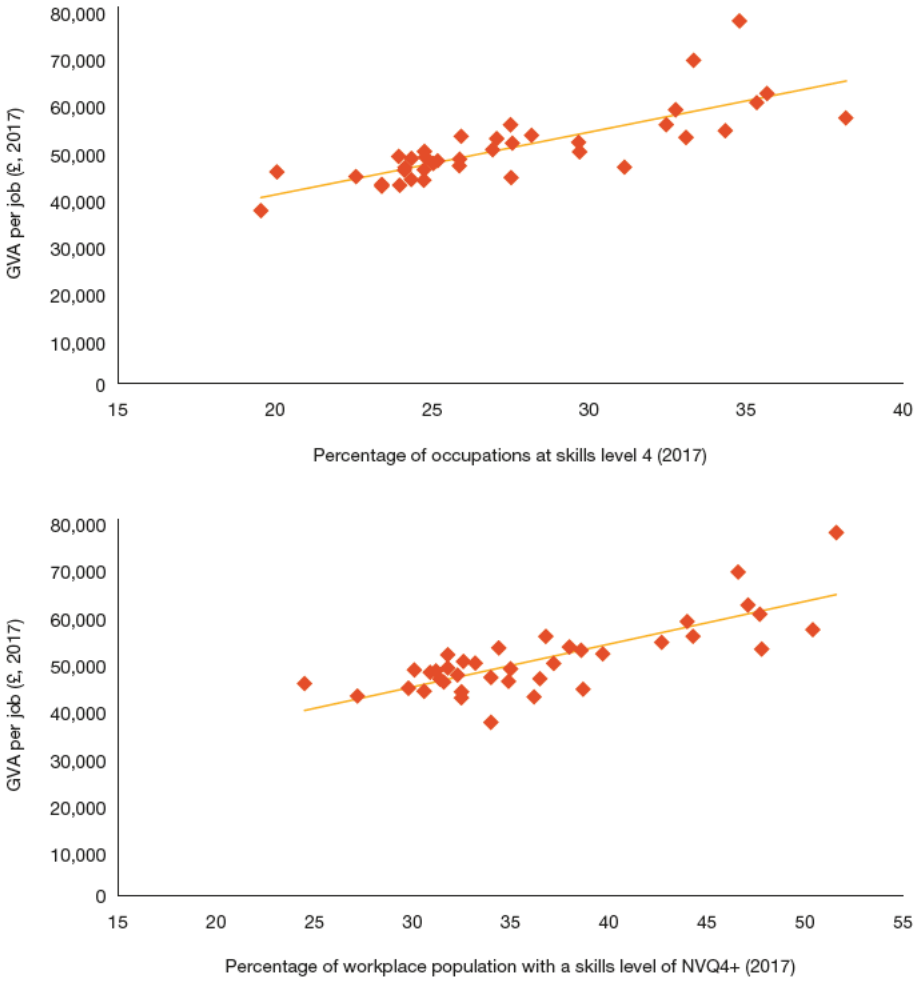
Regional deficiencies in workplace skills and regional variations in demand for skills may partly explain differences in productivity. Higher-skilled workers tend to be more productive and are better able to adapt to the use of new technology, or new production and management techniques that contribute to productivity.

We use two measures of skills (Figure 4.6):

- the proportion of workplace jobs whose skills are equivalent to at least skills level 4 (based on SOC2010); and
- the proportion of the residential working-age population whose educational attainment is equivalent to NVQ level 4 or higher.

As seen in Figure 4.6, we observe a strong positive correlation between skill levels and increased productivity.

Figure 4.6 – GVA per job vs occupational skill levels and GVA per job vs educational qualifications, at the LEP level, 2017



Sources: ONS, PwC analysis

There is some evidence to support the "long-tail" hypothesis, i.e. bigger firms tend to be more productive than SMEs

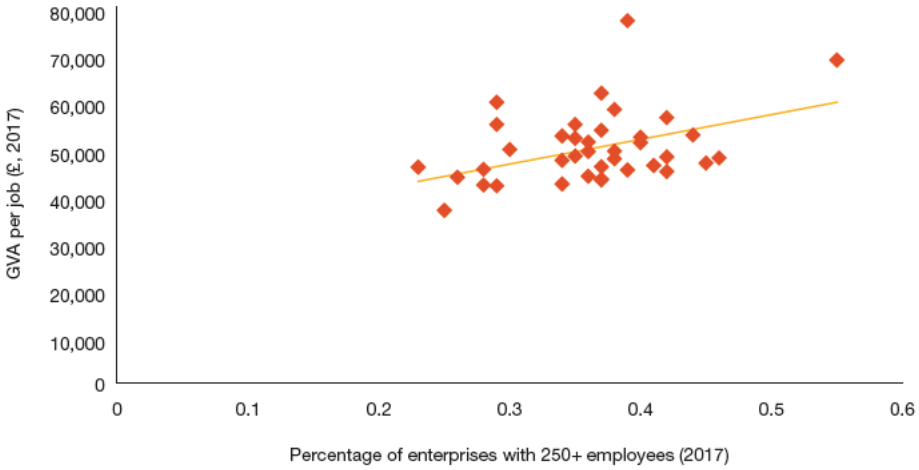
Another reason that might explain regional differences in productivity is the distribution of smaller firms that contribute to the "long-tail" of low productivity. Central to this hypothesis is the idea that larger firms are better able to invest in research and innovation and reap the benefits of those investments through greater economies of scale, while smaller businesses are on average slower to adopt new technology, less able to raise capital, and/or less likely to adopt more sophisticated management practices.

There is some evidence to support this "long-tail" hypothesis: analysis by Andy Haldane[11] at the Bank of England shows that the productivity gap between top- and bottom-performing businesses is larger in the UK than in France, Germany or the US.

To consider the impact of the distribution of enterprises across regions on productivity, we use a measure that captures the proportion of enterprises with greater than 250 employees from the UK Business Counts dataset within each LEP.

From Figure 4.7, we can see that there tends to be a positive correlation between the proportion of large businesses and local productivity. However, this relationship is not as strong as for the skills and connectivity measures.

Figure 4.7 – GVA per job vs enterprises with >250 employees at the LEP level, 2017[12]



Source: ONS

Regional disparities in investment levels and innovation could be one factor driving differences in regional productivity performance, but the association is not particularly strong

Numerous studies have linked the accumulation of R&D with economic output and growth[13]. R&D and innovation more broadly can have a transformative effect on business productivity, with evidence linking innovation to positive organisational growth[14]. The impact of a firm's own R&D can also lead to broader spillover benefits for firms in the same or related industries as it is imitated elsewhere. A study by the Institute of Fiscal Studies showed that while the private rate of return to firms from R&D investment is about 10-15%, the social rate of return (specifically for the UK manufacturing sector), can be as high as 100% when including benefits from upstream industries[15].

However, the latest ONS data on UK business investment show that it has fallen in five out of the last six quarters to Q2 2019[16]. As shown in Section 3, the UK's investment rate is one of the lowest in the OECD and its ratio of R&D spending to GDP has also been relatively low. But is this also a factor in regional productivity differences within the UK?

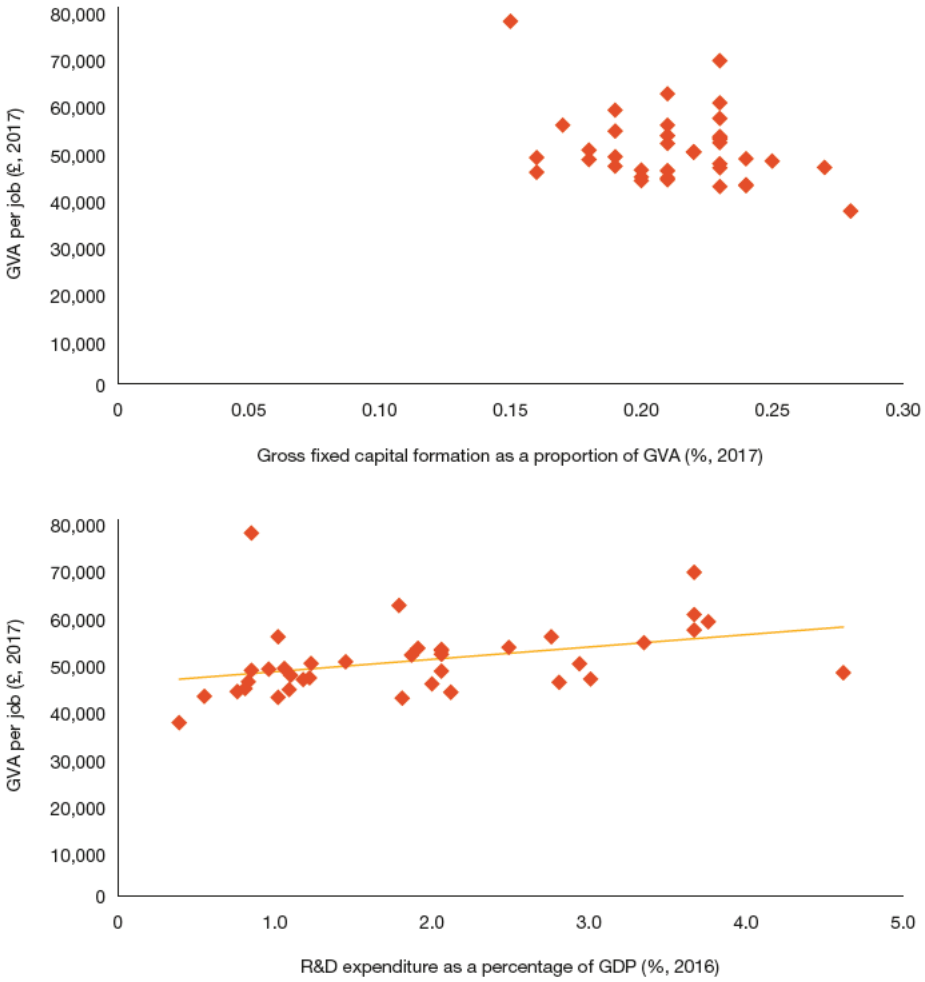
11 Haldane, A., The UK's Productivity Problem: Hub No Spokes, speech at the Academy of Social Sciences Annual Lecture, June 2018.
12 Our correlation analysis also found a positive correlation between microbusinesses and productivity.
13 See for example Griliches, Z., The search for R&D spillovers, Scandinavian Journal of Economics, vol. 94, pp. 29–47, 1992, and Aghion, P. and Howitt, P., A model of growth through creative destruction, Econometrica, vol. 60, pp. 323–51, 1992.
14 See for example: Oke, A., Innovation types and innovation management practices in service companies, International Journal of Operations and Production Management 27 (6), 564–587, 2007.
15 Griffith, R., How important is business R&D for economic growth and should the government subsidise it?, Institute for Fiscal Studies briefing note, October 2000.
16 ONS, Business investment in the UK: April to June 2019 revised results, 2019.

To test this, we compare the following measures of business investment and innovation with productivity using data for LEPs (see Figure 4.8):

- gross fixed capital formation as a proportion of GVA, as a measure of business investment; and
- the level of expenditure on research and development (R&D) as a proportion of GDP, as a measure of innovation.

Regional disparities in investment levels and innovation could be another factor driving differences in regional productivity performance, but the association does not appear particularly strong, perhaps because of limitations in the data available at local level. It may be that the degree of adoption of existing technologies and practices is the more important factor for productivity at a local level, but this is harder to measure. A new innovation may originate in one place, but it can lead to higher productivity in firms across the country (or even the world) if it is widely adopted. Of course, for UK productivity relative to other countries, investment and innovation remain critical, but this importance is harder to pick up in the local data.

Figure 4.8 – GVA per job (2017) vs business investment as a proportion of GVA (2017) and GVA per job (2017) vs business spending on R&D as a proportion of GDP (2016) at the LEP level[17]



Sources: ONS, Eurostat

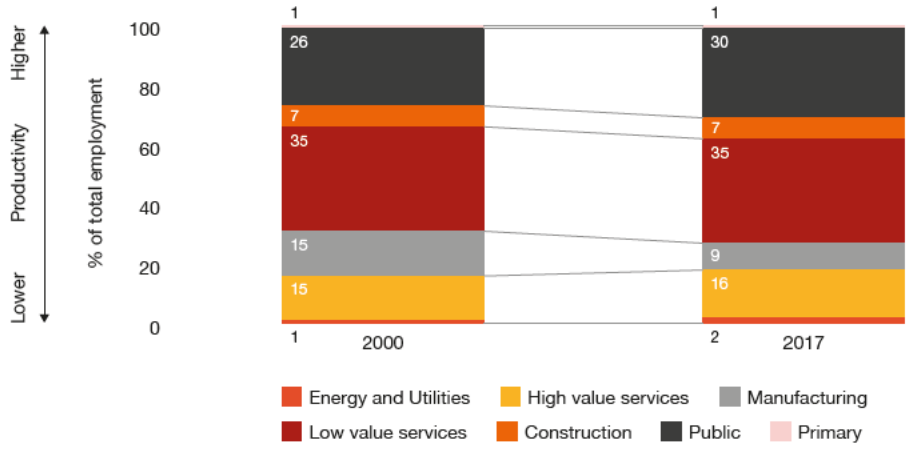
17 Please note that the data for business investment and innovation has been disaggregated from NUTS2 data due to a lack of data availability.

The composition of economic activity may explain some of the differences in productivity across regions

The change in industrial composition over time can partly explain trends in productivity. At the national level, Figure 4.9 shows that there has been a small but discernible shift in employment shares over the long-run, from relatively high productivity sectors, mainly driven by manufacturing, towards lower productivity sectors, such as the public sector, health and education sectors.

As in Section 3, we can apply a 'between-within' decomposition to understand if and where regional differences in productivity can be explained by different industrial structures.

Figure 4.9 – Employment shares by industry sector, 2000 vs 2017



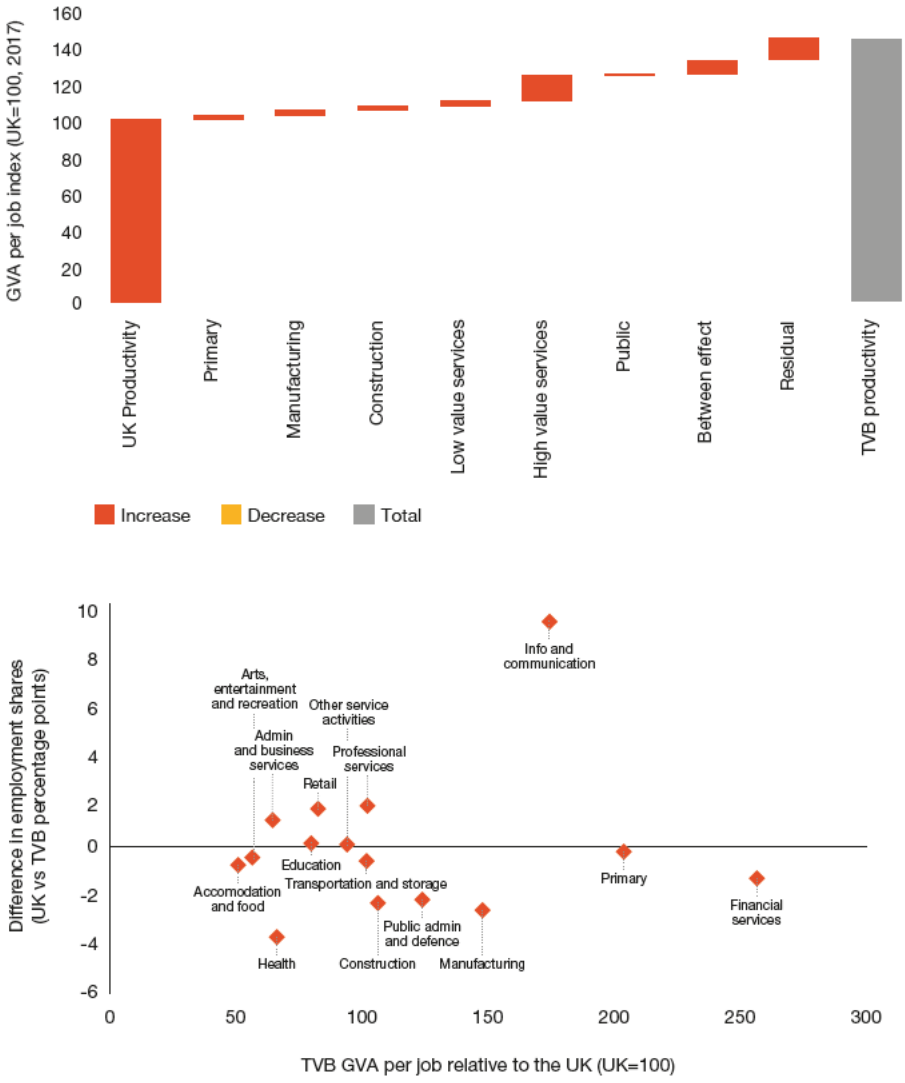
Source: ONS

Fig 4.10 compares UK with TVB Thames Valley Berkshire (TVB), which is the highest-performing LEP outside of London, and Cornwall and the Isles of Scilly (C&IS), the lowest-performing LEP. A decrease indicates a negative contribution to productivity, while an increase indicates a positive contribution to productivity.

The following analysis indicates where the differences in productivity come from: the 'within effect' shows us where productivity differences are as a result of differing productivity levels within a sector and the 'between effect' gives us an indication of the proportion of the productivity differential between two regions that can be attributed to the composition of economic activity.

There is an almost 40 percentage point gap in productivity between TVB and the UK. Most firms located in TVB across sectors are generally more productive than the average UK firm. However, it is the performance of the high value-added services sector (which includes financial services and professional and scientific services) in TVB that stands out. These sectors have above average productivity in most parts of the UK, but are particularly productive in TVB. The outperformance of this sector, relative to the UK average, explains around 14 percentage points of the gap in aggregate performance between the UK and TVB.

Figure 4.10 – Decomposition of productivity differences and employment composition by industry sector and productivity – UK vs Thames Valley Berkshire, 2017[18]



Note: The X-axis shows productivity in each industry in the UK, relative to the average for the UK economy as a whole.

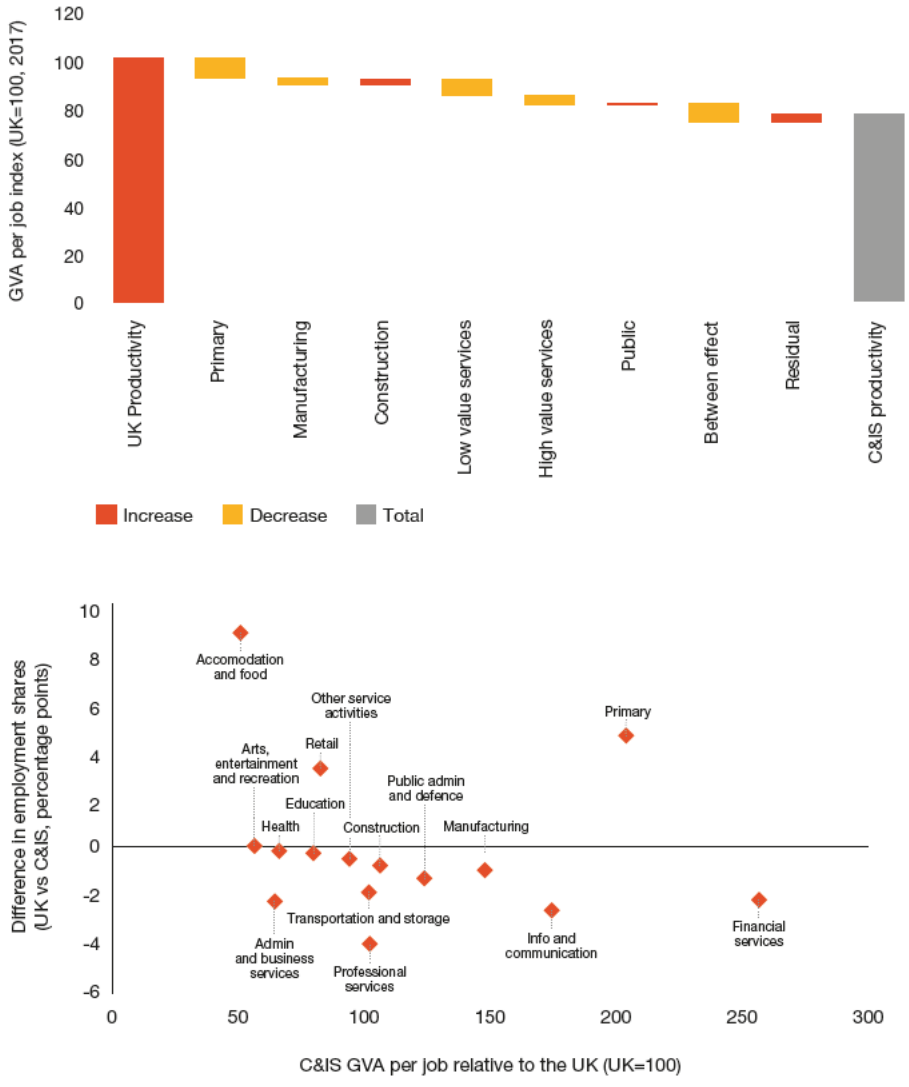
Sources: ONS, PwC analysis

18 Primary services include: Agriculture, mining, energy and utilities; Low value services include: Retail and wholesale, accommodation & food services, transportation and storage, administration and business services and arts, entertainment and recreation services; High value services include: Information and comms, Financial and insurance services, professional and scientific services and other services; Public includes: Public administration and defence, Education and Health and social care services.

The 'between effect', contributes to 7 percentage points of the productivity differential[19]. The scatter plot in Figure 4.10 shows that TVB has relatively bigger employment shares in higher productivity sectors, such as information and communications and professional services.

At the other end of the spectrum, Figure 4.11 presents the same decomposition for C&IS. It shows that most sectors – apart from construction and public services – are less productive than the UK average. In addition, the Cornwall LEP is also over-represented in terms of the share of employment in lower productivity sectors, such as the agriculture, retail and tourism-driven sectors such as accommodation and food services.

Figure 4.11 – Decomposition of productivity differences and employment composition by industry sector and productivity – UK vs Cornwall and Isles of Scilly, 2017[20]



Note: The X-axis shows productivity in each industry in the UK, relative to the average for the UK economy as a whole.

Sources: ONS, PwC analysis

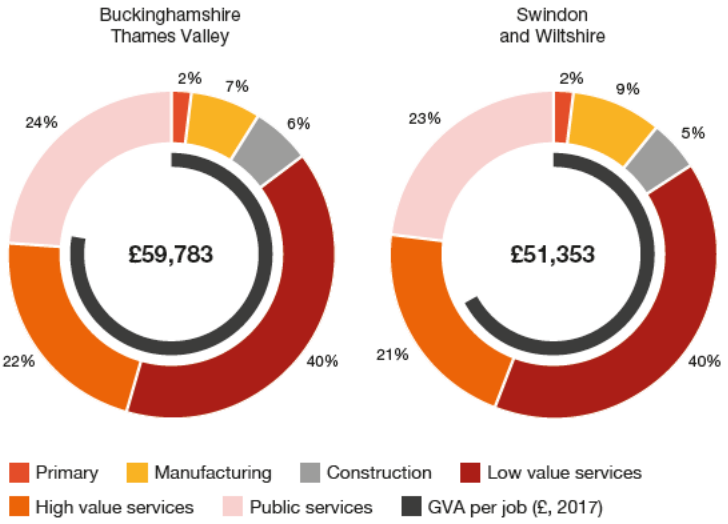
19 In the right hand panel, each industry sector is represented by a dot: dots above the x-axis are where TVB has a larger employment share than the UK, dots below where the TVB has a lower share. The sectors are ordered by their relative productivity; the further to the right, the more productive an industry is.

20 Primary services include: Agriculture, mining, energy and utilities; Low value services include: Retail and wholesale, accommodation & food services, transportation and storage, administration and business services and arts, entertainment and recreation services; High value services include: Information and comms, Financial and insurance services, professional and scientific services and other services; Public includes: Public administration and defence, Education and Health and social care services.

Industrial structure does play a role, but it alone is insufficient to explain all productivity differences. To illustrate this point, we compare two more similar LEPs: Buckinghamshire Thames Valley (BTV) and Swindon and Wiltshire (S&W). The composition of employment (based on the same high-level industry breakdown) across these two LEP areas is fairly similar, as shown in Figure 4.12.

However, BTV outperforms S&W's productivity levels by around 16%. The reasons for this are discussed in more detail in Box 4.1, with the key being BTV's higher share of technology companies and other high value services activities relative to S&W.

Figure 4.12 – Share of employment and productivity for Buckinghamshire Thames Valley and Swindon and Wiltshire, 2017



Sources: ONS, PwC analysis

Box 4.1 – Explaining the differences in productivity between BTV and S&W

To explain this gap, we apply a similar decomposition to explain the productivity gap between BTV and S&W.

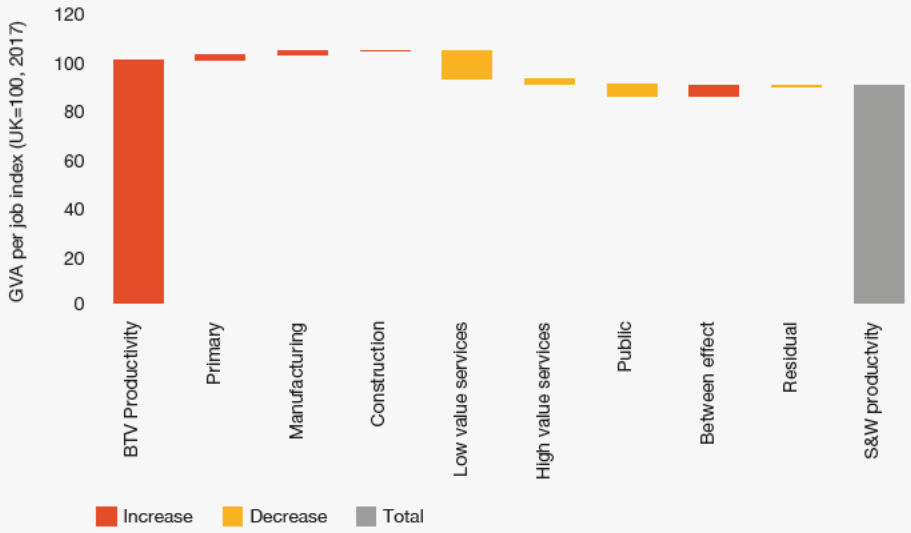
S&W lags behind BTV in terms of productivity, particularly within the services sectors, as well as public services. The decomposition shows that c.19 percentage points of the productivity differential between these two LEPs can be attributed to the service sectors.

Some of these differences may be attributed to economic activities in S&W tending towards less productive sub-sectors (especially within the low value-added services sector), such as accommodation and food services.

The largest sectors by employment in Swindon and Wiltshire[21] are in the public sector, including health and education, followed by professional and financial services.

In contrast, BTV is home to high tech and engineering clusters, such as Silverstone and Westcott Venture Park, that are located in the region, meaning that BTV is in a region with one of the highest shares of employment in high-tech services in Europe.

Figure 4.13 – Decomposition of productivity differences – Buckinghamshire Thames Valley vs Swindon and Wiltshire, 2017



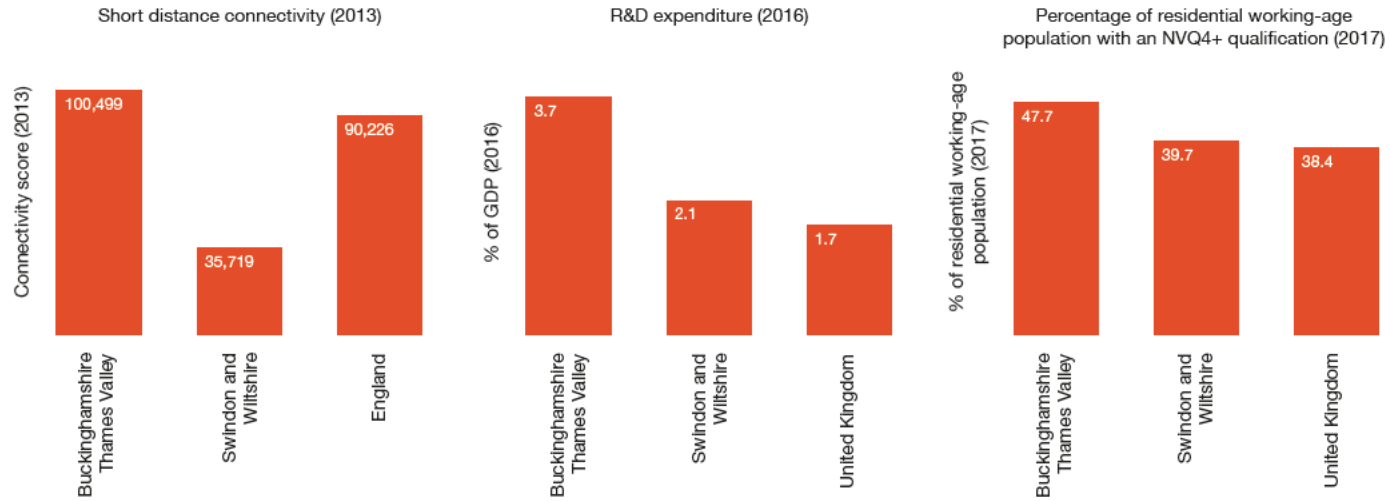
Sources: ONS, PwC analysis

While S&W also hosts clusters of Advanced Manufacturing, with employers such as Dyson Technologies and Honda operating in the area, the region's natural capital also lends itself to a thriving tourism sector and related services. But these also tend to have lower labour productivity.

We find that the 'between effect' (i.e. the composition of economic activity) exerts a small positive contribution in favour of S&W, which partly offsets some of the negative contribution from the services sectors. But industry structure is only a small part of the story here.

21 SWLEP, Swindon and Wiltshire's Local Economic Assessment, 2018.

Figure 4.14 – Short distance connectivity (2013), R&D expenditure as a percentage of GDP (2016) and percentage of working age population with an NVQ 4+ (2017), Buckinghamshire Thames Valley vs Swindon and Wiltshire



Sources: PwC analysis, Eurostat, Nomis

These findings suggest that differences in industrial structure offer only a partial explanation for regional differences in productivity. What is more, differences in the structure of a local economy only beg further questions about why particular industries have flourished in some places and not others. This turns the spotlight back to the differences in skills, connectivity, and investing in innovation which are the fundamental factors behind economic performance.

For example, within connectivity, BTV has strong connectivity linkages with Heathrow Airport and other major cities along the Oxford-Cambridge arc, which allows it to engage in highly-productive economic activity such as professional, scientific and technical services[22]. It is also 78 minutes from the UK's economic centre (London) by public transport. In contrast, S&W is, on average, just over two hours from London by public transport. Similarly, BTV performs slightly better than S&W in terms of business spending on R&D, as well as the share of the residential adult population that are highly skilled.

22 Buckinghamshire Thames Valley, Local Industrial Strategy Economic Evidence base, 2019.

Which variables have most explanatory power for regional productivity differences?

We have also carried out a more formal multivariate regression analysis to identify more precisely the relative importance of possible drivers of differences in regional productivity at the LEP level.

To do this, we regress productivity on key drivers for which adequate local data are available, namely skills, connectivity and investment in R&D and innovation, and business size. The technical annex contains more details of our modelling methodology and results.

We find that two variables reliably have statistically significant impacts on relative local productivity:

- **Workplace skills**, measured by the share of professional and managerial occupations in the local area, has a statistically significant impact on the productivity of the local area. A 1 percentage point increase in this measure, results in a 2% increase in productivity.
- **Physical connectivity** also matters. A 1% increase in the short-distance connectivity score boosts productivity by 0.06%. To put this into perspective, if Cornwall and the Isles of Scilly could improve its short distance connectivity score to match the score of the Heart of the South West LEP (an increase of c. 85%), its productivity would increase by around 10%, or £4,600 per job.

The lack of significance for the innovation driver might suggest that while it is important to create new inventions or innovations, it is the adoption of new technology (or diffusion) that is more important for the relative productivity ranking of different regions. But this is not easy to measure at local level as precisely as needed for this kind of formal regression analysis.

While the other drivers have not appeared to be significant in our multivariate regression analysis, our univariate analysis of these drivers show that they are individually positively associated with productivity. However, when taken together, our analysis shows that better workplace skills and greater physical connectivity appear to be the most important factors associated with higher local productivity levels.

One might also expect the local level of educational attainment to matter for productivity, as the young people that live and grow up in the local area may then tend to move into jobs in the same locality after leaving school or university. As a result, LEPs that are able to produce highly qualified young people should be more productive as these young people enter the workforce.

We include 'Attainment 8' as a measure of educational attainment. Attainment 8 is the average score for pupils' in eight English Baccalaureate subjects taken at GCSE within a local area. When educational attainment is included in our model, it is statistically insignificant, but the workplace skills variable remains significant.

This may reflect the fact that young people tend to be relatively mobile, often moving to a new city for university, and then migrating to another in search of job opportunities[23]. These patterns of mobility potentially weaken the link between local educational attainment and productivity, meaning that the ability of local areas to attract and retain high-skilled workers after they finish their school or university education matters more for local productivity.

23 See Centre for Cities, The great British brain drain: an analysis of migration to and from Liverpool, January 2017.

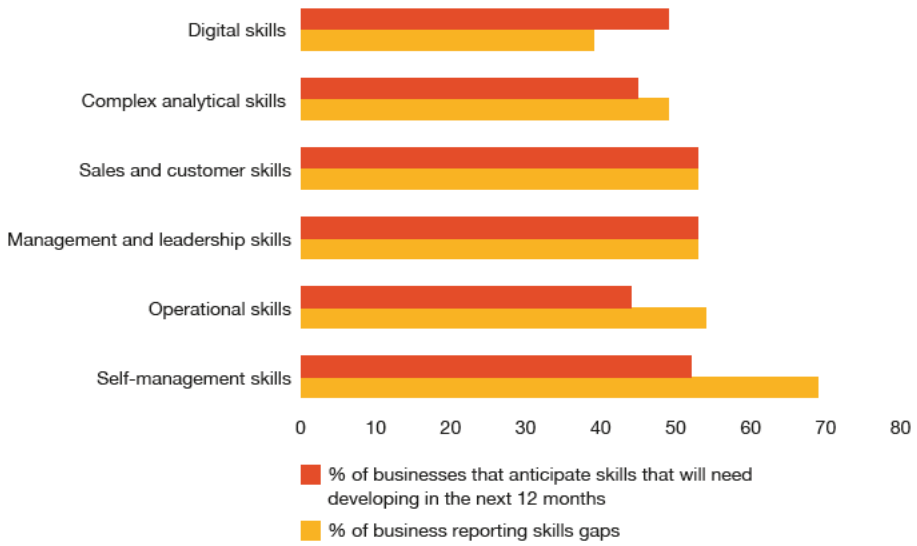
4.3 – How can the UK boost productivity for regions that lag behind?

Our analysis shows that local factors, particularly connectivity and workplace skills matter for productivity. Following the National Industrial Strategy, LEPs in England have developed, or are in the process of developing, local strategies that will promote the coordination of local economic policy and national funding. They will establish new ways of working between national government, local councils and businesses to identify priorities to improve skills, increase innovation and enhance infrastructure and business growth.

Particularly for workplace skills, our results imply that continuing skills development over people's working lives to improve their productivity could have a positive impact on regional productivity performance. The continued upskilling of UK workers and the development of our education system to support the education of our young people should be fundamental for policymakers as a means of boosting both local and national productivity.

While the results for the impact of local education attainment from our regression analysis suggest that local areas could make up for any educational attainment gap somewhat by attracting skilled workers from other areas, this does not mean that local areas should neglect the development of young people's skills in schools and through vocational training. It does, however, reinforce the need to ensure that there are plentiful job opportunities to attract highly skilled young people, supported by a conducive living and working environment (as our most recent Good Growth for Cities report explores[24]). If job opportunities are scarce, young people will seek better fortunes elsewhere.

Figure 4.15 – Profile of skills gaps, 2017



Source: Department for Education, Employers skills survey 2017

Businesses also have a critical role to play, particularly to help address skills gaps and shortages in the labour force. The UK Employers Skills Survey, a study led by the Department for Education based on the responses of over 87,000 employers, provides some insight into the skills challenges that UK employers face within their existing workforces and recruiting[25]. More than one-third of UK businesses reported experiencing a skills gap or skills shortage vacancy in 2017. Businesses also report that the majority of hard-to-fill vacancies are caused, at least partly by a lack of skills, qualifications and experience among applicants.

Figure 4.15 summarises some of the key skills in which businesses report experiencing gaps. Ares with the most acute skills gaps include "soft skills" such as self-management and leadership skills (which have reported gaps of 69% and 53% respectively).

While digital skills are expected to increase in importance in the short-term, it is notable that interpersonal skills, such as management and leadership skills, and sales and customer skills, may be even more important in the future job market. This is not altogether surprising, as people skills can have a big impact on the ability of staff to adapt to the workplace and work effectively with others towards a common goal. In contrast to digital skills, which employees will need to constantly renew as these skills could become obsolete quickly with technological change, human skills are also likely to be more enduring and less vulnerable to future automation[26].

24 See PwC, Good Growth for Cities, November 2019.
25 Department for Education, Employers skills survey 2017, August 2018.
26 PwC research shows that 30% of jobs are at risk from automation by the mid-2030s.

Businesses can support this through workplace training and upskilling. This is especially critical given that PwC's recent global skills survey shows that the desire of UK employees to learn new skills is not being met adequately by business at present[27]. Training existing employees is, however, only part of the overall solution: businesses also need to join forces with schools, colleges, universities and policymakers to link curricula to jobs of the future.

Our analysis also shows that connectivity, particularly physical connectivity, matters to relative local productivity. The UK's National Industrial Strategy[28] includes infrastructure as one of the five foundations of productivity, supported by a projected pipeline of public and private investment of around £600 billion and public infrastructure investment in the next decade. The investment in local infrastructure could help boost the connectivity of a place (and consequently its productivity). To support connectivity between cities, LEPs could work in collaboration to strengthen intra-region connectivity. One such example is the Oxford-Cambridge arc, which is supported by four LEPs with ambitions to boost east-west transport connectivity through the East West Rail and Expressway[29]. As the government and others have recognised, more such initiatives are also needed in other parts of the country, such as the North of England, which often have less well-developed transport infrastructure.

Another important issue is the need to improve the adoption rate of new technologies across the country. Research by the CBI suggests that, while the UK's best performing firms are highly innovative, best practices must reach a greater range of businesses through the adoption of proven technologies and ideas[30]. A survey by the ONS also shows that most UK firms are yet to adopt more sophisticated technologies for e-commerce and to improve organisational efficiency[31]. The UK Innovation Survey published by BEIS also shows there are clear benefits from increasing the rate of innovation at the firm level, but doing this consistently across the country will take sustained long-term efforts by both government and business.

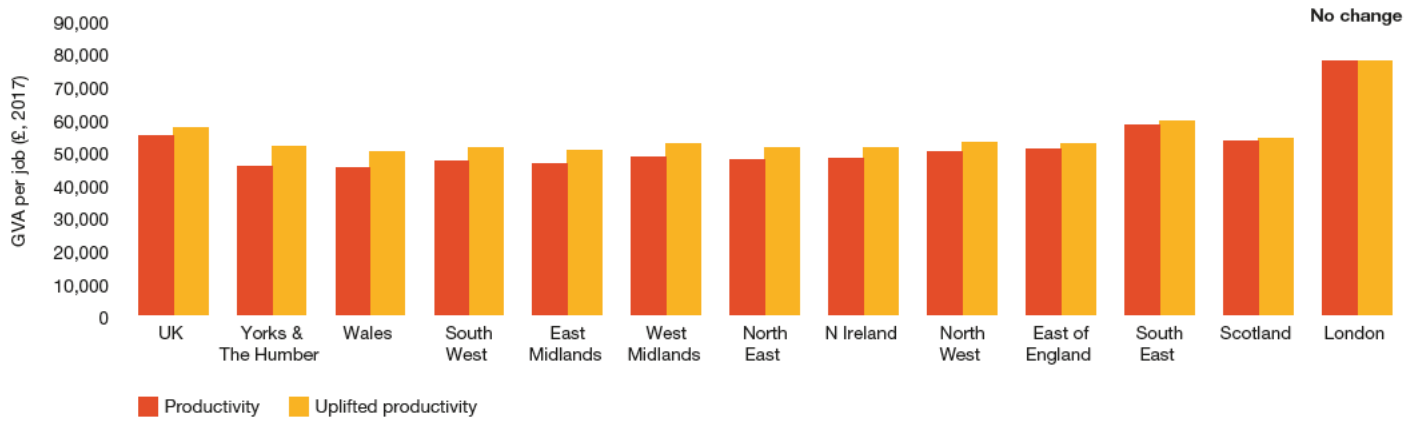
4.4 – The potential prize from closing the regional productivity gap

Our analysis shows that there is a wide range of policy levers that local and central government can use to deliver local improvements in productivity. Businesses can also do their part by contributing to the skills and innovation agenda.

The prize for getting this right is potentially large. If LEPs and countries that are currently performing below the UK average can close 50% of the gap in productivity performance with the UK median, it could boost UK GVA by around £83 billion, equivalent to nearly 4% of GDP. At the NUTS1 level Yorkshire and the Humber could see the largest percentage increase (13.5%), followed by Wales (10.7%).

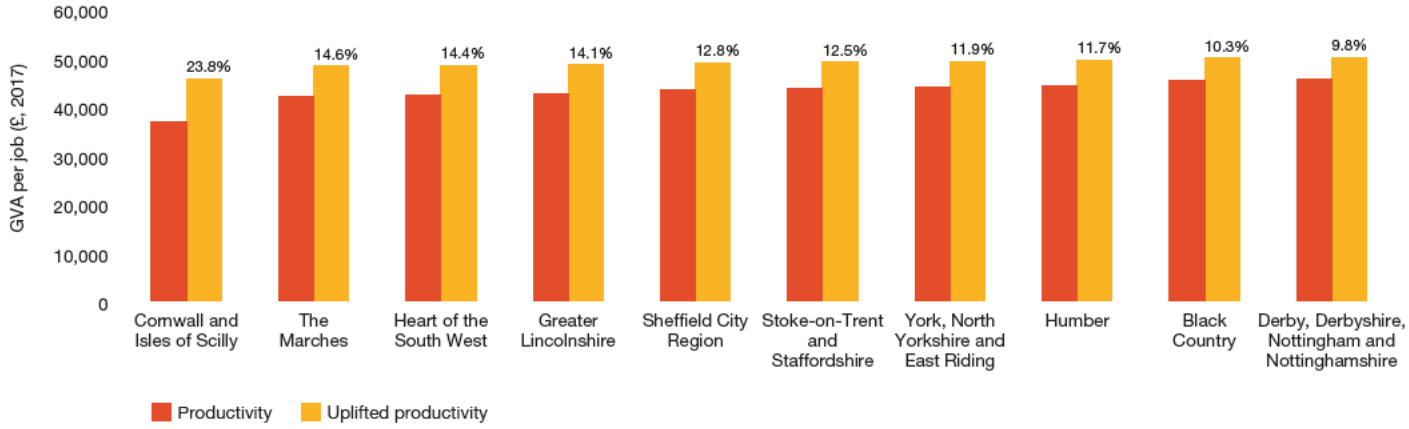
27 PwC, The Upskilling Hopes and Fears research, September 2019.
28 Department for Business, Energy and Industrial Strategy, National Industrial Strategy, 2017.
29 The four LEPs include the Oxfordshire Local Enterprise Partnership (OxLEP), Buckinghamshire Thames Valley Local Enterprise Partnership (BTVLEP), South East Midlands Local Enterprise Partnership (SEMLEP), and the Business Board of the Cambridgeshire and Peterborough Combined Authority.
30 CBI, From Ostrich to Magpie, November 2017.
31 ONS, Information and communication technology intensity and productivity, October 2018.

Figure 4.16 – GVA per job and potential GVA per job if productivity uplift was attained in the NUTS 1 regions, 2017



Sources: ONS, PwC analysis

Figure 4.17 – GVA per job and potential GVA per job if productivity uplift was attained for the bottom 10 LEP regions, 2017



Sources: ONS, PwC analysis

If LEPs were to benefit from this work to raise productivity to close the gap with the UK average, it would have the greatest impact on Cornwall and the Isle of Scilly; with a potential productivity increase of almost 24% (equivalent to £8,752). Significant gains could also accrue to areas like The Marches, Heart of the South West and Greater Lincolnshire (see Figure 4.17).

Such a significant increase in productivity would improve the UK's economic prosperity and its comparative performance across advanced economies, as well as addressing the significant geographical income inequalities across the UK. Moving in this direction will be one of the key challenges for future UK governments as they look beyond Brexit.

Technical annex: econometric analysis of the drivers of regional productivity

We use a simple cross-sectional regression approach to understand the relative importance of the various drivers that influence regional productivity. We estimate the model parameters using the standard ordinary least squares (OLS) econometric technique using data on all 38 LEPs.

Table 4.1 sets out the variables we included in our modelling specification.

The primary skills measure we use relates to the share of occupations within the LEP that fall within the SOC definition of skill level 4, which is comprised of professional occupations and high-level managerial positions in business or government.

In our second model, we also test the importance of educational attainment as a measure of local educational attainment levels. To do this, we included the UK Government's Attainment 8 scores for LEPs[32].

Technical annex model 4.1

$$\ln\text{Productivity}_j = \beta_o + \beta_1\text{Skills}_j + \beta_2\ln(\text{Connectivity}_j) + \beta_3\text{Digital}_j + \beta_4\text{R\&D}_j + \beta_5\text{Business size}_j + \mu$$

Technical annex table 4.1: Variables included in our modelling specification

	Variable	Definition	Data source
Dependent variable	$\ln\text{Productivity}_j$	Log of productivity (GVA per job) for LEP_j	ONS
Explanatory variables	Skills_j	Percentage of workplace adult population working in an occupation with a skill level 4 (SOC) for LEP_j	Nomis, ONS
	$\ln\text{Connectivity}_j$	Log of short distance connectivity 'score' for LEP_j	PwC analysis
	Digital_j	Percentage of fixed broadband connections with speeds of >30Mb/s for LEP_j	Ofcom Connect Nations
	$\text{R\&D}_j$	The level of R&D expenditure as a percentage of GDP for LEP_j	Eurostat
	Business size_j	Percentage of large businesses (250+ employees) for LEP_j	Nomis, ONS
	$\ln\text{Attainment8}_j$	Log of LEP_j's average Attainment 8 score	Department for Education

Source: PwC analysis

Technical annex model 4.2

$$\ln\text{Productivity}_j = \beta_o + \beta_1\text{Skills}_j + \beta_2\ln(\text{Connectivity}_j) + \beta_3\text{Digital}_j + \beta_4\text{R\&D}_j + \beta_5\text{Business size}_j + \beta_6\ln(\text{A8}_j) + \mu$$

32 This score is measured by calculating the average score for pupils' eight English Baccalaureate subjects taken at GCSE within the local area.

The results from our analysis are shown in Table 4.2.

To test the relationship between productivity and individual drivers, we also test each of the individual variables in isolation using a univariate regression, again using the OLS approach, based on the following specification:

Through our series of univariate regressions, we have found that all of the variables individually appear to have a statistically significant relationship with productivity (at the 1% significance level), as shown in Table 4.3. However, our multivariate analysis is more powerful in indicating which of the variables has greater explanatory power.

Technical annex table 4.2: Log-linear coefficients for explanatory variables of productivity, 2017

	Model 1	Model 2
Dependent variable	**Log of productivity**	**Log of productivity**
Percentage of level 4 occupations (SOC)	2.043***	1.660***
ln(short distance connectivity score)	0.062**	0.052*
% of fixed broadband connections >30Mb/s	-0.055	0.082
ln(average Attainment 8 score)		0.484
Constant	9.516***	1.777***
N	38	38
VCE	OLS	OLS
Adj R squared	0.739	0.743
RESET p value	0.059	0.035

*** Statistically significant at the 1% level, ** statistically significant at the 5% level, * statistically significant at the 10% level

Source: PwC analysis

Technical annex model 4.3

$$\ln\text{Productivity}_j = \beta_o + \beta_1 \text{Skills}_j + \beta_2 \ln(\text{Productivity driver}_j) + \mu$$

Technical annex table 4.3: Univariate regressions

	Univariate regressions
Dependent variable	**Log of productivity**
ln(percentage of level 4 occupations (SOC))	0.707***
ln(short distance connectivity score)	0.147***
ln(% of fixed broadband connections >30Mb/s)	0.532***
ln(R&D expenditure as a proportion of GDP)	0.102***
ln(% of large enterprises (250+ employees))	0.326***
ln(average Attainment 8 score)	2.082***
N	38
VCE	OLS

*** Statistically significant at the 1% level, ** statistically significant at the 5% level, * statistically significant at the 10% level

Source: PwC analysis

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The Design Group 34113 (11/19)