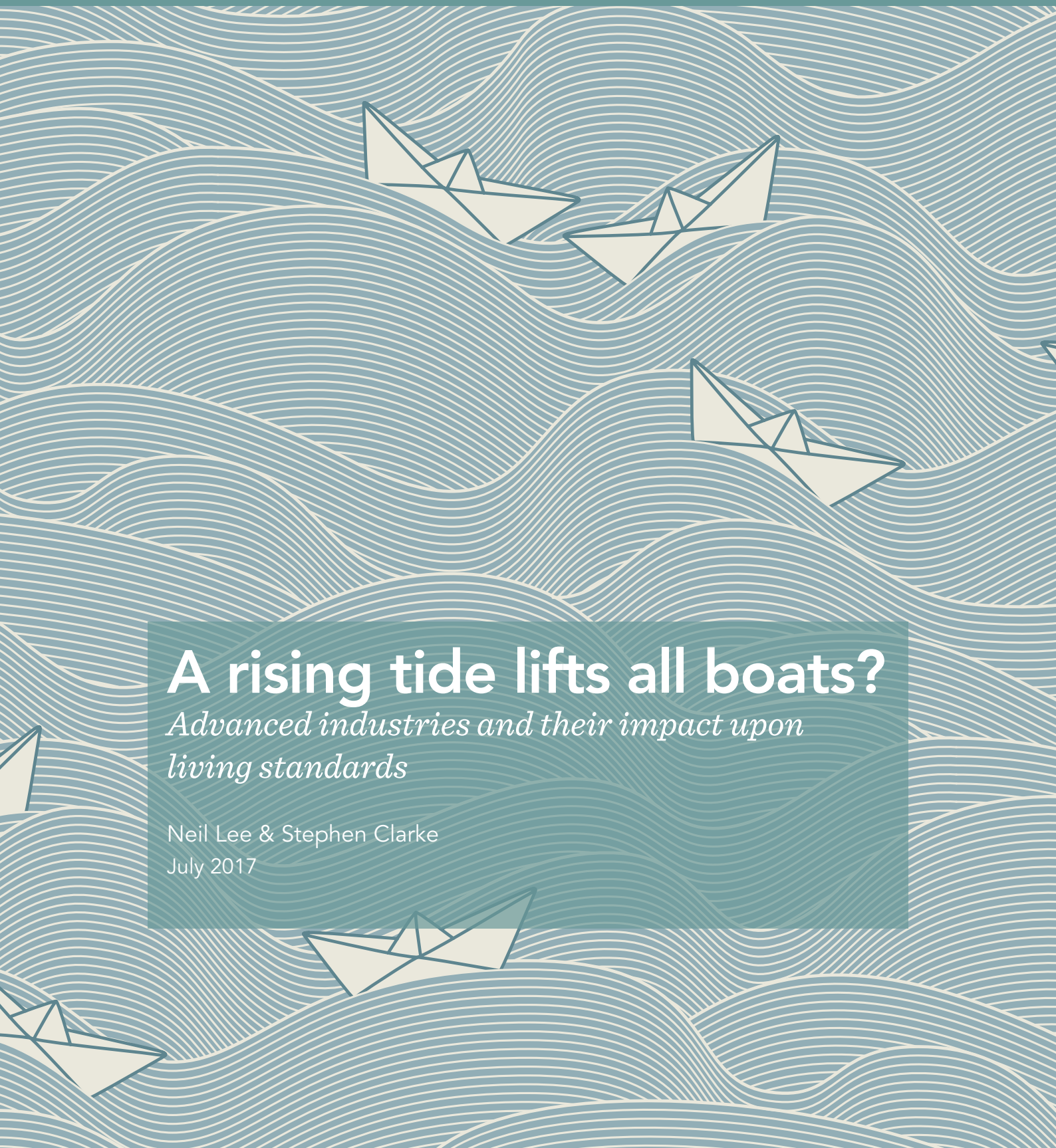
RF

Resolution Foundation

REPORT



A rising tide lifts all boats?

Advanced industries and their impact upon living standards

Neil Lee & Stephen Clarke

July 2017

Acknowledgements

This work contains statistical data from ONS which is Crown Copyright. The use of the ONS statistical data in this work does not imply the endorsement of the ONS in relation to the interpretation or analysis of the statistical data. This work uses research datasets which may not exactly reproduce National Statistics aggregates.

Contents

Executive summary 4

Section 1

Introduction: Advanced industries, industrial strategy and devolution... 7

Section 2

Regional differences in living standards..... 10

Section 3

The growth of advanced industries since the financial crisis..... 17

Section 4

Advanced industries create jobs, but the jobs may be low paid..... 23

Section 5

Conclusion 29

Annex 1: Data and definitions used in this analysis 33

Annex 2: Regression model 35

Executive summary

Industrial strategy is back in fashion

Policy makers in Westminster, devolved administrations, cities and local authorities struggle with many of the same challenges. Encouraging economic growth is vital but so too is ensuring the prosperity created is evenly shared. After a long absence, industrial strategy is back on the agenda as a way of providing this inclusive growth.

The cornerstone of the consensus view of industrial strategy is the need to help advanced sectors develop and spread them across the country. The intention is that growth that is inclusive *across* places is also inclusive *within* places, as those not directly involved in advanced sectors will benefit from positive spillover effects. This theory underpins both industrial strategy and city economic empowerment.

But to what extent does this hold true? The key tests of this approach are, firstly, whether growth in advanced sectors been dispersed and, if so, whether the benefits have been shared within those areas. Answering these questions is a prerequisite not just for the government's industrial strategy but also for those at the levers of power beyond Westminster, including the newly-elected Metro Mayors.

Regional disparities have remained entrenched

On this first test, the South East of England and London continue to dominate when it comes to advanced industries, defined here as high-tech, digital economy, tradeable finance and the creative industries. London contributed three-quarters of the growth in these sectors between 2009 and 2015 and currently accounts for over one-quarter of all jobs in advanced tradeable industries, up slightly from 2009.

Wider inequalities remain too. Differences in household income between the countries and regions of the UK have held relatively constant in the past two decades; although these gaps are less marked than in the 1980s, regional inequality is higher than in the 1970s. The case for industrial strategy placing a greater emphasis on tackling these gaps is therefore strong.

Growth in advanced industries has led to growth in non-tradeable jobs

The second test of this approach to industrial strategy is whether families not directly involved in these sectors gain too. Two of the most important indicators of living standards are employment and wages. On the first of these, our analysis suggests that growth in advanced industries is helping to bring more people into the labour market.

We estimate that the approximately 234,000 advanced industry jobs added between 2009 and 2015 in turn created 147,000 'non-tradeable' jobs, such as roles in hotels, restaurants or hair salons that can't be moved out of an area. As well as creating well-paid jobs for people directly employed in these advanced industries, their expansion in turn accounted for 20 per cent of all jobs in the non-tradable service sector created during the period, and 7 per cent of total jobs growth. This equates to every 10 additional jobs in these advanced industries leading to six additional non-tradeable roles.

And the beneficiaries of these additional non-tradeable jobs are those with fewer qualifications. For each 10 additional jobs in advanced industries, a further 4 jobs are created and filled by workers with relatively low levels of education, meaning over the period approximately 60,000 additional jobs were created for people in this group. This new evidence suggests that an industrial strategy taking this approach can bring rewards within in area.

A national approach isn't enough to ensure jobs growth however

The figures outlined above are the average impact of advanced industries on jobs across the country. The interplay of this with other local factors mean in some parts of the country this effect was larger while in others it was smaller. For example, the knock-on or multiplier effect in Cambridge was much larger than average. Instead of every 10 jobs in advanced industries leading to a further three jobs in non-tradeable services, we find that for every 10 jobs in advanced industries an additional 28 jobs in non-tradeable services, although all these jobs cannot be attributed to the growth in advanced industries. Bath, on the other hand lost non-tradeable service sector jobs while gaining advanced jobs over the period. This variation underlines the need for a national industrial policy to sit alongside a city level approach, with city leaders needing to make sure that, for instance, transport routes

help people across an area access new jobs.

The impact on pay of the lower skilled is less impressive

Having established the positive jobs impact advanced industries can have, we next turn to the effect on wages. The expansion of advanced industries appears to increase the demand for mid-skilled workers. We estimate that as a result a worker with an average education level received an annual boost of around £70 over the period.

But for workers with lower education, our analysis suggests advanced industries do little to raise their pay. In fact, pay actually falls for this group by £85 a year for a full-time worker because the new jobs that are created and the people who fill them are – on average – lower paid. This result does not mean that advanced industries reduce living standards for people on low wages but it does act as a reminder that the expansion of such industries will not solve the UK's low pay problem. A modern industrial strategy must be able to take in both these advanced industries and help to raise productivity in non-tradeable sectors. A failure to focus on industries like retail and hospitality that are low-paying but employ much of the population is likely to mean a failure to narrow regional divides or boost living standards.

Section 1

Introduction: Advanced industries, industrial strategy and devolution

Industrial strategy is back on the agenda

After a long time out of the policy limelight, industrial strategy has re-emerged as a focus for policy makers. While this is evident among the main political parties at Westminster, industrial strategy has featured more regularly in debates at all levels of government. With leaders in devolved governments, local authorities and the new Metro Mayoralties increasingly seeking to achieve not just economic success but inclusive growth, the role industrial strategy can play is being revisited.

A number of shared views underpin this shift. A fear that London and the South East have too dominant a position and have left the rest of the country behind is common. For example, the Conservatives have promised to "deliver growth across the country", particularly in places where "prosperity has waned".[1] Similarly, the Labour party has argued that the country has relied too much on London, the South East and the financial sector to generate economic growth and promises to "deliver prosperity to every corner of the country".[2]

Another element of this consensus on industrial strategy is that there are strategically important sectors that need to be supported. Such a consensus shows how the political and economic debate has changed from a time when such talk would have been criticised as government picking winners, or propping up losers. Industries such as car and aero manufacturing, financial services, life sciences, digital technology and creative industries have been highlighted as key by the government.

The theory follows that government support of specific sectors can raise economic growth and spread the benefits of economic growth more evenly across the country. The Industrial Strategy Green Paper, issued by the government in January 2017 notes that public R&D funding is disproportionately spent in the South East, particularly in Oxford, Cambridge and London. This partly reflects the fact that these cities contain universities that top the league tables for research, and clusters of innovative firms, but it also speaks to choices that the government has made. This raises the question of whether reallocating spending to less affluent areas could promote similarly innovative clusters, and begin to reduce economic inequality, or whether it would be money inefficiently spent. Government invests a great deal of effort seeking to attract inward investment. An important consideration then is the optimum balance between encouraging innovative firms to grow wherever circumstances are conducive and trying to encourage such firms to expand in economically disadvantaged areas.

Does growth in advanced industries raise living standards?

As well as being more evenly spread *across* the UK, this growth is also intended to be inclusive *within* the areas in which these industries are developed. While it is of course important to ask

[1] Conservative Manifesto 2017

[2] Labour Manifesto 2017

if inward investment improves economic outcomes in an area (and so narrows inter-regional disparities), so too is determining whether investment and economic expansion improves the lives of existing residents, and if so, which existing residents. Clearly, investment provides employment for those who work in the growing sector or incoming firm. To take one example, when Nissan chose to invest in Sunderland in 1986, it brought with it thousands of jobs in its plant. But as well as those roles within the plant, it created jobs in its supply chain. More indirectly, it is also likely to have generated jobs in Sunderland as Nissan employees spent their earnings in restaurants, bars and other local shops and services. In this way, jobs in advanced industries can lead to jobs in other, seemingly unconnected parts of the local economy.

But this feed-through is not the only potential knock-on effect, with other more negative consequences possible. Investment in one sector may 'crowd out' other sectors. That is, if the supply of labour is relatively inelastic, at least in the short run before other workers move into an area, then the growth of one industry may bid up wages and reduce the available labour pool for other sectors. Such a critique has been made of the growth in public sector employment, which was particularly rapid in some areas during the 2000s.[3]

Inward investment can also raise the prices of some assets, particularly land and housing of which there is a fixed or slow-to-respond supply. This may reduce or even nullify the benefits of higher wages and more employment, and is a common critique of gentrification and urban renewal.

Doubts may be raised too about the benefit for the existing population. Inward migration by higher-skilled workers may raise the employment rate in the area, but not actually improve outcomes for more longstanding residents. There may also be distributional effects: the benefits of inward investment may not accrue to all residents in an area. Depending on the match between the skills required in the jobs created and the skills of local people, some workers may be better positioned than others to take advantage. And from a perspective of growth being truly inclusive, even if the gains of investment are felt by lower-qualified or relatively low-paid workers, other higher-skilled workers may benefit more, thereby increasing inequality.

Tallying up the various benefits and costs is a challenge, but it is something that economists have attempted. It is a long-held assumption that tradeable sectors – those that produce goods that are or can be sold internationally, or at least outside of the local area – generate broader benefits for a local economy. The sale of such goods or services to places beyond the area itself generates income that is then spent locally.

Some of the most famous recent work on this subject has been done by Enrico Moretti. Moretti calculated that for each 10 additional manufacturing jobs created in a US city, 16 jobs are created in the wider economy.[4] This positive impact was not uniform; the more advanced the industry and/or the more well-paid the workers, the greater the wider benefits. Moretti calculated that firms in the 'innovation sector' (loosely defined) create 40-50 additional jobs in the wider economy.[5] These are very big multiplier effects and would suggest that policy makers should do all within their power to attract such inward investment.

There have however been criticisms of Moretti's work. Van Dijk replicated his approach and found that for each additional 10 tradeable jobs, a further 8 jobs were created in the wider economy, a significant boost but much lower than Moretti's estimate of 16.[6] Other research has found that although inward investment and the growth in advanced industries may raise pay and

[3] G Faggio & H Overman, 'The effect of public sector employment on local labour markets', *Journal of Urban Economics 79*, pp.91–107, January 2014

[4] E Moretti, 'Local Multipliers', *American Economic Review*: Papers & Proceedings 100, May 2010

[5] E Moretti, *The New Geography of Jobs*, 2012

[6] JJ van Dijk, *Local Multipliers In United States Cities: A Replication of Moretti (2010)*, Department of Economics Discussion Paper, December 2015

reduce poverty, those at the bottom of the earnings distribution fail to benefit.[7] Another query for this report is how transferrable these results are beyond the US given question marks over whether geographical and tax differences limit their applicability elsewhere. Taken together, although there is some evidence that encouraging inward investment and the growth of advanced industries can produce widely felt economic benefits, the jury in the UK is still out.

Policy makers need a better understanding of the spillovers of economic development

National leaders have long been involved in attracting inward investment and encouraging the growth of advanced industries, including more recently those in Scotland, Wales and Northern Ireland. However, given the centralised nature of the UK's political system regional politicians – aside from the mayor of London – have had less of a role. The election of Metro Mayors in city regions is changing this.[8]

These mayors and other local leaders may wish to use the formal and informal powers at their disposal to attract and develop advanced industries and specific sectors in their region. Therefore it is important to know whether such action – if successful – will raise living standards across the region, or whether the benefits will be felt by a small, relatively privileged group of people. A particularly important question is whether the multiplier effects outlined above are quite uniform across a country or whether local factors, and therefore local policy makers, can help to maximise the inclusivity of such growth.

This paper explores some of these core assumptions of an industrial strategy built on advanced industries and its ability to spread growth both geographically and across households. The remainder of this paper is set out as follows:

- Section 2 outlines the scale of the problem, describing the economic disparities that the government's industrial strategy hopes to address.
- Section 3 discusses what we mean by advanced industries and looks at the growth of these industries across the country in recent years.
- Section 4 investigates the key question of the effect advanced industries has had on local economies since 2009 and whether this has an impact on the living standards of those with lower levels of education.
- Section 5 concludes by outlining implications for public policy and the design of an industrial strategy.

We provide details of data and definitions in Annex 1 and a description of the regression modelling in Annex 2.

[7] N Lee & A Rodríguez-Pose, 'Is there trickle-down from tech? Poverty, employment and the high-technology multiplier in US cities', *Annals of the Association of American Geographers*, 2016

[8] The city regions that elected mayors this year were: Greater Manchester, West Midlands, Liverpool, Tees Valley, the West of England, Cambridge and Peterborough

Section 2

Regional differences in living standards

Before we assess the impact of the spread of advanced industries, we first turn to how living standards vary across the country, establishing the size of the geographic disparities that an industrial strategy may seek to address. A person's living standards are a function of a number of factors: whether they have a job, how much they earn, how much tax is deducted from that wage, the price they have to pay for essentials like housing and food and how much support they receive from the state.

Our analysis focuses on the first two of these factors: employment and pay. Here, we ignore the impact of taxes and benefits because the state has greater control over these and often uses them to reduce the economic disparities produced by the market. Due to a lack of suitable data, we do not take into account how costs and prices may vary across the country. These elements are of course a vital consideration of how economic growth impacts living standards and will be a subject we return to in future analysis.

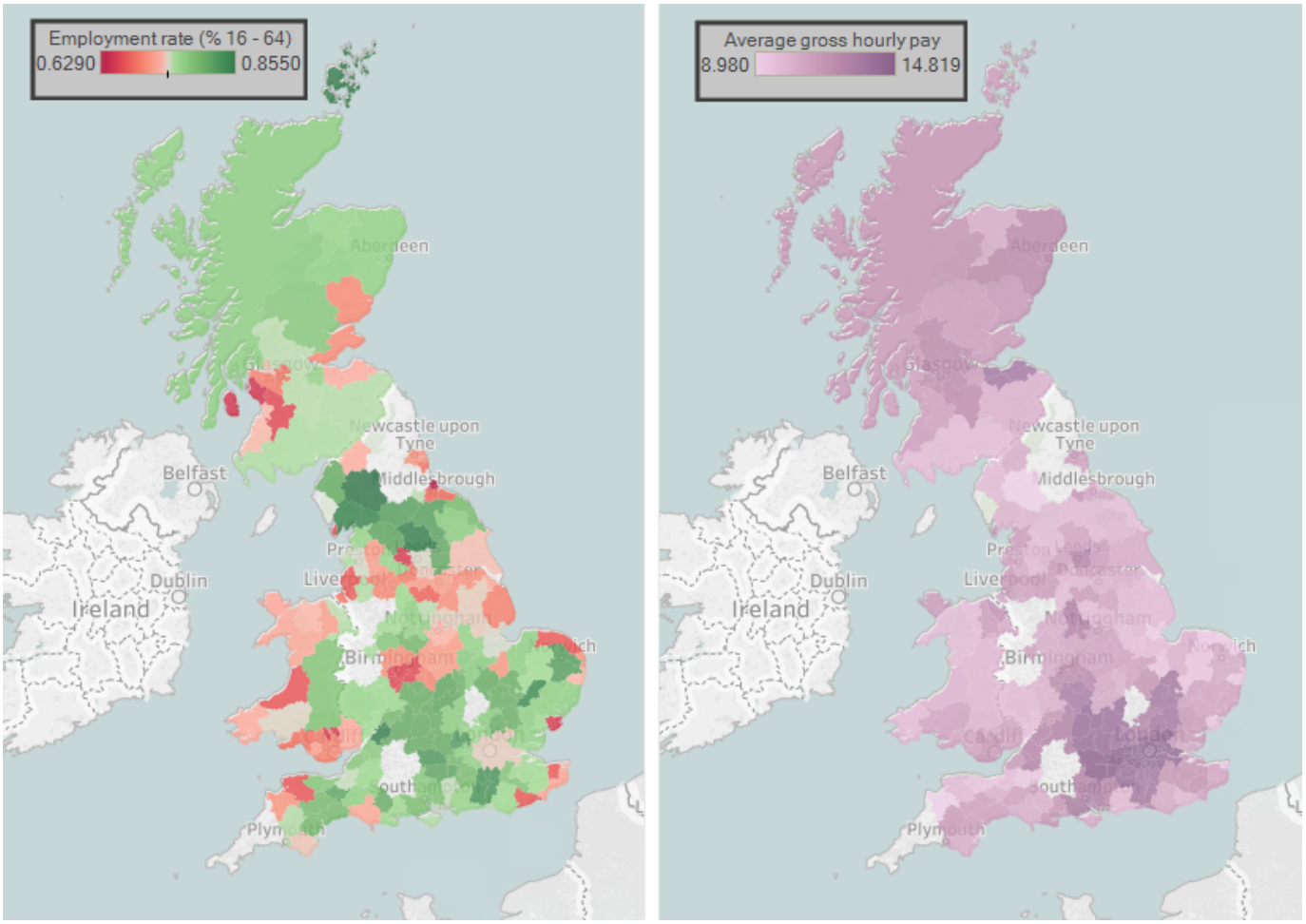
Employment and pay is higher in the South East

Broadly put, disparities in pay manifest themselves in a North-South divide. Pay is far higher in London and the South East than anywhere else in the country (right hand panel of Figure 1). When it comes to employment, the divide as shown in the left hand panel of Figure 1 is far less clear cut. That said, there are very few local economies – Figure 1 uses travel to work areas (TTWAs)[9] – in the South East with an employment rate below the national average. The exceptions are London, Hastings, Folkestone & Dover, Canterbury, Margate and Clacton.

But more of an urban-rural split is evident, with urban areas in the North and Midlands performing particularly poorly. The Birmingham TTWA has an employment rate of 66.1 per cent, for Liverpool it is 67.2 per cent and in Manchester it is 69.9 per cent, all well below the overall UK rate. By contrast, London, though still below the national average, fares better with an employment rate of 73.8 per cent.

[9] Travel to work areas (TTWAs) are produced by UK Government to indicate an area where the population would generally commute to a larger town, city or conurbation for the purposes of employment. Due to this they are the best way to capture relatively self-contained labour markets.

Figure 1: Employment and pay are higher in the South East: 2016



Notes: Data is shown for 182 travel to work areas (TTWAs) in Great Britain. TTWAs with populations below 60,000 are excluded. In the left panel, the red areas are those with employment rates below the national average and green those with rates above.

Source: RF analysis of ONS, *Annual Survey of Hours and Earnings*

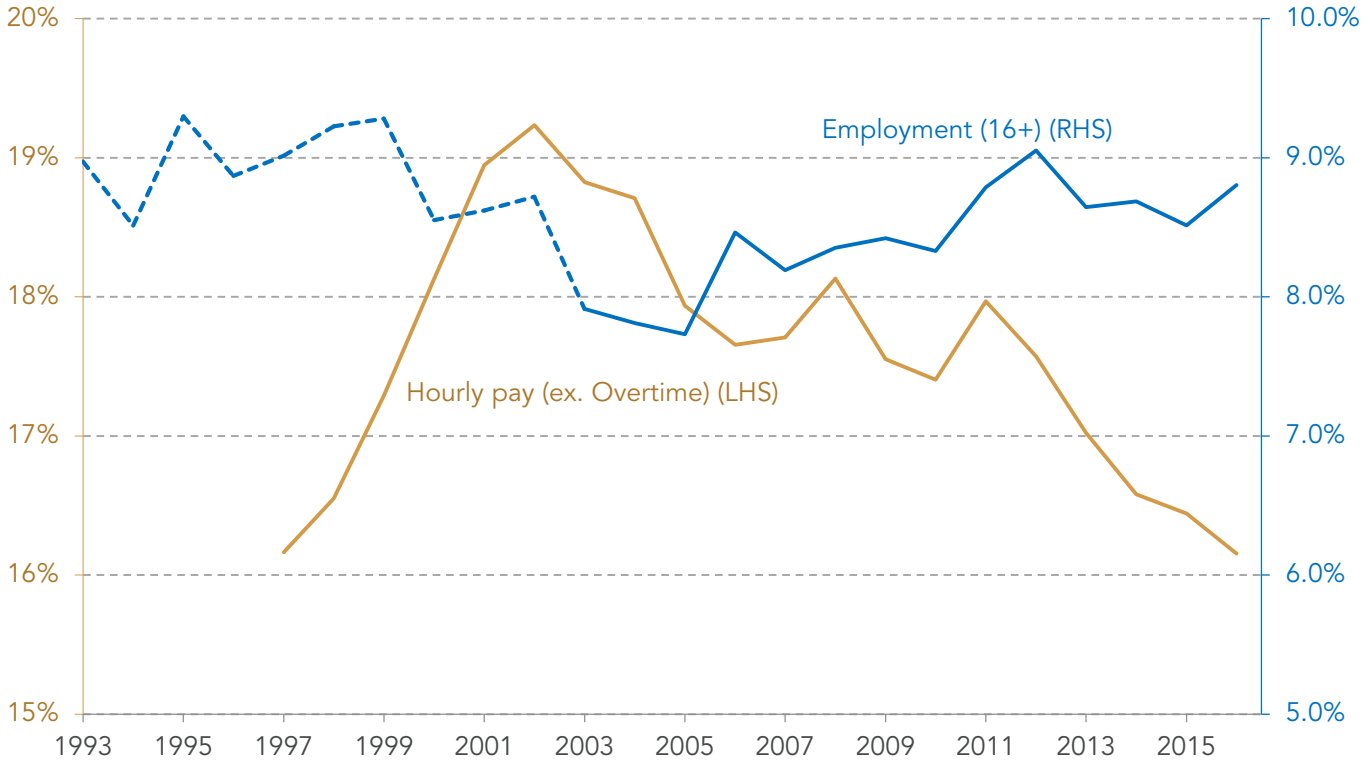
Pay and employment disparities are enduring

The evidence, at least over the past two decades or so, is that regional disparities have remained relatively constant. To measure this we look at how much employment and pay varies across local authorities in Great Britain. Figure 2 shows that differences in employment rates (as measured by the coefficient of variance)[10] between local authorities have not changed greatly. There was a decline in the gaps between areas during the early 2000s, followed by an increase as employment fell during the recession. Unfortunately however, inequality has not decreased as employment has risen in recent years.

[10] The coefficient of variance is the standard deviation divided by the mean. It therefore provides a unit-less measure of variance.

Figure 2: Regional disparities have remained relatively constant, although pay disparities have fallen recently

Coefficient of variance across local authorities in Great Britain



Notes: Dashed line shows where the *Annual Population Survey* series has been cast backwards using trends from the old unreweighted *Labour Force Survey*

Source: RF analysis of ONS, *APS/LFS* and ONS, *ASHE*

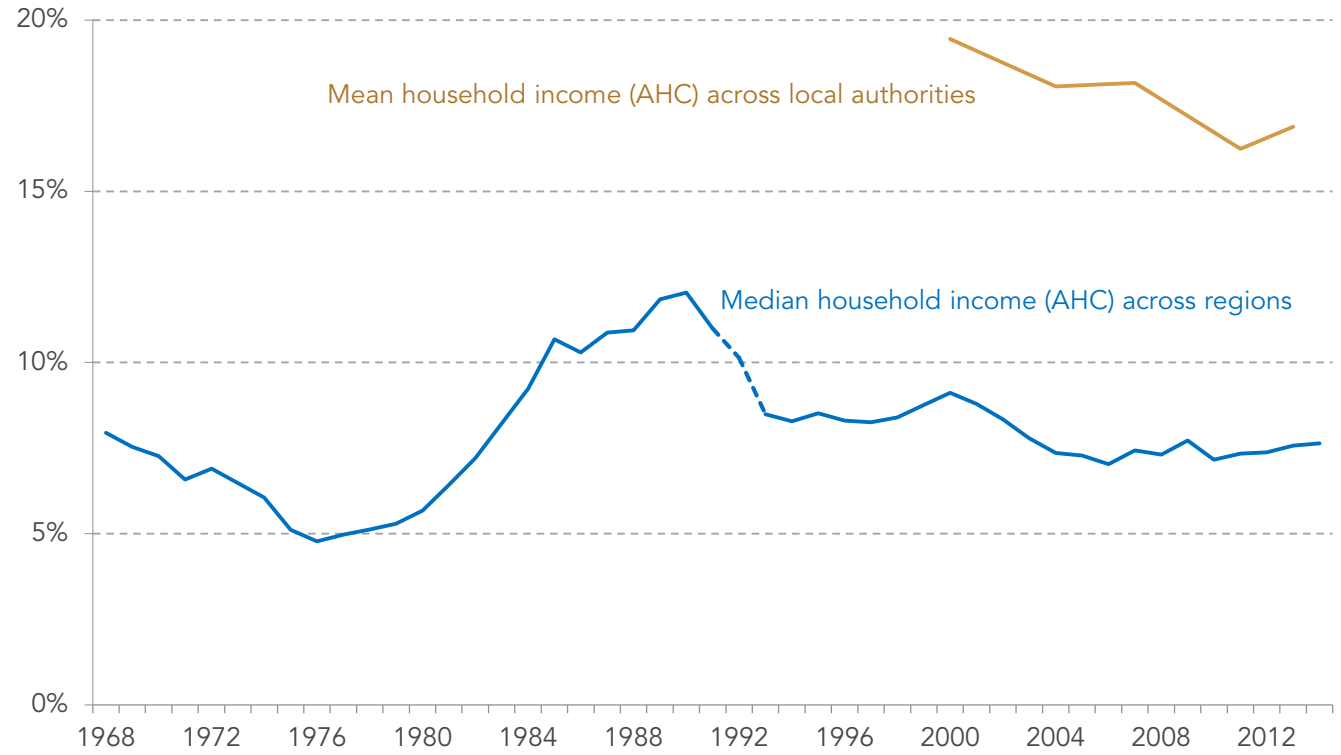
In terms of hourly pay, there is more variation, with that widening in the early 2000s but narrowing since the financial crisis. There is also evidence that the recent pay squeeze has helped narrow the differences between higher- and lower-earning areas, although disparities remain broadly the same today as they were in 1997.

Differences in household income are greater at the local level but relatively constant over time

The differences between regions of Britain have changed over time, but changes have been minimal in the past two decades. At the more local level inequality is greater, but it has fallen recently. Figure 3 shows how regional inequality has evolved since the 1960s and how local inequality has evolved since the millennium. In 1968, household income varied across the regions and countries of Britain by about 8 per cent. This rose to 13.3 per cent in 1990 before falling back again later in the 1990s and in the 2000s. This rise in inequality to 1990 coincided with the industrial decline that particularly affected many communities in the Midlands and the North. The subsequent fall represents both an improvement in living standards in the North and Midlands but also rising housing costs in the South East and particularly London which acts to drag down after housing costs incomes there. Since 2004, regional disparities have remained relatively constant.

Figure 3: Regional inequality rose in the 1980s but is today no higher than it was in the late 1960s

Coefficient of variance across Great Britain



Notes: The coefficient of variance measures the degree to which incomes vary across the 10 regions of the Britain and Scotland and Wales. It is the standard deviation divided by the mean to give a standardised measure of dispersion that can be interpreted as the average percentage amount by which incomes for regions/countries vary the British average. Income is real annual disposable household income after housing costs.

Dashed line are where we have interpolated observations because there is no data due to the end of the FES series

Source: RF analysis of ONS, *Family Expenditure Survey* and DWP, *Family Resources Survey*

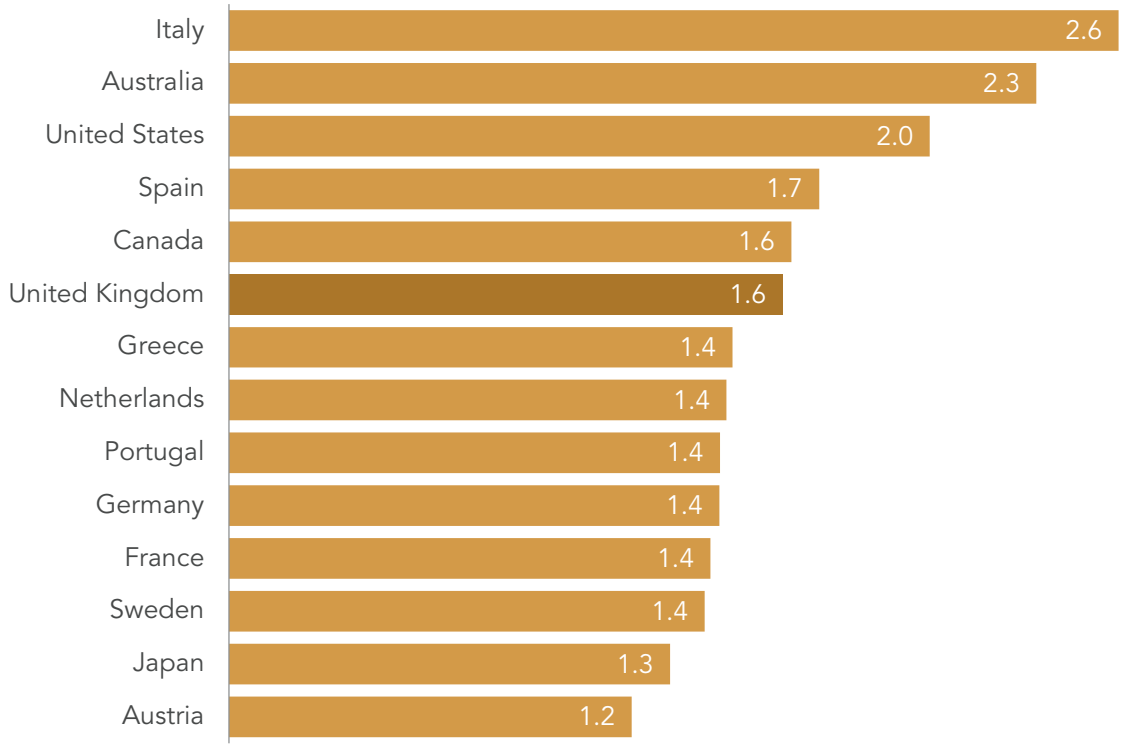
Turning to data for local authorities, there is evidence that disparities have fallen recently. Differences have narrowed since 2001 with a pronounced fall – perhaps in part due to the financial crisis – between 2007 and 2011. Nevertheless, as we are unable to obtain data for local authorities before 2001 we cannot be sure if disparities have narrowed over the long term. The regional data suggests that any recent improvement may represent an unwinding of the previous rise in inequality, rather than inequality dropping to new lows.

Regional inequality is relatively high in the UK, but not an outlier

In terms of differences in living standards across regions, the UK performs poorly compared to its peers. It is difficult to compare regional inequality across countries because how regions are defined varies and so the size and number of regions can significantly affect the results. Nevertheless, data compiled by the OECD allows for some comparison of regional inequality. Figure 4 shows that the UK is somewhat more unequal than its peers but is far from the most regionally unequal country. Household incomes are 1.6 times higher in Greater London (the region with the highest incomes) than in the North East (the region with the lowest). This compares favourably with countries like Italy and the United States, where inequality is higher, but poorly compared to many other European countries. Using other measures of inequality, such as the coefficient of variation, paints a similar picture.

Figure 4: Regional inequality is relatively high in the UK

Ratio of highest to lowest household income (US$ per household, 2010 prices, constant PPP) across regions



Notes: Data was collected for large regions for each country. The OECD follows countries' own definitions when defining 'large regions' in the UK's case the OECD uses the Scotland, Wales, Northern Ireland and nine regions of England. Income is equivalised disposable household income in 2010 US$, constant PPP.

Source: RF analysis of OECD, *Regional Database*

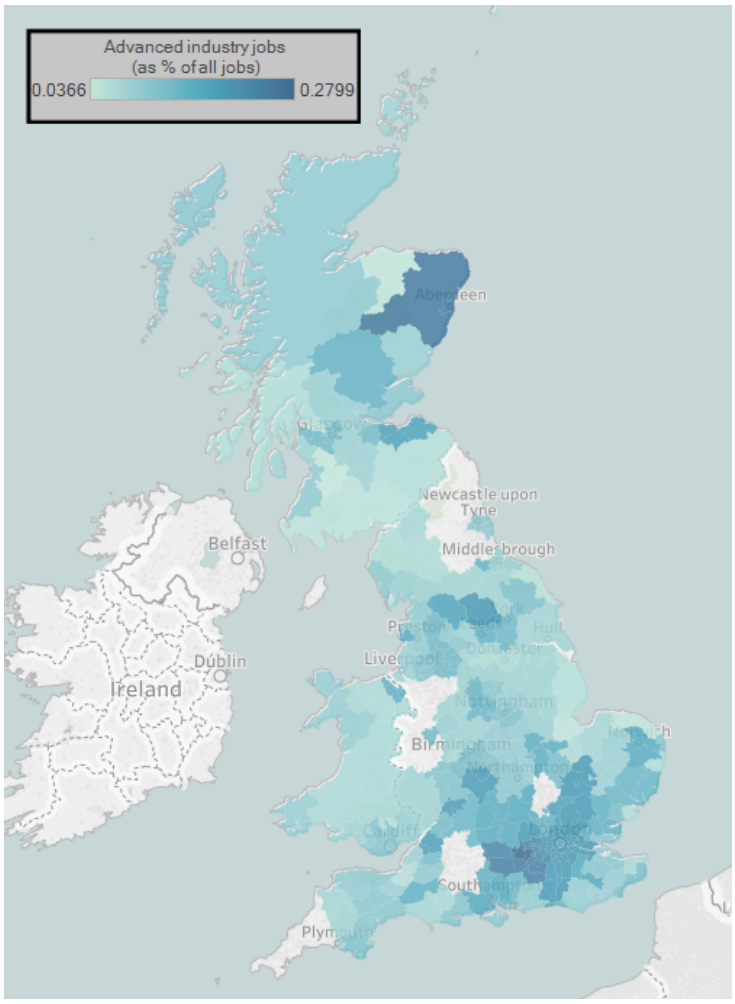
However, as we have highlighted above, regional disparities rise when we focus on smaller geographical areas. On average, net household income varies across the regions of the UK by 7.6 per cent, by 16.9 per cent across local authorities and by 22.8 per cent across neighbourhoods.[11] Unfortunately, we do not have comparable data at these lower levels across the OECD so cannot test whether the UK is more or less unequal at lower geographies, but it is important to bear in mind that regional disparities disguise a significant amount of inequality within them.

Employment in advanced industries is higher in the South East, although clusters exist across the country

It is beyond the scope of this paper to provide a comprehensive explanation of these enduring regional inequalities. In Section 4, we test whether economic growth – particularly growth in advanced sectors – has an impact on the living standards of those with lower levels of education. We do not however assess the extent to which this explains overall differences in living standards. A quick inspection of the data does suggest that advanced industries – defined here as high-tech, digital economy, tradeable finance and the creative industries – are more concentrated in the South East, where living standards are higher. As Figure 5 illustrates, there are clear clusters of advanced industries such as in London, Cambridge, Basingstoke, Reading and Newbury. Aberdeen also stands out, along with Bristol, Leamington Spa, Harrogate and Edinburgh.

[11] Neighbourhoods here refers to middle super output areas (MSOAs).

Figure 5: Advanced industries tend to cluster in the South East: 2015



Notes: Data is shown for 182 travel to work areas (TTWAs) in Great Britain. TTWAs' with populations below 60,000 are excluded.

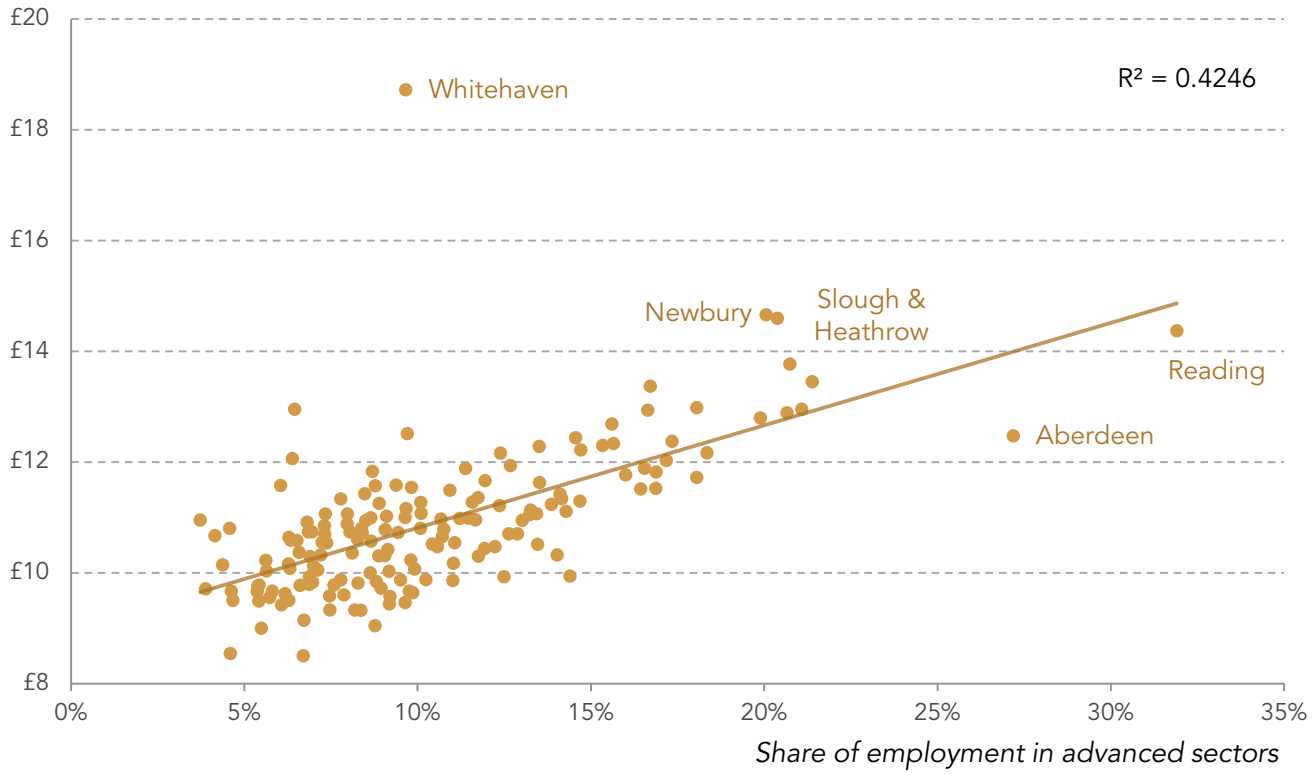
Source: Resolution Foundation & N Lee analysis of ONS, *BRES*

There is more variation when we look at each of the four specific advanced industries we examine here. Derby, due to its large automotive sector, and Cambridge, due to the cluster around the university, stand out for having a high proportion of high-tech employment. There is a digital cluster to the west of London, with concentrations of employment in Newbury, Reading and Basingstoke. Tradeable finance is perhaps the most dispersed high-tech industry with clusters in Edinburgh, Bristol, Harrogate and Skipton and Norwich. Nevertheless, despite the existence of these regional clusters in each advanced industry, there is a concentration in the South East.

This is likely to have an impact upon living standards because there appears to be a strong relationship between advanced industries and pay. As Figure 6 highlights, areas where advanced industries account for a higher share of employment also tend to have higher levels of pay.

Figure 6: Pay is higher in areas with greater concentrations of advanced industries: 2015

Gross hourly pay



Source: RF analysis of ONS, *BRES* and ONS, *ASHE*[12]

This has obvious implications for policy: to the extent that government can attract or nurture such industries, it should do so. However, while private sector jobs growth is obviously vital in raising the prospects of economically disadvantaged areas, and clearly helps those who find work, we do not yet know if this also benefits those who are not directly employed in these new jobs. This is the question we will test formally in Section 4. In the next section, we look at which areas have benefitted from inward investment and advanced industry jobs growth between 2009 and 2015.

Section 3

The growth of advanced industries since the financial crisis

There has been strong jobs growth since 2009, but this has been unevenly spread across different regions

The relationship this paper focuses on is a key test of the effectiveness of industrial strategy: how growth in tradeable, particularly advanced tradeable sectors affected local economies over the period 2009 to 2015.[12] By 'advanced tradeable' we mean those sectors that that produce relatively innovative goods or services that are predominantly sold abroad or outside of the local area. We look at the effect that these sectors have on employment and pay in non-tradeable services within the area. To help place the impact of advanced tradeables into context, we explore the impact that manufacturing – a traditionally tradeable sector – has on employment in non-tradeable services.

Table 1[13] provides an overview of the sectors we have analysed, with a more detailed description in Annex 1. For each local economy, we collected data on the number of employees in each sector in 2009 and 2015; the employment rates of lower-, mid- and higher-educated workers; and wages for each group. To define our education groups, we divide the population into three equally-sized sections, with the most highly-qualified third of the population in the higher-educated group, those with the lowest levels of qualification in the lower-educated group and the remaining third in the mid-educated group.

[12] We are forced to use the period 2009 to 2015 because of the need to use ONS, *Business Register and Employment Survey* which provides the best data on industrial structure at low geographic levels and which began in 2009. However we use the ONS, *Annual Business Survey* to test an earlier period and find our results are broadly similar.

[13] For the digital tech and creative sectors the data is defined according to the Business, Energy and Industrial Strategy Department and the Department for Culture Media and Sport.

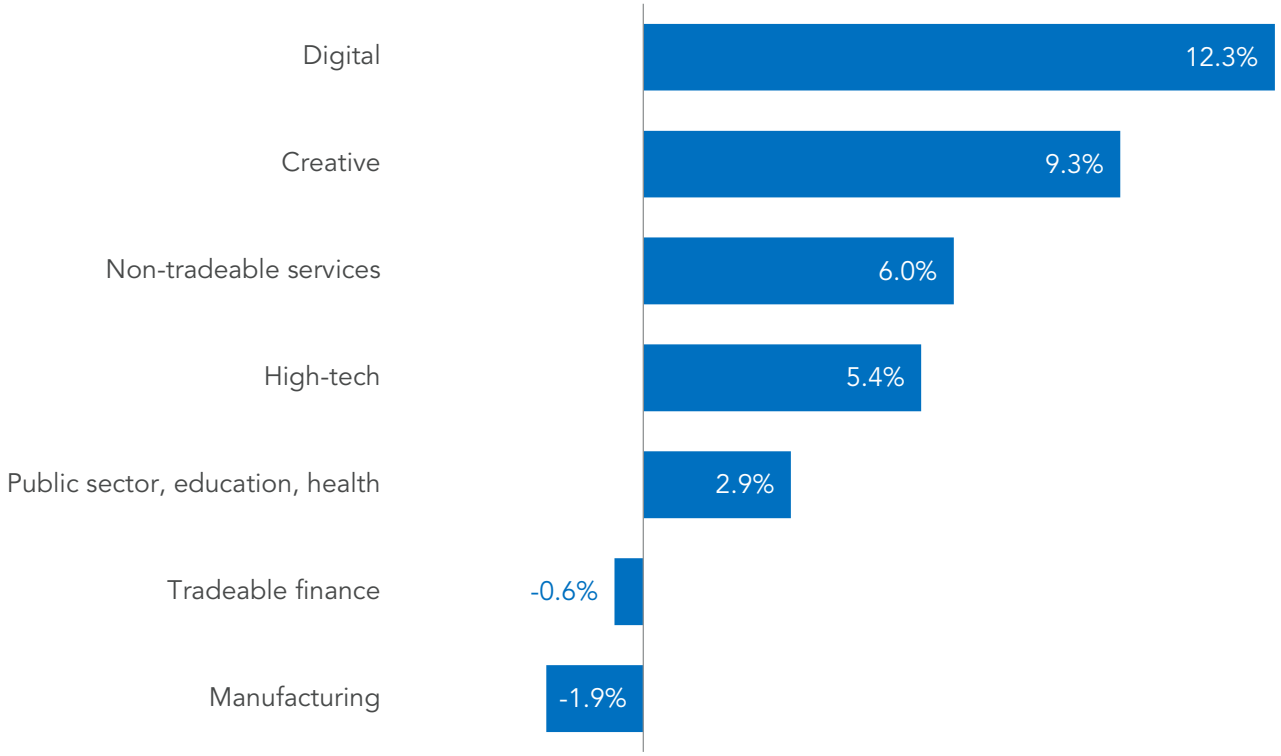
Table 1: The sectors analysed

Sector	Description
Manufacturing	All manufacturing, excluding that in the categories below.
Public sector, education and health	Education and health (public and private), social care, government and defence.
Creative industries	Advertising, architecture, fashion, film and photography. Publishing, radio and television related activities.
Non-tradeable services	These are services that are consumed locally such as hairdressers, restaurants, bars, etc. Also includes construction activities and an estimate of non-tradeable self-employment.
Tradeable finance	Defined as those parts of finance that do not serve local demand. Investment banking and fund management activities, pensions, insurance and supporting finance services. Excludes retail banking.
Digital tech	Manufacture of electronic, computing and communication equipment. Production of computer games and other software. Telecommunications consulting.
High-tech	Natural resource extraction and supporting activities; chemical and pharmaceutical manufacturing, manufacturing of advanced equipment. Also includes aerospace and rail manufacturing, science and engineering activities. Consulting, research and other professional activities.

Across the local economies studied in this paper, the sectors in Table 1 accounted for around 80 per cent of all employment in 2009. Employment in many of these sectors has grown over the period studied (2009 to 2015). As Figure 7 shows, the greatest growth in employment has been in the digital and creative sectors. Perhaps unsurprisingly given the challenges in the sector over this period, employment in tradeable finance has fallen as has employment in manufacturing. Employment in the public sector has decreased too, but there has been strong growth in non-public sector education and health so that employment in this sector has actually increased overall. There has been strong growth in non-tradeable services, which includes jobs in sectors such as hospitality, bars and restaurants, construction and self-employment. Furthermore, given the combined size of these sectors the number of jobs created is of a far larger magnitude. Over the period, employment in non-tradeable services rose by approximately 660,000 whereas employment in digital tech, creative and high-tech combined rose by 234,000.

Figure 7: Employment in most advanced sectors, and non-tradeable services, has increased since 2009

Change in employment by sector



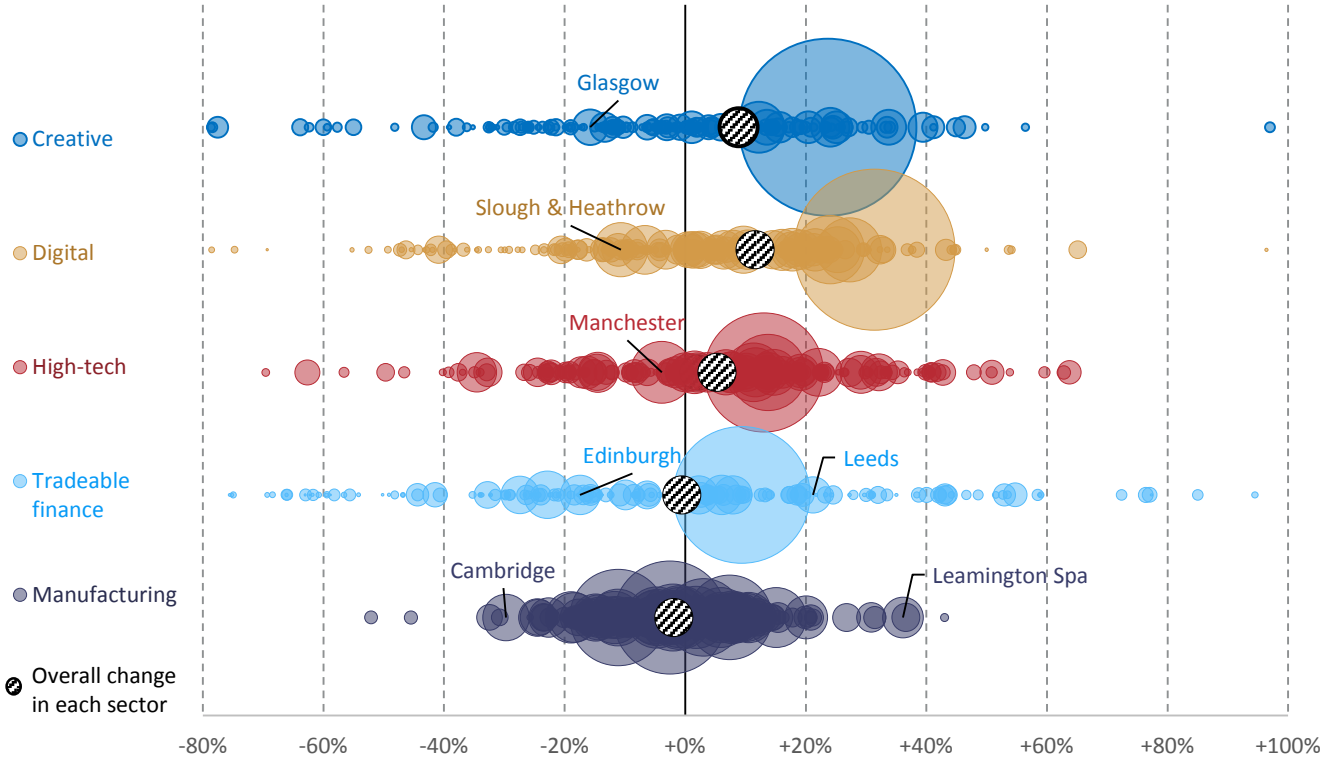
Notes: Data is for 182 local economies

Source: Resolution Foundation & N Lee analysis of ONS, *BRES*

However, gains and losses have not been spread evenly across local economies. London stands out, both because it is the largest economy and because employment grew in all advanced sectors bar manufacturing. Indeed, London accounts for 75 per cent of the growth in advanced industries over the period. In other large economies, the picture was more mixed (see Figure 8). Digital and creative employment grew in Greater Manchester, but employment fell in high-tech, tradeable finance and manufacturing. Creative and manufacturing employment grew in Birmingham but fell in digital, high-tech and finance.

Figure 8: Growth in advanced industries has been unevenly spread: 2009 - 2015

Change in employment in selected industries and size of industry in local economies



Notes: Each bubble represents one of 182 local economies or travel to work areas (TTWAs). The size of the bubble corresponds to the number of employees in 2015.

Source: Resolution Foundation & N Lee analysis of ONS, *BRES*

Other economies stand out for their specific industries. Despite its strong artistic scene, employment in the creative industries fell in Glasgow over the period. Leeds recorded strong growth in finance jobs whereas Edinburgh – a city with a relatively large financial services industry – registered a decline of nearly 20 per cent over the six years. Leamington Spa, home to Jaguar Land Rover, bucked the national trend with a large rise in manufacturing employment, although as discussed below much of the growth was not in high-tech manufacturing.

Table 2 shows the growth of advanced industries was spread across the country. Although there are some usual suspects amongst the top 10 local economies in terms of advanced industry growth, such as Cambridge, London, Reading and Brighton, there are other less obvious inclusions such as Middlesbrough and Stockton and Falkirk and Stirling. Middlesbrough benefitted from its involvement in the oil industry; over 70 per cent of the oil platforms for the North Sea were produced in the area,[14] while Falkirk gained from the disproportionately high share of advanced manufacturing in the region. The poorly performing regions are also spread across the country, although parts of the Midlands and North are overrepresented. Leamington Spa stands out: although it saw very strong growth in manufacturing, employment in the four advanced industries declined over the period.

[14] Tees Valley Combined Authority, *Oil and Gas*, 2017

Table 2: Top and bottom 10 local economies in terms of growth in advanced industries (2009 – 2015)

Area	Change in advanced industries
Durham and Bishop Auckland	32%
Middlesbrough and Stockton	28%
Brighton	25%
London	21%
Reading	20%
Lincoln	20%
Chester	18%
Falkirk and Stirling	18%
Southend	18%
Cambridge	16%
Stevenage and Welwyn Garden City	-9%
Liverpool	-10%
Basingstoke	-10%
Leamington Spa	-13%
Dunfermline and Kirkcaldy	-14%
Sunderland	-14%
Dudley	-17%
Norwich	-20%
Plymouth	-20%
Blackburn	-35%

Notes: Local economies with fewer than 100,000 employees have been excluded

Source: Resolution Foundation & N Lee analysis of ONS, *BRES*

There appears to be a relationship between growth in advanced tradeable industries and jobs in non-tradeable services

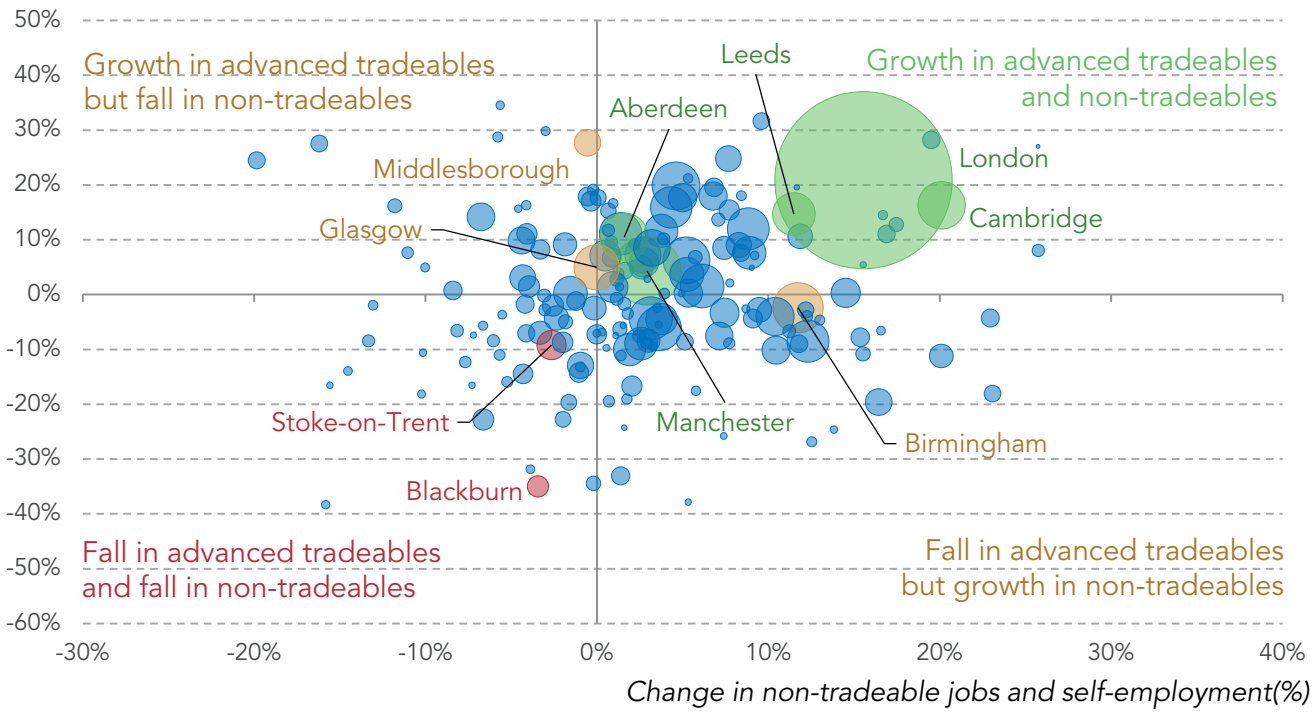
Having established that advanced industry grew in many parts of the country over the period we analyse, we next turn to the impact that growth had on non-tradeable jobs in the wider economy. Figure 9 examines our two main variables of interest: the change in employment in advanced industries and change in employment in non-tradeable service jobs and non-tradeable self-employment.[15]

On the face of it there is a relationship between the two (although we will test this formally below); areas with greater growth in advanced industries (or less of a decline) tended to have a greater change in non-tradeable service jobs and self-employment. What also stands out is the dominant positon of London. London currently accounts for 27 per cent of all jobs in advanced tradeable industries up from 23 per cent in 2009.

[15] The BRES data does not include most of the self-employed and so we have to estimate a measure of non-tradeable self-employment. We do this by estimating a measure of self-employment in the non-tradeable sector and apportioning this to TTWAs.

Figure 9: Growth in advanced tradeable industries has varied across local economies: 2009 - 2015

Change in advanced tradeable industries (%)



Notes: Each bubble represents one of 182 local economies or travel to work areas (TTWAs). The size of the bubble corresponds to the number of employees in advanced tradeable sectors in 2015.

Source: Resolution Foundation & N Lee analysis of ONS, *BRES*

However, despite a general relationship between the growth in advanced industries and jobs in non-tradeables, the experiences of local economies differed, often due to specific strengths or weaknesses. For instance, Aberdeen and Middlesbrough both benefitted from the high oil price (which was over $100 a barrel for most of the period studied), the former as a hub for the industry and the latter – as discussed above – because the Tees Valley produced the majority of the oil platforms for the North Sea.

What is also striking about Figure 9 is that the proportion of local economies that have experienced growth in non-tradeable service jobs and self-employment is far greater than that which have experienced growth in advanced tradeable industries. This perhaps reflects the fact that although employment grew strongly in this period, there are concerns about the quality and security of many jobs.[16]

In the next section we attempt to identify and isolate the causal effect that the growth in advanced tradeable industries has had across 182 local economies in Britain. We look at the effect that these sectors have had on jobs growth, employment rates and pay for people who are not directly employed in these industries.

[16] S Clarke, 'Atypical day at the office', *Work in Brexit Britain*, Resolution Foundation, July 2017

Section 4

Advanced industries create jobs, but the jobs may be low paid

In Section 1 we stated that the jury was still out as to the benefits that inward investment and the growth of advanced industries bring to the wider economy. In this section we address this question. In particular, we test whether growth in employment in advanced tradeable industries creates jobs in the non-tradeable service sector and whether such growth has an impact on jobs that tend to be filled by people with relatively lower levels of education and the wages of these workers.

Theory suggests growth in advanced industries could have a number of different impacts

We do not know exactly what impact an increase in employment in advanced industries will have on a local economy, but economic theory provides some suggestions. When a new firm (in an advanced tradeable sector) moves into an area or an existing firm expands, the immediate effect will be an increase in the demand for workers. Assuming that in the short-term the number of possible employees is relatively fixed then this increase in demand will also lead to an increase in wages.[17] An increase in the number of jobs, combined with an increase in wages, is likely to increase demand in the local economy and could create further jobs (this is the multiplier effect).

But an increase in employment in advanced industries may also produce negative effects. An increase in wages may make labour too expensive for other firms and so crowd out some employment. This is the mechanism by which some argue that the growth in public sector employment may have reduced employment in private sector jobs in the tradeable sector in the run up to the financial crisis.[18] In our case, the growth in advanced industries (and demand for high-educated workers) may crowd out employment in less advanced tradeable sectors and so reduce employment opportunities for mid-educated workers.

In addition to this there may be concerns as to the quality of the jobs created in the wider economy if many of these jobs are relatively low-paid service roles in firms that have expanded to serve employees in advanced industries (although it is arguable that employment growth – whatever the quality of the jobs created – is better than no growth). Below we test for all of these impacts.

For every 10 jobs created in advanced industries a further 6 jobs are created in the wider economy

In the period between 2009 and 2015, around 234,000 jobs in advanced industries were created

[17] In the longer-term the pool of available labour is likely to change. More demand for workers is likely to stimulate inward migration. However, in the relatively short period that we are analysing it is unlikely that the increase in demand for labour can be fully met by inward migration and we find no effect on migrant jobs.

[18] G Faggio & H Overman, 'The effect of public sector employment on local labour markets', *Journal of Urban Economics 79*, pp.91–107, January 2014

in Britain. Based on our statistical modelling (full details of which are in Annex 2), we estimate for every 10 advanced tradeable jobs created a further 6 jobs were created in non-tradeables in the wider economy. Therefore advanced industries generated an additional 147,000 jobs in the non-tradeable sector. This is the 'multiplier' or 'spillover' effect. We estimate the impact that growth in advanced tradeable jobs had on employment in the wider economy by looking at the relationship between the two variables while controlling for a range of possibly confounding factors including total employment (to control for the size of the local economy and possible agglomeration effects), the unemployment rate and the share of high-skilled workers. We also take into account unexplained differences between regions and test if our findings are robust to the exclusion of London, Wales and Scotland.

To isolate the causal relationship (as opposed to just the correlation) between the two variables we use an 'instrumental variable' approach, where our instrument is the national growth in advanced industries. In essence, we strip out the impact of the general growth in advanced industries and just examine the impact of changes in employment beyond that accounted for by the national trend. Doing so, we find that the expansion of advanced industries accounted for around 20 per cent of the total growth in non-tradeable service jobs, and around 7 per cent of the total jobs growth, over the period.

This is the average effect that the four advanced sectors had, but the evidence is that this was driven primarily by two sectors: high-tech and digital. The digital and high-tech sectors accounted for 175,000 of the 234,000 advanced tradeable jobs created during the period. For every 10 jobs created in the high-tech sector a further 9 jobs were created in non-tradeable services, while for every 10 digital jobs a further 12 jobs were created. Our analysis indicates that we cannot be sure if growth in the creative and tradeable finance sectors created jobs in the wider economy during the period. [19]

But this positive jobs effect was not uniform across the country

Of course, even at this sectoral level these are average effects. In some areas the growth in advanced industries coincided with the creation of far more, or far fewer, jobs than these average multipliers imply. For example our average 'multiplier' effect suggests that for every 10 jobs created in advanced industries over the period a further 3 jobs in non-tradeable services would have been created in Cambridge. We arrive at this figure using the ratio of non-tradeable to advanced tradeable employment, multiplied by a coefficient that describes the relationship between the two key variables (in this case 0.18). [20]

However, 10,100 jobs in advanced industries were created in Cambridge which coincided with the creation of around 28,200 jobs in non-tradeable services. This implies that for every 10 jobs in advanced industries a further 28 jobs in non-tradeable services were created. Clearly not all these non-tradeable service jobs were created as a result of the growth in advanced industries, but this ratio implies that the spillover effect in Cambridge was much bigger than the average.[21]

In other cases, employment in advanced industries grew but employment in non-tradeable services fell. There were 8,600 jobs in advanced industries created in Bath between 2009 and 2015, but the city experienced a fall of 800 in the number of non-tradeable service jobs. The opposite occurred in Liverpool: 3,300 jobs in advanced industries were lost but 5,300 non-tradeable service jobs were created.

[19] The fact that growth in the creative and tradeable finance sectors had no statistically significant impact upon wider jobs growth does not necessarily mean that they did not contribute to the impact that the advanced tradeable sectors had on local economies during the period. The results suggest that they also had a positive impact upon jobs growth but – possibly due to problems with measurement – our analysis could not confirm if this effect was statistically significant.

[20] We estimate the multiplier through the formula: Ratio of non-tradable to advanced tradeable employment in 2009 multiplied by the coefficient. In Cambridge's case this implies: (130700/57201)*0.18 = 0.41.

[21] We can't calculate a specific multiplier for each area because we cannot calculate a unique coefficient for each TTWA.

Such differences speak to the fact that national economic changes play out very differently at the local level. Our estimates of the number of additional jobs that advanced industries create is an average across all local economies, and given that lots of other factors would have influenced the number of jobs created over this period it is unsurprising that the experience of many local areas differs from our average.

Based on how local economies performed relative to this average, Table 3 shows the 10 top and bottom areas that either over- or under-achieved in terms of creating non-tradable service sector jobs over the period. As discussed, Cambridge created more non-tradeable service sector jobs than our estimates would have predicted. However, it was far from the only area to do so and far from the biggest over-achiever. For every 10 advanced industry jobs created in Chelmsford over the period 1,453 non-tradeable service sector jobs were generated, whereas our estimates predicted that this figure would have been five. This likely reflects the fact that wider economic growth sparked significant demand for non-tradeable services over the period.

By contrast, for every 10 advanced industry jobs created in Portsmouth over the period, there were 135 fewer non-tradeable service jobs. This could simply reflect the fact that employment in the city was moving towards higher-skilled sectors and that there were fewer lower-skilled jobs, but it does show that in this city at least the expansion of advanced industries did not produce jobs in the wider service sector economy.

Table 3: Over- and under-achieving areas

Area	For every 10 advanced industry jobs created the number of non-tradeable service jobs predicted	For every 10 advanced industry jobs created the number of non-tradeable service jobs created	Number of 'unexpected' jobs
Chelmsford	5	1453	1449
Wolverhampton and Walsall	10	753	744
Crawley	4	122	117
Warrington and Wigan	7	105	98
Manchester	6	46	40
Northampton	8	47	39
Milton Keynes	5	39	34
Coventry	6	34	28
Newcastle	6	33	27
Cambridge	3	28	25
Oxford	4	0	-5
Exeter	8	0	-8
Falkirk and Stirling	9	-1	-10
High Wycombe and Aylesbur	4	-7	-11
Mansfield	8	-5	-13
Bradford	9	-10	-20
Fort William	8	-14	-22
Preston	7	-26	-33
Poole	7	-125	-132
Portsmouth	5	-135	-140

Notes: Local economies with fewer than 100,000 employees and those where employment in advanced industries declined during the period have been excluded

Source: Resolution Foundation & N Lee analysis of ONS, *BRES*

Putting aside the regional variation, the average impact is that advanced industries created jobs over the period. But the number of jobs created was lower than that found in some previous studies. As discussed in Section 1, Moretti in his study of US cities found that for each 10 jobs

created in the tradeable sector a further 16 jobs were created in the wider economy. Our estimates – which are based on advanced, rather than all tradeable sectors – are closer to those of van Dijk who found that eight non-tradeable jobs were created. Moretti even more starkly also found that each 10 high-tech jobs (based on a different definition to ours) may create an additional 40-50 jobs in the wider economy, where we find that at the most they create between six and 12.

There are a number of reasons that our estimates for the UK may be smaller. First, UK TTWAs are different from US metropolitan areas. TTWAs are a lot closer together and in many cases a lot smaller, thus increasing the chances that jobs created in one TTWA may create jobs in another TTWA.

Second, Moretti's work looked at the period 1980 to 2000, whereas we have looked at a different and shorter period, and one in which there was significant slack in the labour market as a result of the aftermath of the financial crisis. We limited our main analysis to this period because of a lack of appropriately detailed data for early periods. Nevertheless, using less detailed data for the pre-crisis period we find that there is still a significant relationship between the growth in advanced industries and wider jobs growth.

Third, there could also be a smaller multiplier in the UK because jobs in advanced industries pay less well than their counterparts in the US, particularly after tax is deducted. This would lower the multiplier effect because people obtaining newly-created jobs in the advanced industries would have less disposable income to spend in the local economy.

The growth in employment in advanced industries resulted in rising wages for workers with average levels of education but falling pay for lower-educated employees

Of course, employment is only one determinant of an individual's living standards. Important too are the wages they are paid. To investigate the impact that the growth in advanced tradeable jobs had on the wages of different workers over the period, we test the relationship between growth in advanced industries and real hourly pay for low- and mid-educated workers.[22] We also investigate the impact on the numbers of jobs filled by low- and mid-educated workers. [23]

The top half of Table 4 shows the impact that a 10 per cent increase in advanced industry jobs has on the pay of these two groups. The bottom half of Table 4 shows the impact on jobs that an additional 10 jobs in advanced industries has on the two different groups. Gross hourly pay for workers with an average level of education increased by 1.7 per cent for every 10 per cent rise in advanced industry jobs in an area. The average change in advanced sector jobs over the period was 2 per cent, and the average hourly wage for mid-educated workers in 2009 was £12. Therefore, the growth in advanced industries over the period raised hourly wages for these workers by £0.04, increasing the average annual earnings for a full-time worker by around £72.

[22] We define 'low-skilled' workers as those whose highest qualification puts them into the bottom third of the skills distribution. 'Mid-skilled' are those whose highest qualifications places them in the middle third. For full details of how we create three equally sized skill groups see Annex 1.

[23] In order to define a job as either high, mid, or low-skilled we calculate the share of total employment by skill group for each TTWA. This information is then used to estimate the total number of jobs taken by high, mid or low-skilled workers.

Table 4: The growth in advanced industry jobs dragged down pay for low-educated workers, but raised pay for mid-educated workers

	Workers with average level of education	Lower-educated workers
Impact on **pay** of a 10 per cent increase in jobs in advanced industries	1.7 per cent *increase* in pay	2.2 per cent *fall* in pay
Impact on **jobs** for for every 10 jobs created in advanced industries	No effect	4 *more* non-tradeable jobs

Notes: There was no impact on tradeable jobs for both groups.

Source: N Lee analysis of ONS, *BRES* & ONS, *APS/LFS*

This appears a relatively small effect but we know from Figure 9 that in some areas there were large increases in advanced industry jobs over the period. Leeds for instance experienced growth of around 10 per cent and so the effect on wages in some areas is likely to be higher than the £72 figures suggests.

More worrying is the finding that the growth in advanced industries reduced the pay of low-educated workers. In this instance the average increase in advanced industry jobs over the period of 2 per cent can be applied to the average wages for lower-skilled workers of £11 an hour. Therefore, the average effect on the pay of lower-skilled workers is to reduce it by £0.05 an hour or £85 a year for a full-time worker. Once again, this effect varies by area, with the 15 per cent increase in advanced industry jobs in London likely leading to a greater reduction in wages there.

Pay falls because of more jobs being created towards the bottom of the labour market

That the growth of advanced industries reduced average pay for lower-educated workers is potentially of great concern but there are a number of reasons why this could be happening. Before we look at these possibilities, it is worth acknowledging that this result is driven to some extent by a relatively small number of local economies. These economies either saw large falls in pay and large rises in advanced industry employment (for example, Barrow-in-Furness), or pay growth along with a decline in advanced industries (as happened in Newquay, Penzance, Harrogate). When these are excluded from the analysis, there is no longer a significant relationship between the growth in advanced industries and pay.

The first, and more benign, reason why pay may have fallen is that an expansion in employment for those with low levels of education draws workers that were previously unable to find work or not participating in the labour force into jobs. Pay for these workers is likely to be lower than for those already in work and so this change in the composition of the in-work population drags down average wages. Similarly, an expansion of jobs filled by relatively lower-educated workers could also signify that the local economy is creating more relatively low-paid jobs in response to an increase in demand, for example more roles in restaurants and bars, which would also drag down average pay.

The second plausible hypothesis is that the growth in advanced tradeable industries crowds out lower-paid tradeable employment, with workers shifting into non-tradeable service jobs. Given that lower-educated workers earned about £0.86 more an hour in the tradeable than non-tradeable sector over the period studied this reallocation of jobs would drag down pay.

We can test these two explanations against the evidence. The results show that for every 10 additional jobs created in advanced industries a further 4 jobs are created and filled by workers with lower levels of education. The fact that there was an increase in jobs filled by workers with lower levels of education suggests that the first hypothesis has some merit – more people were brought into the labour force. As it is likely that these people are paid on average less than those people already in work, average pay will fall as a result.

By contrast, there is little evidence that there was a crowding out of lower-paid tradeable jobs as there is no relationship between the growth in advanced industry employment and changes in tradeable jobs filled by people with average or lower levels of education.

Two other statistics support the idea that it is the growth in lower-skilled non-tradeable employment that is dragging down average wages. There is a negative correlation between change in real hourly pay between 2009 and 2015 and change in non-tradeable lower-skilled jobs. That is, areas that saw greater increases in lower-skilled jobs also experienced greater falls in average pay. Second, in 2015 the average hourly pay of lower-educated workers in a tradeable job was £0.86 higher than among those in non-tradeable employment. This supports the theory that the jobs created as a by-product of the growth in advanced industries tend to be lower paid.

There is an important caveat to this finding, however. In cities with inelastic housing supply, the benefits of growth in advanced sectors are likely to be capitalised into house prices. In this way, workers in the private rented sector may lose out in real terms from growth in advanced sectors. Emerging evidence suggests that this may be the case in US cities.[24]

The upshot is that although we cannot be certain, our research suggests that during this period the growth of advanced industries created jobs at the bottom of the labour market rather than having reallocated jobs from the middle to the bottom. Having established this, the next section turns to the lessons policy makers should draw from these findings.

[24] T Kemeny & T Osman, *The wider impact of tech*. Mimeo, University of Southampton, 2017

Section 5

Conclusion

The expansion of advanced industries has a greater effect on jobs than wages

Policy makers may wish to grow advanced industries in order to meet a number of goals, such as advancing the sum of human knowledge or providing outlets for the highly skilled. However, we will concentrate on the implications for inclusive growth, particularly on raising the living standards of those who may be out of work or on low pay.

Section 4 showed that the expansion of advanced industries creates jobs in the wider economy and that these jobs are often filled by relatively low-educated workers. This is a very welcome finding and implies that efforts to attract and expand such industries are the right approach, even from the point of view of those that do not directly work in them. This reinforces previous work which has shown that jobs growth is a particularly progressive form of economic growth because those moving into work are predominantly from the lower half of the income distribution.[25] From the perspective of someone designing an industrial strategy, seeking to spread these advanced industries across the country is therefore a worthwhile goal.

But the evidence from Section 4 also makes clear that if the aim to is provide an overall living standards boost, the increase in employment is not sufficient. The jobs created pay below the average thus dragging down average pay in the area. While the expansion of advanced industries raises the return to the skills of workers with an average level of education (and so raises their pay), the roles it creates for lower-educated workers tend to be low-paid. For example, the expansion of an advanced manufacturing plant may raise the demand for the skills of those employed in their supply chain, while simultaneously creating demand for low-wage service jobs.

While it is difficult to directly compare impacts on employment and pay, of these two effects the positive boost to jobs appears larger than the negative impact on lower-skill wages. For every 10 per cent increase in the number of advanced jobs in an area, there is a 5 per cent increase in jobs filled by workers with average or below average levels of education. This coincides with pay rises of around 2 per cent for workers with an average level of education and falls of around 2 per cent for lower-educated workers.

The evidence then is that advanced industries can play an important role in job creation, but policy makers should be aware that such sectors will achieve far less in terms of raising pay for workers in the wider economy. Furthermore, although the growth of advanced industry jobs has a compositional effect on pay towards the bottom of the labour market, this effect is relatively small and previous research tells us that such compositional effects generally have a limited impact on changes in pay.[26] This suggests that support for such industries cannot be relied upon to provide inclusive growth and rising living standards for everyone within a locality.

[25] P Gregg & L Gardiner, *The road to full employment: what the journey looks like and how to make progress*, Resolution Foundation, March 2016

[26] A Corlett, *The RF Earnings Outlook: Q4 2016*, Resolution Foundation, March 2017

Local factors – and local policy makers – play an important role

While the overall jobs result is encouraging, the analysis makes clear that each local area we examine does not experience the exact same benefit. The differing experiences of Cambridge, Bath and Liverpool show that in some cases growth in advanced industries can bring with it a far higher number of jobs in non-tradeable services, while in others it can coincide with a fall in non-tradeable jobs.

This report has not explored the exact local factors that determine these differences. But they are sufficient to draw two important conclusions. First, it underlines that an industrial strategy built solely upon the spread of advanced industries is unlikely to be enough to achieve broad living standards rises. Second, it highlights the positive role that more local policy makers can play. While a well-designed national level approach is a vital first step, policy makers in cities and local authorities need to be aware of the power they can wield in helping to spread the benefits from such an approach.

The potential of Metro Mayors to achieve this is a topic Resolution Foundation research has addressed in the past.[27] As those reports highlighted, the most appropriate policy responses will vary from city to city. In general, well-planned travel networks that connect a diverse range of neighbourhoods with the areas in which the new jobs are created is a helpful first step. But local approaches to housing, skills and policies targeted at those furthest from the labour market are all vital too. City leaders cannot sit back and assume that the average employment gains outlined above will just naturally accrue in their area.

Support the whole economy not just 'key' sectors

Although supporting advanced industries shouldn't be the be-all and end-all of the government's strategy, given that they do benefit those who are more likely to be low paid or out of work, how can they best to support them? The evidence, although far from complete, suggests that a strategy that seeks to make a locality more attractive to a diverse array of firms may be more effective than one which targets specific sectors. Furthermore, such an approach is more consistent with an economic strategy that appreciates that attracting advanced industries will do little to raise the pay of the lowest earners, and so other things, such as investments in skills for such workers, will need to play their part.

Despite this there is often the perception that specialisation and the creation of specific clusters of firms is the route to success. This perception is likely borne from a relatively simplistic reading of the academic literature that discusses the benefits of agglomeration. Agglomeration refers to the idea that the concentration of economic activity (both industries and people) is good for productivity. Furthermore, as agglomeration boosts productivity this boosts concentration, which in turn begets greater improvements in productivity, and so on. Concentration can be sectoral (such as in the City of London) or it can refer to a concentration of economic activity in general. The first refers to more specialised economies, while the latter is consistent with the idea of diverse yet complementary economic activity (such as technologists, private equity firms, and lawyers all being based near one another).

The evidence is that the latter is probably more important for growth and comes about, not necessarily by focusing on a few specific sectors, but by boosting the overall economic environment. This also chimes with the evidence (in Figure 1) that the South East has a relatively high proportion of jobs across all advanced industries, although some specialisation does exist.

There is something intuitively appealing about the argument that specialisation begets further specialisation and ultimately greater economic growth, but what of the evidence for agglomeration economies in the UK? Professor Ron Martin, Ben Gardiner and Professor Peter Tyler

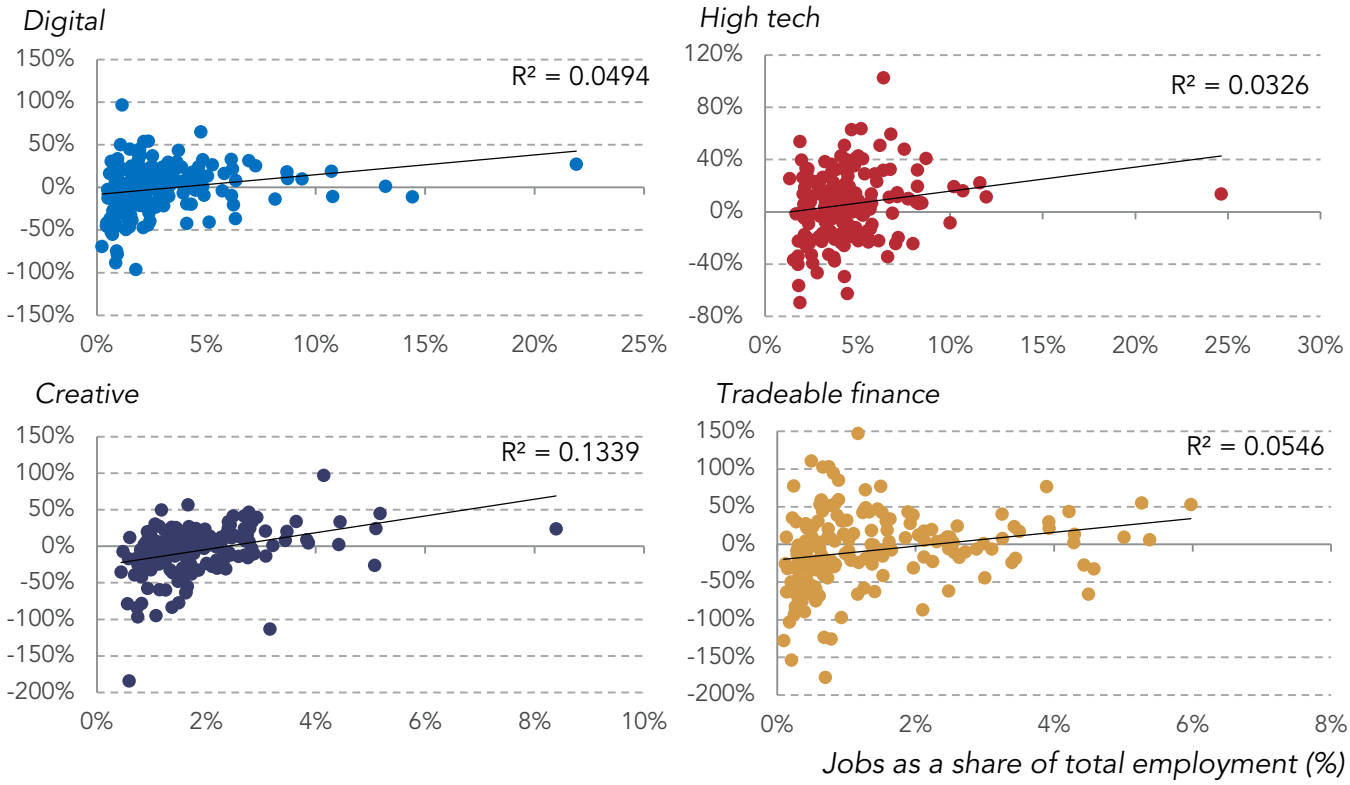
[27] See for instance S Clarke, *City living: Devolution and the living standards challenge*, Resolution Foundation, October 2016

investigated the relationships between economic specialisation, size and economic growth for TTWAs. They found that there was no relationship between size and economic growth and a limited relationship between specialisation and economic growth in the UK, suggesting that the agglomeration story is more complex.[28] In the UK, it might be more helpful to think about proximity to economic mass rather than a single measure of agglomeration.

Figure 10 shows that in many advanced industries between 2009 and 2015 it has not been true that there is a particularly strong relationship between the relative concentration of an industry and its subsequent growth. The relationship is stronger for the creative industries - those areas that are higher on the y axis also tend to be further along the x axis - but in the other sectors the relationship is weak or non-existent.

Figure 10: Limited suggestion of agglomeration in advanced industries: 2009 - 2015

Change in jobs (%)



Source: Resolution Foundation & N Lee analysis of ONS, *BRES*

The implication for policy makers is that, while it is important for cities and areas to build on their existing strengths, this should not take precedent over taking steps that make the area a more competitive location for firms in all sectors. This chimes with the evidence that increasingly industrial structure has less of an impact on growth than an area's general competitiveness.[29]

[28] R Martin, B Gardiner & P Tyler, *The evolving economic performance of UK cities: city growth patterns 1981-2011*, Government Office for Science, 2014

[29] B Gardiner, RL Martin, P Sunley & P Tyler, 'Local long-run growth evolutions across Britain: some exploratory empirics', forthcoming

In Section 2 it was clear that economic disparities in the UK are long-standing and that those areas with greater concentrations of advanced industries also tend to enjoy higher wages and living standards. By contrast the relationship between earnings and concentrations of specific advanced industries is a lot weaker; it pays to have a more diverse economy. Given this spending money on infrastructure, including schools and housing, is important and will do more to raise living standards than narrowly focusing on advanced industries or firms.

A modern industrial strategy must include low-paying sectors too

Beyond this debate on agglomeration, another important step policy makers can take to help industrial strategy be effective is having a more open mind to the kinds of sectors included. There is a danger that the growth of advanced industries may contribute to a bifurcated labour market, boosting pay for those at the top (and to a lesser extent in the middle) but creating more low-wage jobs at the bottom. In this respect the expansion of advanced industries may in of itself do little to solve the UK's low pay problem.[30] While the evidence presented here shows that advanced industries can have positive impacts on employment, the case it can make for low earners in an area is less convincing.

These advanced industries, while highly productive, are generally quite low-employment from the point of view of the entire economy. Just focusing on them at the expense of relatively low-paying but high-employment parts of the economy like retail and hospitality will be needed too. As research by IPPR has highlighted, the productivity of many of the lower-paying sectors is lower in the UK than in other countries. More can be done to improve these sectors, with large potential benefits to those working within the industries.

This is all the more important now given the increases in labour costs many employers in these sectors will face in the coming years. A rapidly rising National Living Wage, the introduction of the apprenticeship levy and the increasing employer contribution rates for workplace pensions may be especially challenging for firms in these sectors. A greater recognition of this from government, paired with a belief that these sectors can become more productive and deliver benefits to a wide range of workers, is essential to delivering an effective modern industrial strategy.

[30] S Clarke & C D'Arcy, *Low Pay Britain 2016*, Resolution Foundation, October 2016

Annex 1: Data and definitions used in this analysis

This paper has been produced in conjunction with an academic paper – Neil Lee & Stephen Clarke "Who gains from high-tech growth? High-technology multipliers, employment and wages in Britain" (forthcoming). This provides a full overview of the academic literature, datasets and empirical approach.

Datasets

The main source of data used in this report is the Business Register and Employment Survey (BRES). BRES is the best source of data on employment by sector at a local level. Around 80,000 firms are sampled each year. Data is for employees and business owners, however it misses small businesses that are not registered for VAT or PAYE and so excludes the vast majority of self-employed workers. In order to impute self-employment into our data (which is necessary given that self-employment accounts for around half of the total increase in employment since the financial crisis) we estimate a measure of self-employment in the non-tradeable sector and apportion this to TTWAs.

In addition to this the data on wages and employment rates comes from the Annual Population Survey (APS).

Definitions

Geography

Our analysis covers 182 travel to work areas (TTWAs) in Great Britain. TTWAs are defined as functional labour markets and are based on commuting patterns. They are the most appropriate unit of analysis because they comprise relatively self-contained local labour markets, with around 75 per cent of the local workforce also living in the area, and an economically active population of at least 3,500.

Sectors

Full details of the sectors used in this report are provided in Table 5 below.

Table 5: Full sectoral definition[31]

Sector	Description
Tech	Extraction of crude petroleum; Support activities for petroleum and natural gas extraction; Reproduction of recorded media; Manufacture of refined petroleum products; Manufacture of other inorganic basic chemicals; Manufacture of other chemical products n.e.c; Manufacture of basic pharmaceutical products; Manufacture of pharmaceutical preparations; Casting of steel; Casting of iron; Manufacture of irradiation, electromedical and electrotherapeutic equipment; Manufacture of optical instruments and photographic equipment; Manufacture of non-electric domestic appliances; Manufacture of engines and turbines, except aircraft, vehicle and cycle engines Manufacture of machinery for textile, apparel and leather production; Manufacture of air and spacecraft and related machinery; Repair and maintenance of aircraft and spacecraft; Production of electricity; Construction of roads and motorways; Construction of railways and underground railways; Construction of other civil engineering projects n.e.c.; Freight rail transport; Transport via pipeline; Engineering activities and related technical consultancy; Technical testing and analysis; Research and experimental development on biotechnology; Other research and experimental development on natural sciences and engineering; Research and experimental development on social sciences and humanities; Other professional, scientific and technical activities n.e.c.; Botanical and zoological gardens and nature reserve activities
Digital tech	Manufacture of electronic components and boards; Manufacture of computers and peripheral equipment; Manufacture of communication equipment; Manufacture of consumer electronics; Manufacture of magnetic and optical media; Wholesale of information and communication equipment; Publishing of computer games; Other software publishing; Telecommunications; Computer programming, consultancy and related activities; Information service activities; Repair of computers and personal and household goods
Creative industries	Advertising, Architecture, Crafts, Design, Designer fashion, Video, film and photography, Publishing, Software, Radio and TV (excludes heritage, non-tradeable performing arts)
Tradeable finance	Fund management activities; Activities of holding companies Central banking. Pension funding. Administration of financial markets. Security and commodity contracts brokerage; Other activities auxiliary to financial services; Risk and damage evaluation; Activities of insurance agents and brokers; Other activities auxiliary to insurance and pension funding
Manufacturing	All manufacturing
Public sector	Education, Health and Social Care, Government, Defence
Non-tradeable services	Spatially dispersed industries, as calculated by Jensen & Kletzer for US – excluding parts of 'advanced sectors'. Essentially this is local services and construction

Skill groups

We define the three skill groups using a variable in the APS that details an individual's highest qualification. We rank the variable ranked in descending order. We then split the 18-64 year old UK population into three equally-sized groups (randomly distributing those individuals with qualification levels that straddle the boundaries). We define the bottom third as 'low-skilled', the middle third as 'mid-skilled' and the top third as 'high-skilled'. By repeating this process in each year, we capture 'relative' qualification levels and so control for the general improvement in the qualifications profile of the working age population over time.

[31] JB Jensen & LG Kletzer, 'Tradable services: understanding the scope and impact of services outsourcing' in S M Collins & L Brainard (eds.), *Brookings Trade Forum 2005, Offshoring White-Collar Work*, Brookings Institution, March 2006

Annex 2: Regression model

Model

In order to estimate the impact that growth in tradeable sectors have on non-tradeable jobs in the same TTWA we follow the approach adopted by Enrico Moretti in his 2011 paper:[32]

$$\Delta \text{NonTrade}_{ct} = \alpha + \beta \, \Delta \, \text{Tradeable}_{ct} + \varepsilon_{ct}$$

Where $\Delta \text{NonTrade}_{ct}$ is the change in the natural logarithm of non-tradeable jobs and self-employment in city (TTWA) C, Δ Tradeable_{ct} is the change in the natural logarithm of advanced tradeable jobs in city C and ε is the error term. We control for initial conditions such as total employment, share of high-skilled workers in area and the unemployment rate. We also include regional dummies and cluster standard errors by region.

If the coefficient (β) is significant and positive it shows that the growth in advanced industry is associated with the growth in non-tradeable service sector jobs. In some models we test alternative dependent variables:

- Change in log of real (RPIJ-adjusted) hourly pay, windsorised at the 5th and 95th percentiles to avoid outliers
- Change in employment rate for workers of different skills levels
- Change in tradeable and non-tradeable jobs for workers of different skill levels

In order to be more confident that any relationship we uncover is causal it is important to rule out that some other factor is influencing both the growth in advanced sectors and the changes in jobs, wages or employment. To do this we employ an instrumental variable (IV) approach. This approach was pioneered by Bartik,[33] and has also been employed by Moretti and others investigating multipliers.[34] The instrument we use is a 'shift-share' instrument that is calculated using the predicted employment growth in the advanced industries based on their local shares in 2004/2009 and the national growth rate over the subsequent period. In essence we assume that the various sectors grow from their initial shares in 2004/2009 at the national growth rate, and deviation from this we use as exogenous variation to test the impact upon our dependent variables. Finally we also include dummies for London, Wales and Scotland, to control for the distinctive governance structures in Wales and Scotland the relatively unique scale of London.

[32] E Moretti, 'Local Multipliers', *American Economic Review*: Papers & Proceedings 100, May 2010

[33] TJ Bartik, *Who benefits from state and local economic development policies?* Upjohn Institute Press, 1991

[34] See N Lee & A Rodríguez-Pose, 'Is there trickle-down from tech? Poverty, employment and the high-technology multiplier in US cities', *Annals of the Association of American Geographers*, 2016

Full results

The tables below show the full regression outputs for the various models.

Table 6: The effect of advanced industries on non-tradeable jobs

VARIABLES	(1) OLS	(2) OLS	(4) 2SLS	(5) 2SLS	(6) 2SLS	(7) 2SLS	(8) 2SLS	(9) 2SLS	(10) 2SLS
Growth in advanced industries, 2009-2015	0.0590	0.0475	0.176***						
	(0.0541)	(0.0526)	(0.0683)						
High skill (%), 2009		-0.0544	-0.0798	-0.0865	-0.000322	-0.0552	-0.0503	-0.0503	-0.0305
		(0.120)	(0.114)	(0.117)	(0.112)	(0.120)	(0.117)	(0.120)	(0.127)
Unemployment (%), 2009		-0.443	-0.406	-0.487	-0.148	-0.467	-0.451	-0.451	-0.446
		(0.320)	(0.315)	(0.315)	(0.301)	(0.318)	(0.310)	(0.317)	(0.329)
Employment (ln), 2009		0.0142*	0.0115	0.0176***	0.00811	0.0147**	0.0138*	0.0156**	0.0155**
		(0.00730)	(0.00788)	(0.00675)	(0.00746)	(0.00692)	(0.00723)	(0.00721)	(0.00700)
region==North	-0.0395**	-0.0368**	-0.0444**	-0.0315*	-0.0416**	-0.0395**	-0.0289	-0.0328*	-0.0311*
	(0.0182)	(0.0179)	(0.0179)	(0.0187)	(0.0177)	(0.0178)	(0.0183)	(0.0186)	(0.0172)
region==Scotland	-0.0277	-0.0227	-0.0199	-0.0179	-0.0262	-0.0268	-0.0152	-0.0204	-0.0257
	(0.0183)	(0.0212)	(0.0211)	(0.0207)	(0.0212)	(0.0199)	(0.0217)	(0.0216)	(0.0206)
region==South	0.00820	0.00572	0.00546	0.0246	0.000729	-0.00106	0.0102	0.00901	0.00785
	(0.0179)	(0.0186)	(0.0183)	(0.0215)	(0.0184)	(0.0200)	(0.0192)	(0.0201)	(0.0188)
region==Wales	-0.0189	-0.00785	-0.0171	-0.00616	0.0152	-0.00982	0.000170	-0.00519	-0.00373
	(0.0168)	(0.0183)	(0.0187)	(0.0179)	(0.0211)	(0.0181)	(0.0183)	(0.0180)	(0.0175)
Growth in high-tech, 2009-2015				0.0811*					
				(0.0465)					
Growth in digital, 2009-2015					0.0940***				
					(0.0352)				
Growth in creative industries, 2009-2015						0.0166			
						(0.0240)			
Growth in tradeable finance, 2009-2105							0.0167		
							(0.0171)		
Growth in manfuacturing, 2009-2015								0.0246	
								(0.0601)	
Growth in public sector, 2009-2015									-0.0694
									(0.103)
Constant	0.0389***	-0.0799	-0.0439	-0.121	-0.0410	-0.0787	-0.0799	-0.0989	-0.103
	(0.0134)	(0.0832)	(0.0826)	(0.0762)	(0.0775)	(0.0820)	(0.0812)	(0.0836)	(0.0870)
Observations	182	182	182	182	182	182	182	182	182
R-squared	0.058	0.081							
Multiplier (included even if non-sig)	0.21	0.17	0.63	0.86	1.17	0.29	0.35	0.12	-0.11
First stage F test			128	200.5	147	198.3	256.4	192.9	349.5

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Impact of advanced sectors on non-tradeable employment and self-employment. 2009-2015. Instrument is Bartik shift-share.

Table 7: The effect of advanced industries on wages for different skill groups

Variables	(1) OLS Low-skilled	(2) 2SLS Low-skilled	(3) Medium-skilled	(4) Medium-skilled
Growth in advanced industries, 2009-201	-0.149***	-0.219***	0.120**	0.170*
	(0.0487)	(0.0763)	(0.0571)	(0.0892)
High skill (%), 2009	0.406***	0.420***	-0.269	-0.279
	(0.141)	(0.140)	(0.193)	(0.190)
Unemployment (%), 2009	0.124	0.104	-0.433	-0.419
	(0.305)	(0.300)	(0.376)	(0.363)
Employment (ln), 2009	-0.00771	-0.00629	0.000794	-0.000210
	(0.00701)	(0.00654)	(0.00887)	(0.00843)
region==North	-0.0121	-0.00798	-0.0311	-0.0340
	(0.0249)	(0.0233)	(0.0236)	(0.0239)
region==Scotland	-0.0344	-0.0360	-0.0263	-0.0252
	(0.0296)	(0.0297)	(0.0270)	(0.0264)
region==South	-0.0430*	-0.0428*	-0.0193	-0.0194
	(0.0245)	(0.0240)	(0.0239)	(0.0236)
region==Wales	-0.000573	0.00443	0.00496	0.00142
	(0.0255)	(0.0243)	(0.0248)	(0.0253)
Constant	-0.0453	-0.0648	0.134	0.147
	(0.0873)	(0.0803)	(0.0980)	(0.0939)
Observations	182	182	182	182
R-squared	0.118		0.065	0.061
First stage F test		128		128

Robust standard errors in parentheses.*** p<0.01, ** p<0.05, * p<0.1

Table 8: The effect of advanced industries employment for different skill groups

Variables	(1) OLS Low-skilled Non-tradeable	(2) 2SLS Low-skilled Non-tradeable	(3) OLS Mid-skilled Non-tradeable	(4) 2SLS Mid-skilled Non-tradeable	(5) OLS High-skilled Non-tradeable	(6) 2SLS High-skilled Non-tradeable	(7) OLS Low-skilled Tradeable	(8) 2SLS Low-skilled Tradeable	(9) OLS Mid-skilled Tradeable	(10) 2SLS Mid-skilled Tradeable	(11) OLS High-skilled Tradeable	(12) 2SLS High-skilled Tradeable
Growth in advanced industries, 2009-2015	0.386**	0.483**	-0.0843	0.124	-0.158	-0.196	0.179	0.196	0.00804	-0.0184	-0.0411	-0.0417
	(0.162)	(0.219)	(0.136)	(0.197)	(0.284)	(0.363)	(0.123)	(0.186)	(0.148)	(0.242)	(0.117)	(0.146)
High skill (%), 2009	-0.0142	-0.0333	0.406	0.365	0.236	0.245	1.295***	1.292***	0.669*	0.674*	-0.855***	-0.855***
	(0.481)	(0.468)	(0.476)	(0.464)	(0.771)	(0.762)	(0.416)	(0.410)	(0.376)	(0.364)	(0.301)	(0.295)
Unemployment (%), 2009	1.025	1.053	0.206	0.265	1.999	1.989	1.144	1.149	1.777	1.769	-2.121***	-2.121***
	(1.197)	(1.167)	(1.067)	(1.021)	(2.527)	(2.461)	(0.937)	(0.909)	(1.262)	(1.228)	(0.771)	(0.753)
Employment (ln), 2009	-0.0304	-0.0324	0.0820***	0.0778***	0.0273	0.0280	-0.0629***	-0.0632***	-0.0239	-0.0233	0.0777***	0.0777***
	(0.0249)	(0.0244)	(0.0293)	(0.0278)	(0.0476)	(0.0456)	(0.0222)	(0.0212)	(0.0233)	(0.0223)	(0.0171)	(0.0168)
region==North	0.0466	0.0408	0.110	0.0977	0.0800	0.0824	-0.0442	-0.0452	0.0219	0.0234	0.0550	0.0551
	(0.0639)	(0.0622)	(0.0704)	(0.0704)	(0.110)	(0.107)	(0.0635)	(0.0628)	(0.0741)	(0.0693)	(0.0555)	(0.0546)
region==Scotland	-0.0735	-0.0714	0.283***	0.288***	-0.329**	-0.330**	-0.249***	-0.248***	0.226***	0.226***	-0.177**	-0.177**
	(0.0877)	(0.0856)	(0.0666)	(0.0673)	(0.131)	(0.129)	(0.0735)	(0.0721)	(0.0733)	(0.0724)	(0.0730)	(0.0712)
region==South	0.0502	0.0500	0.110	0.110	0.155	0.155	-0.0841	-0.0841	0.0304	0.0305	0.118**	0.118**
	(0.0615)	(0.0595)	(0.0696)	(0.0690)	(0.102)	(0.0992)	(0.0572)	(0.0558)	(0.0680)	(0.0661)	(0.0525)	(0.0512)
region==Wales	0.0391	0.0321	0.179***	0.164**	0.134	0.137	-0.0962	-0.0974	0.0459	0.0478	0.0626	0.0627
	(0.0769)	(0.0765)	(0.0672)	(0.0649)	(0.115)	(0.111)	(0.0640)	(0.0628)	(0.0745)	(0.0698)	(0.0590)	(0.0579)
Constant	0.444	0.471	-1.189***	-1.131***	-0.498	-0.509	0.502**	0.507**	0.0435	0.0361	-0.590***	-0.590***
	(0.298)	(0.292)	(0.330)	(0.308)	(0.663)	(0.642)	(0.234)	(0.225)	(0.297)	(0.281)	(0.221)	(0.218)
Observations	182	182	182	182	178	178	182	182	182	182	182	182
R-squared	0.074		0.127		0.116		0.125		0.122		0.307	
Multiplier	0.33	0.41										
First stage F test		128		128		127.8		128		128		128

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
Impact of advanced sectors on low-skill job/self-employment. 2009-2015. Instrument is Bartik shift-share.

Resolution Foundation

Resolution Foundation is an independent research and policy organisation. Our goal is to improve the lives of people with low to middle incomes by delivering change in areas where they are currently disadvantaged. We do this by:

- *undertaking research and economic analysis to understand the challenges facing people on a low to middle income;*
- *developing practical and effective policy proposals; and*
- *engaging with policy makers and stakeholders to influence decision-making and bring about change.*

For more information on this report, contact:

Stephen Clarke
Research & Policy Analyst
stephen.clarke@resolutionfoundation.org
020 3372 2953