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Levelling Up Regional Resilience Following the Coronavirus Pandemic

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Levelling Up Regional Resilience Following the Coronavirus Pandemic

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Abstract

We investigate economic resilience of UK sub-regions before, during and after the 2007/08 global financial crisis. We date business cycle turning points in real GVA, employment and productivity to assess the resilience dimensions of resistance, recovery and renewal and rank the economic resilience of regions in a resilience scorecard. We correlate the financial crisis sub-regional recovery growth rates with a range of variables and find that generally resilient regions have: greater shares of the population with higher level qualifications; higher shares of managers and professionals and more specialised industries (particularly in knowledge intensive services and high tech). We discuss recovery policies that could be implemented following the coronavirus pandemic.

Keywords: economic resilience, regional disparities, productivity, business cycles.

JEL classification: C22, E32

Introduction

The resilience of the economy over the business cycle is of great interest to central and local government policy makers in helping them understand how an economy can recover from an economic crisis. At the regional level businesses, local authorities and devolved administrations need to understand the effect of the recession on their local area so they know what economic policies to apply to mitigate the impact of the economic downturn and aid in recovery. The current economic crisis is due to a health crisis – the 2020 global coronavirus pandemic – which led to the UK Government locking down the country on 23rd March 2020. This crisis has been accompanied by a range of mitigation measures including the Job Retention Scheme, business rate relief, local grants and business loan schemes, support for the self-employed and the charitable sector. Although too early to judge these measures the response to this crisis has been led by the central state with some resources redistributed by local authorities.

The official definition of a recession is two consecutive quarters of negative GDP growth. The Office for National Statistics (ONS) has reported a quarterly contraction in UK GDP of 2% in the first quarter of 2020 and this has been followed by an estimated monthly decline of 20% in April 2020. This covers the first full month of lock down when it was anticipated that a fall in demand would decrease economic activity to protect the nation. It is generally anticipated by economists the recovery from this recession will not be quick, or V-shaped (Wren-Lewis, 2020). What will the recovery have in store for UK regions? The headline figures for the UK national economy mask huge regional disparities. McCann (2019) analyses a number of data series and concludes that the UK has the greatest spatial inequality among European countries. The Government has made it a central mission to "level up" investment across UK regions although little detail has yet emerged on what this policy will mean in practice (Tomaney and Pike, 2020). These regional disparities have widened since the financial crisis of 2008, with some regions demonstrating greater economic resilience while others have been slow to recover (Sensier and Devine, 2020a).

The full regional impact of the current crisis is too early to judge but we can learn from the effect of 2008 financial crisis on the sub-regions of the UK and their subsequent recovery and this can help guide policy makers in their responses to the current crisis. Our contribution to the literature is to analyse the economic resilience of UK sub-regions over the course of the financial crisis in terms of their output, employment and labour productivity. We apply a business cycle dating algorithm to retrieve individual turning points for the regional series between 2002-2018 to determine if and when they experienced downturns and recovery. Based on our set of resilience measures for resistance, recovery and renewal we create a resilience scorecard to rank the UK sub-region's resilience at the NUTS 2 level and analyse the determinants of resilience. The structure of the paper is as follows: in the next section we review the literature on economic resilience and levelling up; in section 3 we describe our resilience scorecard methodology and data; in section 4 we

report the empirical results and business cycle statistics with resilience scorecard rankings of all UK sub-regions; in section 5 we analyse the factors that correlate with our measures of resilience and we discuss future policy and conclude in section 6.

Economic Resilience and Levelling Up

Regional economic resilience is defined as "the capacity of a regional or local economy to withstand or recover from market, competitive and environmental shocks to its developmental growth path, if necessary by undergoing adaptive changes to its economic structures and its social and institutional arrangements, so as to maintain or restore its previous developmental path, or transit to a new sustainable path characterized by a fuller and more productive use of its physical, human and environmental resources" (p.13, Martin and Sunley, 2015). The root cause of these shocks could be global (the 2020 coronavirus pandemic), national (1990s house price crash) or local (closing of a factory) in nature. Martin and Sunley (2015) list the determinants of regional economic resilience including: the industrial and business structure (diversity vs. specialisation, supply chains, export orientation); labour market conditions; financial and governance arrangements and interacting with all of these is the capacity of agency and decision making within regions. In recovery from a shock the region will adapt and this may involve changes to a region's economic structure and functions which will then influence the region's resistance or vulnerability to future shocks.

Martin (2012) analysed the resilience of UK regions and defines four dimensions of economic resilience to describe how a regional economy responds to a recessionary shock. The first is resistance which is the sensitivity of a region compared to the nation during the recession. The second is the speed and extent of the recovery from the recession. The third is assessing if the region had undergone structural re-orientation and what implications this has for the region's jobs, output and income. The fourth is the degree of renewal a region will undergo following the shock and the extent to which it renews its growth path. We will quantify the three of these dimensions (resistance, recovery and renewal) in our resilience scorecard. Martin and Gardiner (2019) chart UK cities economic resilience over three recessions and four decades and they forecast how city regions could respond to a Brexit shock. They discover that northern cities have lower recoverability rates from recession than southern cities and that generally city recoverability has declined with distance from London. Beatty and Fothergill (2020) compare the gains in employment in Britain's old industrial towns compared to the rest of the country since the recovery in 2010. They conclude that unemployment has fallen in the old industrial towns but this conceals the fall in the total workforce in these areas and an increase in internal migration to city areas out of towns, this suggests there has been a fall in jobs opportunities in these areas. Martin et al (2016) state that economic structure of places varies across the UK and the degree of foreign ownership, the geographical distribution of supply chains, export orientation and

legacy of the inherited labour market (like old industrial areas, see also Gherhes, et al 2018) all play a part in why some regions are more resilient than others.

Along with economic resilience it is also important to understand the well-being of people and the sustainability of places to help with a stronger recovery. Sensier and Uyarra (2020) explore the role of governance in comparing the resilience, sustainability and inclusive growth of Greater Manchester and Preston in their recovery from the global financial crisis. Within Greater Manchester they find that the City of Manchester has been the most resilient district (particularly in the recovery of jobs since the crisis), but peripheral towns (like Bolton and Wigan) have continued to suffer, so policies targeted at dense agglomerations do not seem to have not benefitted surrounding areas. When the analysis is widened to examine indicators for societal well-being Manchester ranks poorly for inclusive growth, particularly with poor health and life expectancy outcomes, so within Manchester the proceeds of growth are not being shared equitably to improve life chances of its poorest citizens. Preston has enjoyed increasing output and a recovery in productivity but at the same time as falling levels of employment. It has scored better on good growth measures in that it has reduced unemployment and the number of people earning less than the real living wage as a direct result of the community wealth building policies. It ranks highly for measures of health and income equality and local conditions which contribute to inclusive growth.

Rodríguez-Pose (2020) links the role of institutions to the fortunes of territories, he suggests that institutions directly influence local economic growth as they affect the capacity of economic actors interacting within places to attract or repel high growth industries. Indirectly the institutional context affects every public policy that is applied and must be improved to make regions more sustainable and resilient and their inhabitants happier. The stakes are high as discontent and resentment has been building with the failure of development policy interventions to level up regions (Rodríguez-Pose, 2018). In terms of local government, the capacity of UK regions varies significantly after 10 years of austerity economics and a large number of job have been lost in local public services (Longlands, et al. 2019). Since the financial crisis output growth has been subdued along with growth in investment, real wages and productivity. Beneath the national headline figures the regional picture is mixed with areas with the greatest shares of deprivation suffering the largest local authority budget reductions (Gray and Barford, 2018). Areas within the “red wall” (the 50 constituencies that became Conservative during the December 2019 election) generally have a lower productivity sector mix, and their citizens have below-average pay, earnings and incomes and have experienced greater falls in living standards since 2010 (see McCurdy, et al. 2020). This provides a strong argument for levelling up living standards, skills and opportunity between the country’s productivity divides.

As Tomaney and Pike (2020) describe how the government’s agenda seems to be driven by electoral calculation rather than a real engagement with tackling deep inequalities. Beyond

the recent government funding streams of Stronger Towns and Future High Streets, with some commitment to increased infrastructure spending in the March 2020 Budget, little detail has emerged on concrete spending plans, delayed by the onset of the pandemic. Allas (2020) highlights a number of disparities between UK local authorities including income disparities and the gender pay gap. Onward (2020) document the gaps in transport, housing, innovation and culture across UK regions. They also discuss the influence of the HM Treasury's Green Book in regional spending decisions which have been skewed towards richer areas and describe how the static approach does not take into account the possible dynamic or transformative effect of new projects. Weighting should be introduced for the effects on wellbeing as poorer areas with higher unemployment will benefit more from growth enhancing spending that offers employment opportunities. Coyle and Sensier (2020) describe how the Green Book's methodology is fit for purpose but the economic case may be overridden by political decisions that benefit the places where there is already a higher economic return for activity, political vision is needed to truly "level up".

The crisis has also shone a spotlight on the low paid "key worker" jobs in the UK economy which have been at the vital front line of the coronavirus pandemic. These jobs are often paid at the national living wage (the UK Government minimum, compared to the real living wage set by the Living Wage Foundation[1]. Areas which have previously lagged behind national growth have larger shares of workers in the foundational economy.

Economic Resilience Scorecard

In Sensier and Devine (2020a) we detail our methodology for the determining business cycle turning points and present the economic resilience scorecard for UK countries and English regions (at the NUTS 1 level). In contrast to previous studies that largely rely on the onset of the recession to be the same time period for each region within a country our research individually dates business cycle turning points for regions. This allows for some regions to lead and some to lag the movements in their national business cycle. An additional contribution of our study is the introduction of an economic resilience scorecard which allows us to rank places based on their resilience measures of resistance, recovery and renewal compared to the national average before, during and after the financial crisis. This gives a fuller picture of the evolution of regional growth paths before and after the crisis. Our correlation analysis then allow us to test a range of variables that affect regional economic resilience.

We assess how UK regions fared in the run up to the financial crisis, then during the recession and how they subsequently recovered. We compare UK sub-regions at the NUTS 2 level and assess economic performance with the ONS time series of regional real balanced Gross Value Added (GVA) produced in 2016 pounds which takes account of regional price

[1] See the latest real living wage estimates at https://www.livingwage.org.uk/

differences (see ONS, 2020). GVA is measured where the activity takes place so includes the effect of commuters into an area. This will skew the distribution of income across the UK based on where people live which is taken account of in the ONS Gross Disposable Household Income figures. For the purpose of our study we are interested in business cycle turning points in the time series so monitoring where an activity takes place should give an indication of the multiplier effect of wealth into an area as commuters will spend money and support businesses around where they work. UK national GVA is the sum of the regions and countries and excludes Extra-Regio which is the activity that cannot be assigned to regions (this is to match the number of productivity jobs as the UK total is less Extra-Regio). The employment series is the amount of productivity jobs from the latest sub-regional productivity release ONS (2020). We calculate real productivity as:

Real Productivity = Real GVA/Productivity Jobs (1)

When we have established the turning points of the business cycle we can calculate a range of indicators that will be utilised in the resilience scorecard. We calculate the *LOSS* over the recession where we take the difference in the level of employment in a region (Emp_r) between the peak and trough dates and divide this by the level at the peak, multiplying by 100 to show a percentage loss:

$$LOSS=100.(Emp_{peak\_r} - Emp_{trough\_r})/ Emp_{peak\_r}] \quad (2)$$

The duration of the recession is the difference in years between the trough and peak dates.

To compare the resistance of regions to the nation we compute a sensitivity index (β_r) from Martin (2012) which is the percentage change in the variable, here for employment lost in a region (Emp_r) compared to that lost at the national level (Emp_n), between peaks and trough turning points as follows:

$$\beta_r=[100.(Emp_{peak\_r} - Emp_{trough\_r})/ Emp_{peak\_r}]/[100.(Emp_{peak\_n} - Emp_{trough\_n})/ Emp_{peak\_n}] \quad (3)$$

If the value of $\beta_r > 1$ then the region has lost a greater percentage of employment than the nation and is less resistant to the recession but if the $\beta_r < 1$ then the region has lost a smaller share of employment than the nation and is more resistant to the recession than the nation.

To summarise our resilience scorecard, we calculate the resistance of regions to recession and compare this to the nation as the benchmark along with how quickly they recovered from the crisis. The expansion average growth rate (EAGR) measures the 5 year average of the growth rate (first difference of the natural log) before the recession including the date of the peak year. Following the recession we calculate the rate of growth for the series after the trough by taking the second expansion average of the growth rate (E2AGR) for 5 years. The renewal measure compares the growth rates 5 years before the recession and then 5 years after the recession. A greater rate of increase after the recession indicates that the region is accelerating to a higher growth path. The date of recovery is noted when the

region has regained its pre-recession peak level or if by 2018 (last year available) it has not recovered (NR). The economic resilience scorecard ranks the resilience measures for all UK sub-regions. We will compare 4 statistics for each region over the recession and up to 2018, including:

1. **RESISTANCE**: Has the fall in GVA/jobs/productivity been less than the national decrease (so is the sensitivity index θ_r <1)?
2. **DURATION**: Has the duration of the recession been shorter or the same as the national recession?
3. **RECOVERY**: Has the region recovered faster or at the same time as the nation?
4. **RENEWAL**: Was the rate of growth after recession greater than before (E2AGR> EAGR)?

If the answer to the above question is yes then the region is classified as being more resilient than the national data series and is coded 1, if no it is less resilient and coded 0. Based on the binary response to these questions we sum up all regions over 4 statistics for 3 variables (4x3), so the highest score for a region if it has been very resilient is 12.

Regional Business Cycles in UK Regions

During the global financial crisis UK national output peaked in 2007 and contracted over 2 years by 4.1% until the trough turning point in 2009, recovering its peak level in 2011 after 4 years. We date turning points for NUTS 2 level regions for Great Britain (shown in the Appendix Tables A.1-A.3). Table A.1 presents the business cycle turning point dates for real GVA in NUTS 2 regions. We find that East Yorkshire and North Lincolnshire (UKE1) had the longest recession with a duration of 5 years, the greatest loss of -10.4% GVA and this region and Outer London – South (UKI6) had not recovered their pre-recession peak levels with data up to 2018. Few regions experienced greater average growth rates following the recession compared to the years leading up to the recession, exceptions include Merseyside (UKD7), Bedfordshire and Hertfordshire (UKH2), Berkshire, Buckinghamshire and Oxfordshire (UKJ1) and the Bristol region (UKK1). The highest growth rate after the recession was for North East Scotland (UKM5 including Aberdeen) which grew at 4.4% (though lower than the average growth rate of 5.9% before recession). The next highest growth rate is for Outer London – West and North West (UKI7) which grew at a faster 4.2% after the recession than 3.2% before. Lincolnshire (UKF3) and the regions within the West Midlands (UKG1-3) all suffered greater losses than the UK, so were less resistant, but rebounded relatively quickly and experienced higher average growth rates after the recession, possibly helped by the West Midlands Regional Taskforce, see Bailey and Berkeley (2014).

The UK jobs recession was shallower than output with a later peak in 2008 and loss of -1.5% over one year with trough in 2009 and recovery of the peak level in 2012 after 4 years. In Table A.2 the turning points for productivity jobs are shown and from here we can see that employment in Inner London – West (UKI3 with boroughs Camden, City of London, Westminster, Kensington and Chelsea, Hammersmith and Fulham and Wandsworth) actually resisted recession and continued to growth throughout the financial crisis. Overman (2011) suggested the larger proportion of middle income earners and jobs in the professional services helped London recover quicker, along with the Government's bank bailouts protecting jobs in the finance sector. Infrastructure investment in the construction of Olympics venues and Crossrail also helped. Coyle and Sensier (2020) highlight how London had the highest concentration of transport infrastructure spending (£3,200 per head between 2013-2017) compared to the next highest region the North West (£1,300 p.h.). Some regions are yet to recover their pre-recession peak in employment including Tees Valley and Durham (UKC1), Lancashire (UKD4), and three of the five Scottish regions (Highlands and Islands, UKM6; West Central Scotland, UKM8 and Southern Scotland, UKM9). O'Brien et al (2017) describe how the Tees Valley's labour market shows the continued impact of de-industrialisation with high joblessness, low skills and an ageing workforce. The Redcar steelworks closed in 2015 with the loss of 2,200 jobs[2]. Similar de-industrialisation has occurred in Lancashire and around Glasgow (UKM8), as also highlighted in Beatty and Fothegill (2020). Preston, Lancashire has aimed to rebuild itself post financial crisis after the loss of inward investment from a shopping centre development in 2011. McInroy (2018) describes how Preston city council has been working on local wealth building initiatives with anchor institutions to pay the living wage and procure more goods and services locally.

UK national productivity peaked in 2007 and fell by 3.5% over 2 years to a trough turning points in 2009, recovering after 4 years in 2011. The majority of sub-regions have higher growth rates before the recession than after with highest rates for the Scottish sub-regions. Turning points for NUTS 2 sub-regions productivity are shown in Table A.3. North East Scotland (UKM5 including Aberdeen) resisted a recession in productivity over the financial crisis but had lower productivity growth rates after 2009. Here we can see that a number of regions have yet to recover their pre-recession peaks, including Merseyside (UKD7), East Yorkshire and North Lincolnshire (UKE1), North Yorkshire (UKE2), West Yorkshire (UKE4), Outer London – East and North East (UKI5) and Outer London – South (UKI6).

The summary of the resilience scorecard for NUTS 2 sub-regions is shown in Figure 1 and in Table 1. In Sensier and Devine (2020a) we find the most resilient region was the South East, followed by the South West. The least resilient area was Northern Ireland, then in England the regions of the North East and Yorkshire and The Humber (where the pre-recession productivity level had not recovered). Here we analyse the sub-regions at the NUTS 2 level what emerges is that sub-regions within the South East (UKJ1 and UKJ2) are still the most

[2] See BBC story: https://www.bbc.co.uk/news/uk-england-34509329

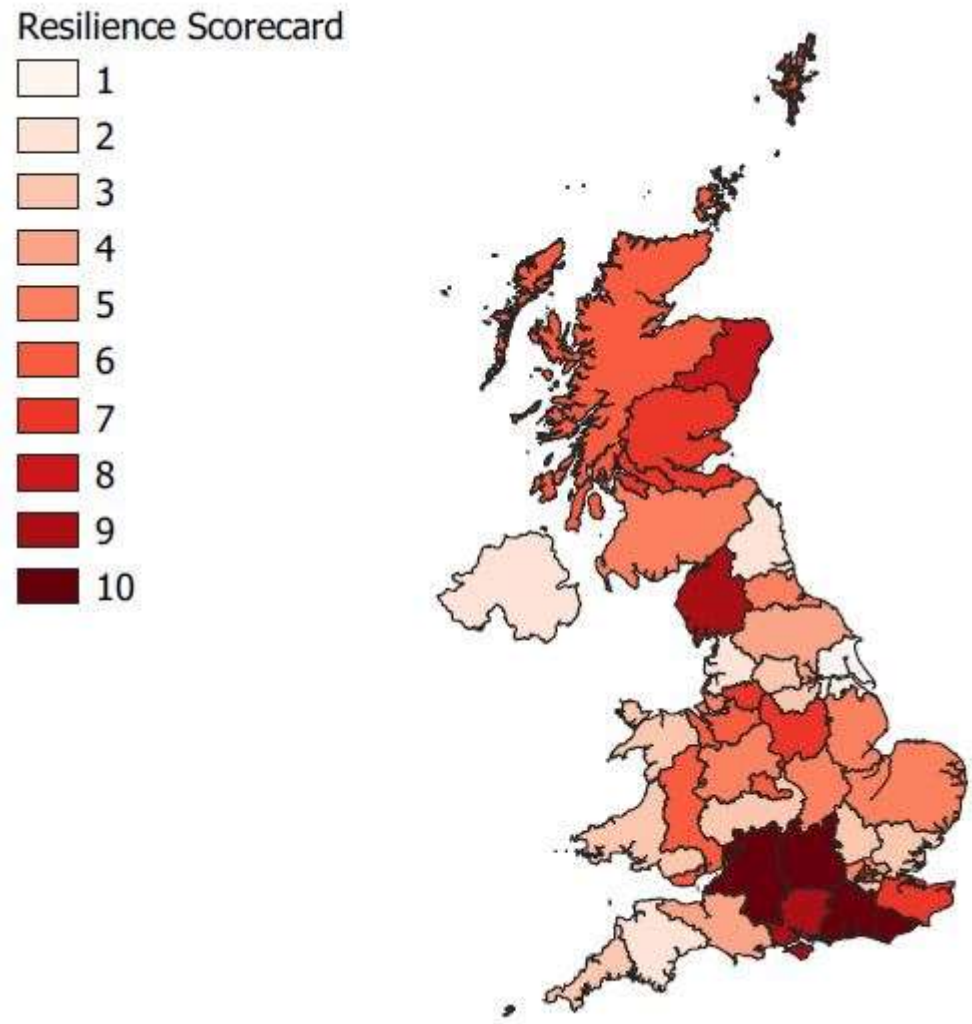
resilient with the least resilient South East region, (Kent, UKJ4) scoring 7/12 points as GVA and employment experienced a deeper loss than the nation and GVA and productivity took longer to recover and were slower to grow after the recession than before. The Bristol region (UKK1) data is shown in Figure 2 with the resilience scorecard points noted, here growth after the recession is greater for GVA and jobs but not productivity. The Bristol/Bath region was the most resilient within the South West but the sub-regions (Dorset and Somerset, UKK2, Cornwall and Isles of Scilly, UKK3 and Devon, UKK4) perform poorly on GVA and productivity indicators so are lower down in the scorecard. When the components of the Midlands are scored by sub-regions the highest ranking were Derbyshire and Nottingham (UKF1) with 7/12 points and the Birmingham city region (UKG3) with 6/12. Other regions within the Midlands do not do as well with Lincolnshire (UKF3) and Leicestershire, Rutland and Northamptonshire (UKF2) scoring 5/12 points and Herefordshire, Worcestershire and Warwickshire (UKG1) scoring the least with 3/12. The least resilient region, East Yorkshire and Northern Lincolnshire (UKE1), is shown in Figure 3 and both GVA and productivity do not recover their pre-recession levels. So looking beyond the headline figures for the nation and the main regions we find quite different levels of sub-regional resilience, in the next section we explore factors affecting resilience.

Table 1: NUTS 2 Resilience Scorecard Ranking

Rank	Region	Score
1	Berkshire, Buckinghamshire and Oxfordshire (UKJ1); Surrey, East & West Sussex (UKJ2); Gloucestershire, Wiltshire and Bath/Bristol area (UKK1)	10/12
2	Cumbria (UKD1); Hampshire & The Isle of Wight (UKJ3)	9/12
3	NE Scotland (UKM5)	8/12
4	Greater Manchester (UKD3); Derbyshire and Nottinghamshire (UKF1); Inner London – West (UKI3); Inner London – East (UKI4) ; Kent (UKJ4); Eastern Central Scotland (UKM7); West Central Scotland (UKM8)	7/12
5	Cheshire (UKD6); West Midlands (UKG3); East Wales (UKL2); Highlands & Islands (UKM6)	6/12
6	Tees Valley and Durham (UKC1); Merseyside (UKD7); Shropshire and Staffordshire (UKG2); Leicestershire, Rutland and Northamptonshire (UKF2); Lincolnshire (UKF3); East Anglia (UKH1); Outer London - West and North West (UKI7); Southern Scotland (UKM9)	5/12
7	North Yorkshire (UKE2); Outer London - East and North East (UKI5); Dorset and Somerset (UKK2)	4/12
8	South Yorkshire (UKE3); West Yorkshire (UKE4); Herefordshire, Worcestershire and Warwickshire (UKG1); Bedfordshire and Hertfordshire (UKH2); Essex (UKH3); Outer London – South (UKI6); Cornwall and Isles of Scilly (UKK3); West Wales and The Valleys (UKL1)	3/12
9	Northumberland and Tyne and Wear (UKC2); Lancashire (UKD4); Devon (UKK4)	2/12
10	East Yorkshire and Northern Lincolnshire (UKE1)	1/12

Note: for details on scoring see Table A.4 in the appendix.

Figure 1: Map of Resilience Scorecard for UK NUTS 2 level regions



Note: 10 is the most resilient region and 1 is the least resilient region.

Figure 2: Example of Resilience Scorecard for Bristol city region

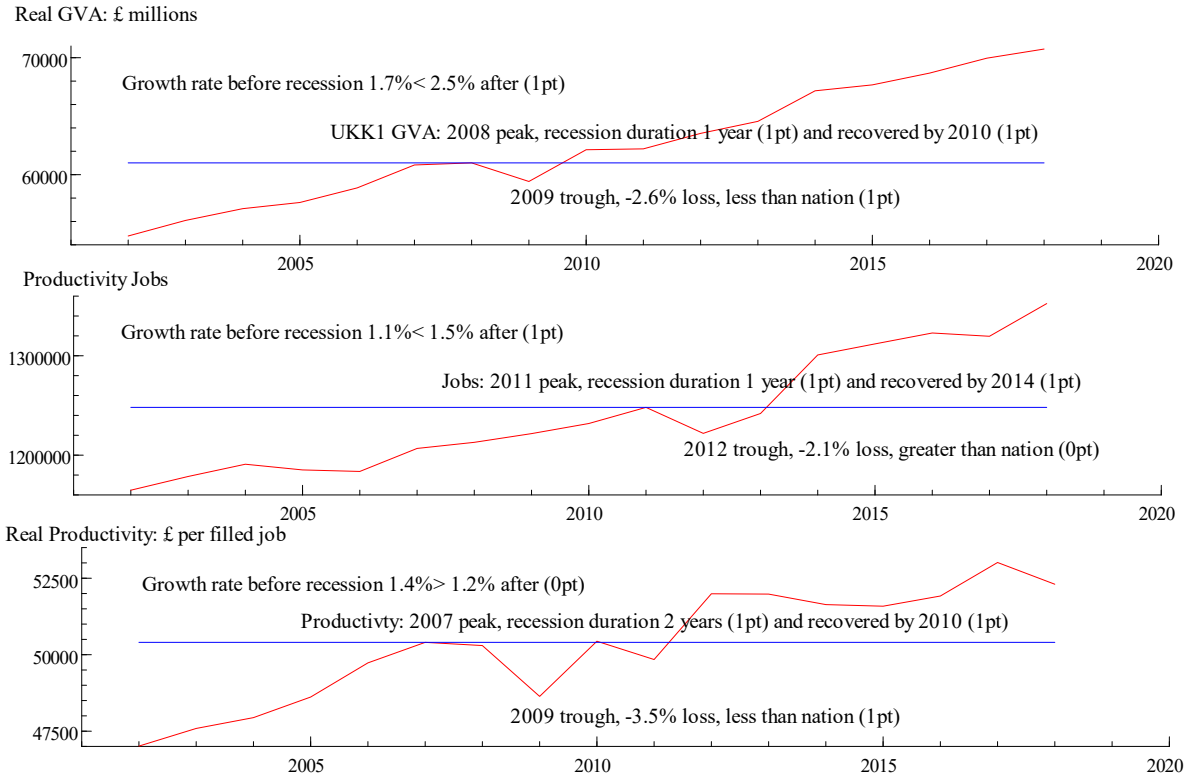
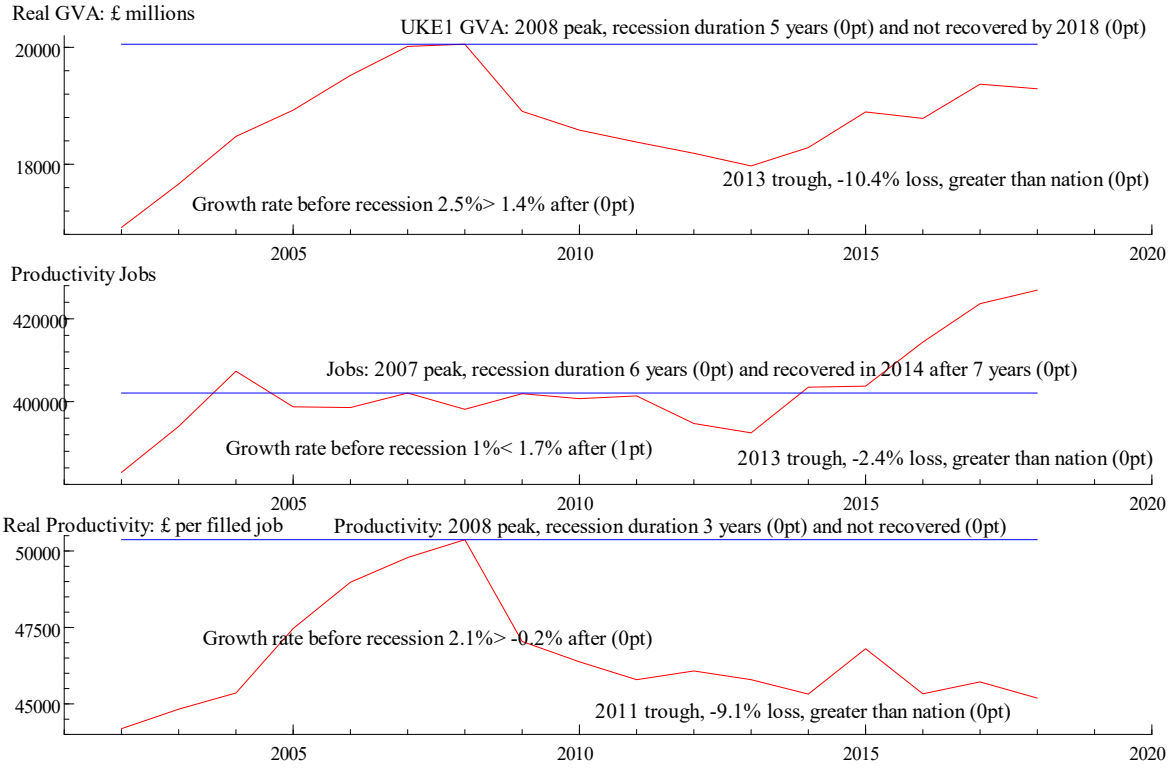


Figure 3: Example of Resilience Scorecard for East Yorkshire and Northern Lincolnshire



Factors Affecting Resilience

There are a number factors affecting resilience that have been discussed in the literature and we correlate these with our variables representing each stage of the business cycle around the time of the global financial crisis (expansion, recession and subsequent expansion). Martin and Sunley (2015) note the debate of diversity vs. specialisation for regional resilience. Regions that specialise in their most competitive sectors are more inclined to increase gains in productivity, but a downturn in that sector could impact the region adversely. Diversifying activity across a number of sectors could help resilience by spreading the risk in a downturn. To gauge how important the concentration of industrial activity is for regions we will consider a specialisation measure and location quotients. The ONS (2018a) have calculated the Krugman Specialisation Index (KSI) which quantifies the differences between the distribution of GVA economic activity across NUTS 2 regions and a reference distribution (national GVA). They compute the KSI using an aggregation of the 2-digit level industries breakdown of the 2007 Standard Industrial Classification into 11 groups according to their technological or knowledge intensity (see the Appendix in ONS, 2018a). The KSI is calculated by the ONS as:

$$KSI_j = \sum ABS \left[\frac{x_{ji}}{x_j} - \frac{(X_i - x_{ji})}{(X - x_j)}\right] \quad (4)$$

where X_{ji} is the output of region (j) in industry (i), X_j is the total output of region (j), X_i is the total output of industry (i) and X is the national output. The KSI indicates the relative specialisation of the region compared to the nation and takes the value zero if region (j) has an industrial structure identical to the rest of the UK, indicating that region (j) is not specialised. Higher KSI values indicate increased specialisation and the maximum value of 2 indicates the region has no sectors in common with the rest of the UK. In the dataset for the last available year, 2016, the region closest to the UK average is Gloucestershire, Wiltshire and Bristol/Bath area (KSI=0.12) and the most specialised region is Inner London – West which includes the City of London and has a high concentration of financial services industry (KSI=0.64). We also included ONS (2018a) location quotients which are used to assess the relative specialisation of regions in groupings of industries. The location quotient for region (j) industry (i) measures the level of relative specialisation of region (j) in industry (i), and it is given by the expression:

$$LQ_{ji} = \frac{x_{ji}/x_j}{x_i/x} \quad (5)$$

With *x* representing output as in equation (4). A location quotient of 1 indicates that the share of industry (i) in the regional output is comparable with the contribution of that industry to the national output, greater than 1.25 signifies a higher concentration and less than 0.75 a lower concentration of that industry in the sub-region. Sectors that are considered here include: Knowledge Intensive Services (KIS) and High-Tech Services; Less

Knowledge Intensive and Other Services; Low to Medium Tech Manufacturing; Medium-High Tech Manufacturing; Other Production and Real Estate Services.

Kitsos and Bishop (2018) include as an explanatory variable the high level skills in an area and suggest they operate through 2 channels: (i) embedded knowledge and experience. Places and firms with more skilled workers may hoard them (reduce hours) rather than make redundancies, these may exhibit lower crisis impact; (ii) human and firm-specific capital created through on the job training, these have less lay-offs and lower staff turnover. We assess the share of people in a region with NVQ4+ qualifications (a University Degree or equivalent and above), from NOMIS along with the share of the population classified as managers and professional occupations. Lee (2014) finds the unemployment rate is related to how British cities recovered their employment rates after the financial crisis so we include this rate from NOMIS and include the share of people employed in Manager and Professional occupations in an area. Work by Gherhes, et al (2018) studies a peripheral post-industrial place (Doncaster) and finds high rates of start-up but mainly for self-employed and small businesses, so we include local rates of new enterprise start-ups.

Table 2: Correlations with Average Growth Rate, Expansion before the Recession

	GVA	Jobs	Productivity
Value at 2002	0.162 (0.31)	-0.209 (0.19)	0.417 (0.01)*
NVQ4plus	0.414 (0.01)*	0.045 (0.78)	0.410 (0.01)*
ManProfOccpn	0.332 (0.04)*	-0.030 (0.85)	0.392 (0.01)*
Unemployment	0.434 (0.01)*	0.005 (0.97)	0.340 (0.03)*
Ln(Density)	0.233 (0.14)	-0.186 (0.24)	0.289 (0.07)*
Investment	-0.034 (0.83)	-0.126 (0.43)	-0.228 (0.15)
Krugman Index	0.559 (0.00)*	0.293 (0.06)*	0.640 (0.00)*
KIS&HighTech	0.426 (0.01)*	0.036 (0.82)	0.370 (0.02)*
LessKIS&Other	-0.444 (0.00)*	0.066 (0.68)	-0.334 (0.03)*
LowMedTechManu	-0.241 (0.13)	0.026 (0.88)	-0.343 (0.03)*
MedHighTechManu	-0.221 (0.16)*	-0.306 (0.05)*	-0.325 (0.04)*
Other Production	-0.021 (0.89)*	0.198 (0.21)	-0.034 (0.83)
Real Estate	-0.259 (0.10)*	-0.136 (0.40)	0.024 (0.88)

Note: correlations coefficient, * significant at 10% level. The correlation is between the average rate of growth calculated as 5 years before the recession including the peak turning point and the other variables are averaged over 2004-2006.

Giannakis and Bruggeman (2017) investigate a range of factors including the pre-crisis level of investment in regional economies. Gross fixed capital formation (GFCF) is used here to indicate how much of the new value added generated in regional economies was invested rather than consumed. GFCF is the largest share of investment, accessed from Eurostat

(2019). GFCF is the acquisition (less disposal) of fixed assets and the improvement of land. It is calculated gross of any deduction for depreciation or consumption of fixed capital. GFCF reflects investment in tangible assets that contribute to the productive process for more than a year and are not used up in the process of production, such as buildings, plant and machinery, and vehicles. It also includes investment in intangibles (for example, intellectual property and brand names), costs of transfer of ownership (for example, estate agency fees) and valuables (for example, precious stones and metals), see ONS (2018a). We include the level and growth rate of investment.

The variables we include in our correlation analysis are three year averages of the series over the three phases of the business cycle as follows: (1) pre-recession expansion phase we average over 2004-06; (2) the recession phase the average is over 2007-09 and (3) the expansion phase after the recession we average 2010-12. The results from the correlation analysis for the expansion before the recession are shown in Table 2. The correlation coefficients for the GVA expansion and determinants of resilience are in the second column, here we find that higher level skills (NVQ4 plus) and the share of Manager and Professionals sub-region are positively correlated with the output expansion, so higher shares of these are related to a higher growth rate before the recession. The Krugman Specialisation index and a greater share of Knowledge Intensive Service (KIS) and High-Tech sectors are also positively correlation with output growth before the recession. Location quotients showing a greater concentration of Less KIS, manufacturing and real estate are negatively correlated with the pre-recession expansion phase, house prices are leading indicators of economic activity and the real estate services may have contracted prior to the recession (as found for Wales in Sensier and Artis, 2016). The Jobs column shows few significant correlations for NUTS 2 sub-regions with resilience determinants before the recession. The Krugman specialisation index is positive and significant for jobs growth, suggesting that relatively more specialised areas have had greater jobs growth before the recession. Areas with greater concentrations of medium-high tech manufacturing had a negative correlation with employment growth before the recession, so areas with high concentrations of these industries had lower rates of job growth. The correlation coefficients of rates of productivity growth before the recession is positive for the value of productivity in 2002 meaning the richest areas experienced the greatest productivity growth. The unemployment rate is positively related to output and productivity growth before the recession so areas with higher unemployment sustained greater growth, this may be a city effect where higher unemployment rates are generally found and productivity growth is also positively correlated with density. Again higher specialisation and higher concentrations of KIS is positively correlated to productivity growth where concentration of Less KIS and manufacturing are negatively related. Investment is not significant for the pre-recession growth rates.

Table 3: Correlations for Loss during the Recession

	GVA	Jobs	Productivity
Value at 2002	0.035 (0.83)	0.189 (0.24)	-0.111 (0.49)
NVQ4plus	0.130 (0.43)	0.096 (0.55)	-0.001 (0.99)
ManProfOccpn	-0.075 (0.65)	0.244 (0.13)	-0.123 (0.45)
Unemployment	-0.388 (0.01)*	-0.181 (0.26)	-0.161 (0.32)
Ln(Density)	-0.412 (0.01)*	0.010 (0.95)	-0.172 (0.28)
Investment	0.065 (0.69)	0.081 (0.61)	0.255 (0.11)
LossDuration	-0.573 (0.00)*	-0.465 (0.00)*	-0.588 (0.00)*
NewEnterprises	-0.408 (0.01)*	0.058 (0.72)	-0.323 (0.04)*
Krugman	-0.026 (0.87)	0.142 (0.38)	-0.231 (0.14)
KIS&HighTech	0.068 (0.67)	0.242 (0.13)	0.059 (0.71)
LessKIS&Other	-0.101 (0.53)	-0.406 (0.01)*	-0.068 (0.67)
LowMedTechManu	0.051 (0.75)	-0.078 (0.63)	0.057 (0.72)
MedHighTechManu	-0.133 (0.41)	0.183 (0.25)	-0.049 (0.76)
Other Production	0.274 (0.08)*	-0.199 (0.21)	0.223 (0.16)
Real Estate	-0.286 (0.07)*	-0.067 (0.68)	-0.349 (0.03)*

Note: correlation coefficient, * significant at 10% level. The correlation is between the rate of loss over the recession and other variables are averaged over 2007-2009.

The results from Table 3 for the loss over the recession with GVA show a negative relationship with the loss duration variable so regions that had longer recessions had greater loss (as also found for the US by Han and Goetz, 2015). The negative correlation between density and GVA loss shows that the greatest loss was for the densest regions. Regions with the greatest GVA loss also saw the greatest level of new enterprise start-ups. Other production is positively correlated with GVA loss meaning areas with lower concentrations of these industries experienced less GVA loss. Real estate is negatively correlated so sub-regions with greater shares experienced more job losses as this is very cyclical activity during a downturn. In terms of jobs, areas with higher concentrations of less knowledge intensive services saw greater job losses during the recession and longer duration of the recession with greater the loss. Productivity loss is negatively related to the recession duration and the level of new enterprise start up, so areas with greater loss of productivity have more new start-ups. Also areas with greater concentrations of real estate services had higher productivity loss.

The results from Table 4 are for the expansion phase following the recession. In the GVA equation as would be expected the longer the recovery lasts it is related to lower growth. We find positive correlations between output growth and the initial level of GVA, the greater share of higher skills, managers and professionals, density, investment, specialisation and higher concentrations of KIS. A negative correlation is found between GVA growth and higher concentration of less KIS and low-medium tech manufacturing. The

correlations with the employment expansion show that sub-regions with larger labour markets (in 2002) had a stronger recoveries along with those with greater shares higher skills (as found by Kitsos and Bishop, 2018) and more manager and professional occupations. Also greater density, investment, specialisation and concentration of KIS and high tech services were positively related to higher job growth following the recession. Jobs growth after the recession is negatively correlated with higher concentrations of LKIS, low-medium tech manufacturing and other production. We find a positive relationship between job growth and higher income inequalities as measured by both 90:10 and 80:20 income ratios. In the productivity equation the negative relationship with unemployment indicates that higher unemployment is related to lower productivity growth along with higher density and greater concentration of real estate services. We find that higher levels of new enterprises and concentrations of other production industries are positively correlated with productivity growth. So to sum up, higher skills levels, shares of manager and professional occupations and specialisation (particularly concentrations of KIS high tech services) are related to areas with greater output, jobs and productivity growth before and after the recession.

Table 4: Correlations for Expansion after the Recession

	GVA	Jobs	Productivity
Value at 2002	0.397 (0.01)*	0.392 (0.01)*	-0.040 (0.80)
NVQ4plus	0.615 (0.00)*	0.591 (0.00)*	0.252 (0.12)
ManProfOccpn	0.633 (0.00)*	0.652 (0.00)*	0.093 (0.57)
Unemployment	-0.192 (0.24)	0.228 (0.16)	-0.291 (0.07)*
Ln(Density)	0.299 (0.06)*	0.697 (0.00)*	-0.305 (0.05)*
Investment	0.436 (0.00)*	0.445 (0.00)*	0.064 (0.69)
LossDuration	-0.154 (0.34)	-0.034 (0.83)	0.059 (0.71)
RecoveryDuration	-0.501 (0.00)*	-0.425 (0.01)*	-0.308 (0.05)*
NewEnterprises	0.460 (0.00)*	0.687 (0.00)*	0.460 (0.00)*
Krugman Index	0.504 (0.00)*	0.379 (0.01)*	0.143 (0.37)
KIS&HighTech	0.553 (0.00)*	0.674 (0.00)*	-0.021 (0.90)
LessKIS&Other	-0.605 (0.00)*	-0.541 (0.00)*	-0.017 (0.92)
LowMedTechManu	-0.346 (0.03)*	-0.578 (0.00)*	0.121 (0.45)
MedHighTechManu	-0.219 (0.17)	-0.168 (0.29)	-0.146 (0.36)
Other Production	-0.021 (0.90)	-0.457 (0.00)*	0.343 (0.03)*
Real Estate	-0.137 (0.39)	0.085 (0.60)	-0.267 (0.09)*
Inequalities90_10	0.260 (0.10)	0.391 (0.01)*	-0.037 (0.82)
Inequalities80_20	0.158 (0.32)	0.277 (0.08)*	-0.142 (0.38)

Note: correlation coefficient * significant at 10% level. The correlation is between the average rate of growth calculated as 5 years after the recession trough and other variables are averaged over 2010-2012.

Policy Responses to the COVID-19 Crisis

The UK Labour Government's policy response to the 2007-08 Global Financial Crisis was to bail out the finance sector (nationalising some banks) and provide a fiscal stimulus to the economy. They also introduced the Future Jobs Fund through the Department for Work and Pensions[3] in October 2009 to support the creation of subsidised jobs for unemployed young people who were at a disadvantage in the labour market. Official Statistics indicated that between October 2009 and March 2011, just over 105,000 jobs were created under this scheme at a cost of approximately £680 million and a peer review by the National Institute of Economic and Social Research[4] found "exceptionally positive results for a labour market programme". The Welsh Government introduced the ReAct (Redundancy Action Scheme) and ProAct schemes in 2009 for firms to apply for training funding so as to retain jobs in the wake of the crisis with money from the European Social Fund. Sensier and Artis (2016) profile the resilience of the Welsh labour market following the 2007/08 financial crisis and find that job losses were stemmed by the Welsh Government Schemes.

Following the general election in 2010 the Conservatives formed a Coalition Government with the Liberal Democrats and under the then Chancellor of the Exchequer, George Osborne, the focus turned to reducing the deficit (which had trebled in size due to the bank bailouts) and the introduction of austerity budget measures in order to stabilise the country's financial ratings and bring down national debt. In the 10 years of austerity policy in the UK output growth has been subdued along with growth in investment, real wages and productivity. In 2015 the Welsh Government introduced a "Wellbeing of Future Generations" Act. This placed a legal requirement of Welsh public bodies to think about the long-term social, cultural, environmental and economic impact of their investment decisions on wellbeing. The aspiration for a similar act for England has come from Lord Bird introduced the Future Generations Bill to the House of Lords for its first reading in January[5]. It aims to ensure that the decisions made by public bodies, including government departments, in the present take into account the impact on wellbeing for the generations that follow. It would require the creation of a UK-wide Future Generations Commissioner to scrutinise decisions and policies to ensure that their future effects are not overlooked, inspired by the existing Welsh act, working to prevent problems, including the climate crisis and poverty, from happening instead of dealing in short-term, political emergencies. In addition, the legislation will require a joint-parliamentary committee to be setup on future generations. There is now a new wellbeing duty on company directors as well as a move to extend the Public Services (Social Value Act) 2012 to cover services, goods and work

[3] See: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/223120/impacts_costs_benefits_fjf.pdf

[4] See Portes (2012) blog at https://www.niesr.ac.uk/blog/future-jobs-fund-what-waste.

[5] See Lord Bird's Future Generations Bill: https://www.bigissue.com/latest/lord-bird-has-reintroduced-his-future-generations-bill-to-the-house-of-lords/

contracts. The bill also aims to set up a new citizens' assembly to determine the wellbeing goals that public bodies will be required to meet.

Response systems to crisis may be stronger where previous local crisis, like flooding or terrorism, has required a co-ordinated response and may have helped to establish strong community support systems. In the UK the 2004 Civil Contingencies Act required every local area to establish a Local Resilience Forum to be able to put in place emergency plans to deal with local/ national shocks. As an example of place-renewal leadership in the UK, Bailey and Berkeley (2014) discuss the operation of the West Midland's Regional Resilience Taskforce that dealt with business and employment issues during the downturn to ensure resilience over the short and longer term. They document a number of central and local government funds that were set up to help firms access credit and advice during the 2008 downturn. The retention of institutional memory and lessons from dealing with the 2005 closure of the Rover car plant were vital in helping deal with recession. They suggest the resilience dimensions of resistance and recovery were important in the short-term but then the renewal and reorientation of the local automotive sector to diversify into low carbon and higher value activities were important for long-term planning. The West Midlands proved to be resilient after adaptation following the 2008 recession as output, employment and productivity bounced back with higher rates of growth post crisis. Lessons should be learned from every crisis.

We discuss policies that could be applied following COVID-19 pandemic in Sensier and Devine (2020b). Although too early to gauge how it has hit regional economies the poorer areas have experienced higher death rates[6] so far it has not been a great leveller[7]. We assume that as countries gradually emerge from lock down an adjustment process will ensue to a "new normal" until a vaccine is developed. Social distancing measures will continue and this could inflict lasting economic damage to some communities as employers are unable to continue with much lower demand for particular services like hospitality and tourism (Warren, et al. 2020). We assume that those places least economically resilient in the recovery from the 2008 financial crisis may also be least resilient to this current crisis. Initial data released on consumer spending (Cook, et al 2020) shows that rural places that rely heavily on tourism have so far been hardest hit. The direct and indirect impact of this crisis will probably last for a number of years (Kitsos, 2020) and further policies are needed that can help with more flexible job retention for part-time working and training, to tackle the scarring effect of the recession for workers, particularly those who are new to the labour market (Johnson, 2020). In cities, agglomeration advantages may turn into disadvantages, requiring significant investment to improve infrastructure, accelerating the roll out of superfast broadband to encourage working from home and investing in alternative transport schemes improving cycle routes.

[6] See: https://www.bbc.co.uk/news/uk-52506979

[7] As Emily Maitlis report on Newsnight, see: https://www.independent.co.uk/news/uk/home-news/coronavirus-emily-maitlis-newsnight-bbc-inequality-boris-johnson-a9456696.html

Local industrial strategies are being introduced across England to improve productivity and create more inclusive growth to benefit people and communities. The challenge now is for localities to increase their resilience as they move into the recovery phase when the public health dangers have receded. In recovery from the crisis we have seen the rise of mutual aid community organisation and support for local business. Local industrial strategies have a crucial role to play in the pro-active recovery of regions from the crisis to encourage reorientation and renewal within local economies.

There is an opportunity for Government to channel resources into local industrial strategies to offer greater support for firms as they emerge from this crisis. The Government needs to increase local capacity and link up the provision between local government and LEPs. As the Local Resilience Forums have been at the forefront on this crisis they could help direct investment into localising manufacturing capacity to supply the health service (for example with personal protective equipment) so local communities can cope with further outbreaks. Sensier and Uyarra (2020) describe an innovation voucher scheme introduced in Stuttgart during the financial crisis which offered grants to firms in the automotive sector to diversify into electric vehicle development. The local industrial strategies could offer green innovation vouchers to firms following the crisis to incentivise investment into green activity to strengthen resilience. These will enhance the capacity of firms to adjust their products and processes and adapt in response to the climate crisis. Environmental policies and green infrastructure investments should be linked up with work retention, training schemes and finance provision to shore up existing employers and provide new employment opportunities to enhance regional economies.

A large number of companies have furloughed staff and even closed down, this has particularly affected those in low paid sectors like hospitality which led the way in employment growth out of the last recession (Bell et al, 2020). As many firms have suspended operations they may find if demand does not pick up in their sector they may have to go out of business. The Government could incentivise SMEs to work with Universities and take on graduate apprentices. Mothballed firms could be offered cash lifelines where equity is bought by the state and for them to offer goods and services that are needed locally and to pivot firms into socially responsible and sustainable business activity. In Sensier and Devine (2018) we recommend a number of policies to strengthen the resilience of local industrial strategies in recovery from the crisis. Including setting up a Co-operative Development Network to encourage co-operative company development (as they are found to be more productive and resilient); encouraging demand-side policies and joining this up with business support services, education and skills opportunities (work retention and training programmes) to improve local supply chains; improve pay and conditions for key workers in the foundational economy (see Gustafsson and McCurdy, 2020), as these are generally in the lower skilled sectors that predominate in lagging regions, but have become the vital front line services in the coronavirus pandemic.

Conclusions

To understand a region's economic resilience we first dated the business cycle turning points so we could determine when the sub-region was experiencing recession, how it recovered and then compared the recovery growth rate to the rate of growth before the onset of the global financial crisis. By quantifying expansion gains and recessions losses for the economic resilience dimensions of resistance, recovery and renewal between the peak and trough turning points of the cycle we created a resilience scorecard to rank the effect of the crisis on UK NUTS 2 sub-regions.

Sub-regional resilience of UK regions in their recovery from the global financial crisis varies across the UK, with the most resilient regions found in the South East and the least resilient in Yorkshire and The Humber. Even within resilient regions, like the South West, we find much less resilient sub-regions. Our correlation analysis of factors affecting resilience shows us that generally resilient regions have greater shares of the population with higher qualifications and are employed as managers and professionals; more specialised industries (particularly in knowledge intensive services and high tech), less lower-medium tech manufacturing industry, denser population (more likely to be cities), more investment, greater amount of new enterprise start-ups and have been quicker to recover. In terms of the jobs recovery places with the higher income inequalities (ASHE 90:10 ratio) have had the greatest growth. Sub-regions that already have greater than average investment and resources within the population will probably be more resilient and emerge faster from this current recession. The sub-regions that were least resilient to the financial crisis will now have even less capacity to recover after 10 years of austerity has reduced resources. These regions should be targeted with more funding and efforts should be made to increase human resource capacity within regions increasing locating innovation centres, skilled jobs and management positions, particularly in the more knowledge intensive digital services.

Our resilience scorecard could be useful for national and local policy makers and the Industrial Strategy Council to help identify the UK regions that have lacked economic resilience during and since the downturn. The factors we have identified as affecting resilience could be explored further and could help direct future funding streams (like the Shared Prosperity Fund) towards the regions lacking economic resilience to help reduce regional disparities.

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Appendix: UK NUTS 2 Business Cycle Turning points in Real GVA, Jobs and Real Productivity and Economic Resilience Scorecard, results updated on 20/4/20

Table A.1: NUTS 2 Real GVA BC Turning Points and Resilience Measures

Region	Peak year	Trough year	Loss Peak to Trough	Beta - Resist	Year Recover	EAGR	E2AGR
UK	2007	2009	-4.1	1	2011	2.99	2.20
UKC1	2007	2009	-1.97	**0.48**	2015	3.00	0.10
UKC2	2006	2009	-5.70	1.39	2015	3.95	0.96
UKD1	2008	2009	-1.72	**0.42**	2010	2.88	1.77
UKD3	2007	2009	-3.17	**0.77**	2012	2.97	1.30
UKD4	2007	2009	-8.01	1.96	2014	3.11	1.87
UKD6	2007	2009	-6.93	1.69	2012	3.16	2.67
UKD7	2010	2012	-3.66	**0.89**	2015	1.15	**1.49**
UKE1	2008	2013	-10.39	2.53	NR	2.54	1.42
UKE2	2007	2009	-7.10	1.73	2016	2.16	1.16
UKE3	2007	2009	-8.65	2.11	2015	3.25	1.62
UKE4	2007	2009	-6.22	1.52	2015	3.20	1.04
UKF1	2007	2009	-5.11	1.25	2011	2.73	2.44
UKF2	2008	2009	-5.50	1.34	2013	2.63	2.11
UKF3	2008	2009	-4.81	1.17	2013	1.52	**1.97**
UKG1*	2006	2009	-6.39	1.56	2011	2.91	**3.68**
UKG2	2008	2009	-6.00	1.46	2013	1.58	**1.81**
UKG3	2007	2009	-7.67	1.87	2013	1.54	**2.33**
UKH1	2007	2009	-3.56	**0.87**	2012	2.67	1.89
UKH2	2008	2011	-7.07	1.72	2014	2.12	**3.41**
UKH3	2007	2009	-5.40	1.32	2014	2.28	1.53
UKI3	2008	2009	-4.84	1.18	2011	4.88	3.82
UKI4	2008	2009	-4.10	**0.9998**	2011	5.01	3.78
UKI5	2007	2009	-9.99	2.44	2013	3.39	2.63
UKI6	2007	2009	-10.10	2.46	NR	3.45	1.30
UKI7	2007	2009	-8.82	2.15	2012	3.24	**4.21**
UKJ1	2008	2009	-3.72	**0.91**	2011	1.74	**2.80**
UKJ2	2008	2009	-3.32	**0.81**	2012	1.96	1.73
UKJ3	2008	2009	-2.19	**0.53**	2010	2.17	2.09
UKJ4	2008	2009	-5.50	1.34	2013	2.10	1.64
UKK1	2008	2009	-2.60	**0.63**	2010	1.68	**2.45**
UKK2	2008	2009	-2.26	**0.55**	2013	1.67	1.44
UKK3	2008	2009	-4.70	1.15	2012	1.87	1.59
UKK4	2006	2009	-5.74	1.40	2013	3.37	1.59
UKL1	2006	2009	-6.02	1.47	2013	3.62	1.76
UKL2	2007	2009	-5.46	1.33	2011	2.81	1.65
UKM5	2008	2009	-1.14	**0.28**	2010	5.87	4.36
UKM6	2008	2009	-0.35	**0.09**	2010	2.35	1.90
UKM7	2007	2009	-2.63	**0.64**	2012	3.00	1.32
UKM8	2008	2010	-4.06	**0.99**	2013	2.02	1.85
UKM9	2008	2009	-4.12	1.00	2013	2.01	1.58

Note: * Double Dip recession; NR is not recovered.

Table A.2: NUTS 2 Productivity Jobs BC Turning Points and Resilience Measures

Region	Peak year	Trough year	Loss Peak to Trough	Beta - Resist	Year Recover	EAGR	E2AGR
UK	2008	2009	-1.49	1	2012	0.94	**1.06**
UKC1	2007	2012	-5.67	3.82	NR	1.45	0.34
UKC2	2009	2013	-2.91	1.96	2017	0.92	**1.00**
UKD1	2009	2011	-1.02	**0.69**	2012	0.20	**0.94**
UKD3	2010	2011	-1.80	1.21	2013	0.16	**1.64**
UKD4*	2008	2012	-2.59	1.74	NR	1.07	0.41
UKD6	2010	2011	-0.29	**0.19**	2013	0.57	**1.98**
UKD7	2008	2012	-1.61	1.08	2014	0.40	**1.44**
UKE1*	2007	2013	-2.40	1.61	2014	0.98	**1.68**
UKE2	2009	2011	-0.66	**0.44**	2012	1.65	1.21
UKE3	2006	2010	-2.91	1.96	2014	2.00	1.00
UKE4	2008	2009	-1.45	**0.98**	2013	0.90	0.68
UKF1	2007	2009	-3.07	2.07	2011	1.42	1.06
UKF2	2007	2009	-2.48	1.67	2011	1.80	0.94
UKF3	2007	2009	-3.49	2.35	2011	2.35	0.44
UKG1	2008	2010	-3.87	2.61	2014	1.66	1.48
UKG2	2008	2011	-3.00	2.02	2013	0.65	**1.79**
UKG3	2006	2009	-6.16	4.14	2015	0.35	**1.26**
UKH1	2006	2009	-3.21	2.16	2013	1.96	1.27
UKH2	2008	2010	-2.61	1.76	2013	1.02	**2.10**
UKH3	2008	2010	-2.40	1.61	2012	0.66	**1.45**
UKI3					RS	1.14	**2.72**
UKI4	2008	2010	-2.40	1.61	2011	2.99	**3.99**
UKI5*	2008	2011	-4.79	3.22	2012	-0.10	**2.78**
UKI6*	2008	2011	-8.91	5.99	2017	0.92	**1.74**
UKI7	2008	2010	-2.25	1.51	2011	0.53	**2.35**
UKJ1	2008	2009	-2.28	1.53	2012	0.80	**1.55**
UKJ2	2010	2011	-0.21	**0.14**	2012	0.85	**1.65**
UKJ3	2008	2009	-2.34	1.58	2011	0.86	**1.10**
UKJ4	2008	2009	-2.31	1.55	2011	0.72	**1.10**
UKK1	2011	2012	-2.10	1.41	2014	1.06	**1.54**
UKK2	2008	2009	-1.10	**0.74**	2013	1.65	0.96
UKK3	2008	2009	-4.00	2.69	2014	2.35	1.04
UKK4	2006	2008	-0.74	**0.50**	2009	1.50	0.45
UKL1	2009	2011	-2.08	1.40	2013	0.98	**1.34**
UKL2	2008	2009	-1.58	1.06	2014	0.83	**0.84**
UKM5	2008	2010	-1.17	**0.78**	2011	1.50	1.32
UKM6	2008	2009	-5.51	3.71	NR	1.32	0.32
UKM7	2007	2010	-3.95	2.66	2017	0.62	**0.73**
UKM8	2008	2013	-11.29	7.60	NR	1.59	**1.80**
UKM9	2008	2010	-7.77	5.23	NR	1.42	0.39

Note: * Double Dip recession; NR is not recovered; RS is resistant to recession.

Table A.3: NUTS 2 Productivity BC Turning Points and Resilience Measures

Region	Peak year	Trough year	Loss Peak to Trough	Beta - Resist	Year Recover	EAGR	E2AGR
UK	2007	2009	-3.51	1	2011	2.06	1.13
UKC1	2008	2009	-0.47	**0.13**	2010	1.62	0.49
UKC2	2006	2009	-6.51	1.85	2012	1.68	1.45
UKD1	2008	2009	-1.91	**0.54**	2010	2.46	1.03
UKD3	2007	2010	-2.51	**0.72**	2012	2.23	0.74
UKD4	2007	2009	-7.82	2.22	2014	2.36	1.65
UKD6	2007	2009	-7.22	2.05	2017	2.51	1.39
UKD7	2010	2011	-3.51	1.00	NR	1.48	0.05
UKE1	2008	2011	-9.09	2.59	NR	2.12	-0.20
UKE2	2007	2009	-9.68	2.76	NR	1.38	0.94
UKE3	2007	2009	-7.22	2.06	2013	1.66	1.14
UKE4	2007	2010	-5.72	1.63	NR	2.10	0.47
UKF1	2008	2009	-2.25	**0.64**	2010	1.02	**1.37**
UKF2	2008	2009	-3.20	**0.91**	2013	1.24	1.16
UKF3*	2008	2011	-3.68	1.05	2012	0.04	**1.06**
UKG1	2006	2009	-7.35	2.09	2011	0.60	**2.93**
UKG2	2007	2009	-6.31	1.80	2011	1.62	1.46
UKG3	2007	2009	-2.32	**0.66**	2010	1.41	1.06
UKH1	2008	2009	-1.78	**0.51**	2011	1.01	0.62
UKH2	2007	2012	-7.00	1.99	2017	1.65	**1.98**
UKH3	2006	2009	-5.83	1.66	2017	2.40	0.86
UKI3	2007	2009	-6.93	1.97	2016	5.28	1.10
UKI4	2007	2009	-4.81	1.37	2010	2.74	0.71
UKI5	2007	2009	-9.85	2.80	NR	4.03	0.44
UKI6	2007	2010	-5.17	1.47	NR	2.75	0.77
UKI7	2007	2009	-8.16	2.32	2014	2.76	2.07
UKJ1	2007	2009	-1.96	**0.56**	2011	1.74	1.25
UKJ2	2008	2009	-3.09	**0.88**	2013	1.64	0.31
UKJ3	2011	2012	-0.50	**0.14**	2013	0.96	0.83
UKJ4	2008	2009	-3.26	**0.93**	2013	1.38	0.53
UKK1	2007	2009	-3.50	**0.997**	2010	1.39	1.20
UKK2	2006	2009	-3.51	1.00	2017	0.68	0.48
UKK3	2005	2009	-9.05	2.58	2018	3.86	0.54
UKK4	2006	2009	-5.84	1.66	2016	1.97	0.99
UKL1	2006	2009	-6.51	1.85	2011	1.31	1.09
UKL2	2007	2009	-4.55	1.29	2011	1.71	0.81
UKM5					RS	4.37	2.72
UKM6	2005	2007	-4.23	1.21	2009	3.30	2.96
UKM7	2011	2012	-0.98	**0.28**	2013	0.62	**1.60**
UKM8	2006	2008	-3.28	**0.93**	2010	2.20	**2.75**
UKM9	2005	2007	-2.47	**0.70**	2009	1.21	**1.30**

Table A.4: NUTS 2 Resilience Scorecard

	Real GVA				Productivity Jobs				Real Productivity				
	1	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**Sum**
UKC1	1	1	0	0	0	0	0	0	1	1	1	0	5
UKC2	0	0	0	0	0	0	0	1	0	0	1	0	2
UKD1	1	1	1	0	1	0	1	1	1	1	1	0	9
UKD3	1	1	0	0	0	1	1	1	1	0	1	0	7
UKD4	0	1	0	0	0	0	0	0	0	1	0	0	2
UKD6	0	1	0	0	1	1	1	1	0	1	0	0	6
UKD7	1	1	0	1	0	0	0	1	0	1	0	0	5
UKE1	0	0	0	0	0	0	0	1	0	0	0	0	1
UKE2	0	1	0	0	1	0	1	0	0	1	0	0	4
UKE3	0	1	0	0	0	0	0	0	0	1	1	0	3
UKE4	0	1	0	0	1	1	0	0	0	0	0	0	3
UKF1	0	1	1	0	0	0	1	0	1	1	1	1	7
UKF2	0	1	0	0	0	0	1	0	1	1	1	0	5
UKF3	0	1	0	1	0	0	1	0	0	0	1	1	5
UKG1	0	0	0	1	0	0	0	0	0	0	1	1	3
UKG2	0	1	0	1	0	0	0	1	0	1	1	0	5
UKG3	0	1	0	1	0	0	0	1	1	1	1	0	6
UKH1	1	1	0	0	0	0	0	0	1	1	1	0	5
UKH2	0	0	0	1	0	0	0	1	0	0	0	1	3
UKH3	0	1	0	0	0	0	1	1	0	0	0	0	3
UKI3	0	1	1	0	1	1	1	1	0	1	0	0	7
UKI4	1	1	1	0	0	0	1	1	0	1	1	0	7
UKI5	0	1	0	0	0	0	1	1	0	1	0	0	4
UKI6	0	1	0	0	0	0	0	1	0	1	0	0	3
UKI7	0	1	0	1	0	0	1	1	0	1	0	0	5
UKJ1	1	1	1	1	0	1	1	1	1	1	1	0	10
UKJ2	1	1	1	0	1	1	1	1	1	1	1	0	10
UKJ3	1	1	1	0	0	1	1	1	1	1	1	0	9
UKJ4	0	1	0	0	0	1	1	1	1	1	1	0	7
UKK1	1	1	1	1	0	1	1	1	1	1	1	0	10
UKK2	1	1	0	0	1	1	0	0	0	0	0	0	4
UKK3	0	1	1	0	0	1	0	0	0	0	0	0	3
UKK4	0	0	0	0	1	0	1	0	0	0	0	0	2
UKL1	0	0	0	0	0	0	1	1	0	0	1	0	3
UKL2	0	1	1	0	0	1	0	1	0	1	1	0	6
UKM5	1	1	1	0	1	0	1	0	1	1	1	0	8
UKM6	1	1	1	0	0	1	0	0	0	1	1	0	6
UKM7	1	1	0	0	0	0	0	1	1	1	1	1	7
UKM8	1	1	0	0	0	0	0	1	1	1	1	1	7
UKM9	0	1	0	0	0	0	0	0	1	1	1	1	5

Note: The economic resilience scorecard ranks the resilience measures for each measures as follows: (1) Has the fall in GVA/jobs/productivity been less than the national decrease (so for the sensitivity index β_r <1)? (2) Has the duration of the recession been shorter or the

same as the national recession? (3) Has the region recovered faster at the same time as the nation? (4) Was the rate of growth after recession greater than before (E2AGR> EAGR)?