Research England/UKRI and WM-REDI expert evidence forum:
Informing Development of the UK Place-based R&D Strategy

APPENDIX 1

This Appendix to the main report contains written commentaries from the following participants:

- Kieron Flanagan
- Riccardo Crescenzi
- Slavo Radosevic
- Maria Savona
- Helen Lawton Smith
- Anna Valero

Plus a partial literature review, listing papers by the participants.

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R&D, innovative collaborations and the role of public policies

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The generation and diffusion of new knowledge and innovation in national, regional and local economies depends on efforts and investments in Research and Development (R&D). These investments need to be coupled by the presence of appropriate Human Capital and skills in the public and the private sectors in order to absorb and diffuse innovation through the entire

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Figure 1 summarises the results of recent research on the fundamental drivers of local innovation in Europe (Charlot et al. 2015). The surface 3D plot shows how innovative output (Z-axis – measured by regional patents) responds to simultaneous changes in R&D (Y-axis – measured by local expenditure in R&D) and Human Capital (X-axis – measured by the presence in the same local economy of individuals with university degrees). For low levels of Human Capital, the patent-R&D relationship is flat, whereas for higher levels of Human Capital intensity, the influence of R&D investments on innovation is positive and increases sharply with a higher level of Human Capital.

**Figure 1** - The joint effect of R&D and Human Capital (HK) on regional patent intensity K, \( f(RD_{r,t},HK_{r,t}) \). A 3D surface plot.

Source: Charlot, S. Crescenzi R. and Musolesi A (2015) *Journal of Economic Geography*, Volume 15, Issue 6, November 2015, Pages 1227–1259, - Article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0/),

These findings suggest that **R&D investments and facilities do have the potential to boost innovation at the local level**. However, this only happens **where appropriate complementary skills and conditions are available locally** to support knowledge generation and absorption. Investments in R&D can enhance regional innovation only when coupled with a supportive endowment of Human Capital. Both are needed simultaneously to boost innovation, and investing in R&D does not appear to produce a positive effect on innovation for low levels of Human Capital. In this context, the richer regions of the European Union (EU) benefit from a persistent advantage in terms of the innovation returns to R&D efforts. Conversely, economically disadvantaged regions appear to be in an innovation trap in the sense that a marginal increase in R&D or Human Capital would not increase their ability to innovate. For
these regions, investing marginally in such inputs would be wasting money. In particular, the return to R&D expenditure is maximized between 2% and 3% of regional GDP, whereas HK has a positive effect when at least 20% of the regional population has completed tertiary education. Large Charlot et al. 2016 also highlights the presence of shadow effects: high levels of external R&D in neighbouring regions are detrimental for regions with low levels of internal R&D, and the highest joint impact of internal and external R&D is obtained in the correspondence of the highest level of both inputs.

Overall this evidence highlights the risk of ‘cathedrals in the desert’ scenario, where major R&D investments are concentrated (e.g. because of policy decisions on the location of research infrastructure or localised incentives for private research programmes) in regions that lack the appropriate receptive environment in terms of Human Capital and other systemic conditions. The local mismatch between R&D and skilled labor can persistently hinder innovation and local spillovers.

How can this be avoided? How can public policies facilitate the embeddedness of R&D investments and research infrastructure into local innovation systems? **The key tool is collaboration.**

The romantic notion that a new Nikola Tesla will emerge from the lab with the next AC motor (or a death ray) increasingly belongs to a bygone era. While in the late 1970s around 75% of EPO patent applications in the United Kingdom (UK) were filed by individual inventors, nowadays that figure is below 15%. More than 80% of all patents are registered to more than one inventor, suggesting that collaboration in research and innovation has become the norm. Teams within the firm or the research centre, but also increasingly complex networks of researchers involving different firms, often in collaboration with universities, public agencies, and research centres drive the world of invention in the early 21st century. As Seaborn (1979: 88) puts it, “big science [has] eclipsed the garage inventor […] Edison has been superseded by a team of white-coated theoretical physicists”.

This fundamental trend towards collaboration in patenting activity is documented in Figure 2 that plots the share of co-invented patents (i.e. patents filed by two inventors or more) in the United Kingdom since 1978.
While the trend towards the formation of ever-larger research teams and inventor networks has been well documented, we know much less about the factors that drive researchers to collaborate with one another in the first place. How important is geographical proximity and spatial clustering for successful collaborations to happen? What can be done to facilitate local collaborations and spillovers?

Crescenzi et al. 2016 have studied empirically the behaviour of ‘multiple patent’ inventors – i.e. the most prolific and innovative individuals in the economy – showing that being part of the same organisation plays a key role in the formation of co-patenting teams. However, social networks and cognitive proximities are key factors in shaping the selection of team members with a limited direct role of geographical proximity. The role of geographical proximity only emerges as well in interaction with other factors reinforcing their role. This suggests that local collaborations between large research centres and their local environment have the potential to happen but other conditions – to be carefully examined and assessed – need to be in place.

Similar conclusions are reached in Crescenzi et. 2017 looking at the University-Industry collaborations (U–I) collaborations. By looking at the collaborative behaviour of all Italian inventors over the 1978–2007 period, the empirical analysis shows that U–I collaborations are less likely to happen when compared to collaborations involving exclusively university partners of business partners, and suggests that they tend to generate patents of more
general applicability in subsequent inventions—measured by forward-citations. As emphasized by the literature, geographical proximity plays an important role in facilitating all forms of collaboration. At the same time, it works as a possible substitute for institutional proximity, facilitating U–I collaborations. However, the involvement of ‘star inventors’ on both sides of the collaboration can play an equally important role in ‘bridging’ universities and industry.

Policy-makers have been attracted for a long time by the concept of innovation clusters with the objective of boosting overall regional innovation, development and employment. Public research centres and large research facilities have often been a core part of these local innovation strategies and have allocated substantial public resources to their support and promotion. The rationale behind these policies has been provided by the assumption that geographical clustering would per se support knowledge exchange and innovation. Further analysis on the complementarities between geographical proximity and other forms of proximities is crucial in this regard. An emerging body of evidence seems to increasingly point in the direction of an ancillary role being played by spatial clustering: if other proximity conditions are not simultaneously in place, spatial clustering may – as recent research seems to point out – be of limited utility to innovation. Conversely, public policies might have an important role to play acting as bridges in order to facilitate the development of connections between local teams and those active in the research facility. The presence of star researchers in large research facilities might – for example – be a key factors to facilitate collaboration with local industrial partners offering significant opportunities for technological upgrading.

**Key References**


In the 1960s the UK was Europe’s most highly R&D intensive economy with the high government spending on R&D (only a small part of which was covered by the Science Budget) that this implies. That spending was very skewed to defence, and the UK developed a defence research system of considerable size dedicated to providing scientific advice and the development of new technologies. This comprised the MOD and its predecessor departments (including the Ministry of Supply, which was also important in civil technology programmes), a range of public sector research establishments, defence industrial companies and universities around the country.

Unfortunately the UK saw fewer spillovers from defence R&D than the US, reflecting cultural and institutional differences in the research base and industry (e.g. the relatively small amount of defence R&D conducted in universities compared with the US, and a greater separation between research and postgraduate teaching in the UK system), differences in the nature of the R&D conducted, and broader differences in the scale and nature of military and civil demand for new technologies.

There were deliberate attempts to reduce the proportion of government spending accounted for by defence R&D from the 1960s onwards, for instance with the creation of the (fairly short lived) MinTech. In the end the goal was achieved not so much through shifting effort from military to civil technology programmes as through the more general decline in defence spending. During the 1970s, there were also efforts to shift some of the more applied research that had traditionally been part of the work of some of the research councils out of the Science Budget and into civil departments, many of whom were already major spenders on R&D and science, but where research spending had to fight against many other budget demands – and often lost.

From the 1980s onwards there was a major policy shift, with the decision to withdraw from government funding of so-called 'near market' research, on the grounds that this was not the proper function of government and risked crowding-out private investment. Instead government should concentrate on 'curiosity-driven' basic research, where there was a clear market failure. At the same time, it was widely felt that basic research funding must be selectively focused on fewer recipients if leading edge capabilities were to be maintained in the face of rising costs and non-existent prospects for significant real-terms funding increases.

A formal two-tier system of research and teaching universities (amongst the pre-92s) was proposed, but in the end a different approach to selectivity was adopted. This evolved into the present REF-based formula funding system for QR, which may be place-blind but which has had obvious place-specific consequences, especially in England. At the same time the original logic of this policy, to concentrate scarce resources ever more tightly in a context of what was expected to be permanently constrained research spending, has been all but forgotten, it being seen instead as a system for rewarding and incentivising ‘excellence’.

Much has changed since the last time UK R&D intensity was much above 2%, in the late 80s: we have seen the privatisation of most nationalised industries, many of which conducted major R&D activities; the transformation, consolidation, and in some cases privatisation or closure, of the many civil and defence public sector research establishments; a global trend towards decentralisation, outsourcing and offshoring of corporate R&D; the growing importance of foreign-owned R&D investment in the UK relative to UK-owned investment (with very different trajectories of investment); the collapse in productivity of the big pharma R&D model; and the rise of new actors in private R&D (not all of which are actually that new), not only start-ups but also, the
neglected but significant sector of R&D services firms. Most importantly, manufacturing industry, the sector where R&D is most significant as a source of innovation, has continued to decline relative to services. The UK is today an 80% services economy - yet there is next to no discussion of what services innovation policies might look like.

Technology policy seen as a subset of industrial (or defence industrial) policy thus largely gave way to sector-, technology- and place-blind ‘innovation policy’, focused on efforts to promote technology transfer and the commercialisation of basic research findings through the incentivisation of and support for academic-industry interaction and increased patenting, licensing and spin-off activity, reflecting a fallacious linear and closed system notion that the supply of scientific discoveries is the driving force of innovation, and that the whole process should normally happen in the same country, region or even city.

This has left the UK looking quite unlike many comparator countries in terms of the balance between public funding for scientist-led versus problem-driven research and technological development, and thus also in terms of the ecosystem in which public funded research is carried out. Curiosity-driven science, conducted largely in universities, has had to become the swiss army knife of UK science policy, expected to solve any and all social and economic problems. Where new kinds of organisation have been introduced in recent years (e.g. Catapults) this has been tentative and subcritical. The geography of all this public spending is also noteworthy, with the distribution of public investment in R&D looking quite different from that of private sector spending, and with much of that public funding, including major new investments such as the Crick, concentrated in the most expensive places in the country to do research.

At the same time a large and influential tech transfer and commercialisation mafia has grown up, to such an extent that attempts to broaden out the basis of innovation policy by creating new kinds of initiative or organisation often founder on the fact that the human and organisational resources available to help deliver a new idea are cognitively and institutionally locked into the dominant linear, closed, tech transfer paradigm.

A further significant challenge is the common tendency to conflate innovation policy with business support policy - seeing it as a means of helping individual companies to become more competitive, one-by-one, rather than addressing economy-wide problems around the development, diffusion and adoption of innovations so as to achieve economy-wide goals, and regardless of the success or failure of individual treated businesses.

Meanwhile, people, rather than a pipeline of commercialisable discoveries, remain the key output of public R&D funding in terms of impacts upon innovation – a fact that was well-known to post-war science policy makers but which has been largely forgotten in recent decades (despite the best efforts of science policy scholars at SPRU and elsewhere). Unfortunately there is a cultural disconnect between PG teaching and research strategies within our research intensive universities. This partly reflects a long-standing disconnect between research policy, which at least attempts to be *systemic*, and university teaching policy, which, especially in England, treats universities as competing institutions delivering educational services to consumers more or less effectively and efficiently.
The current spending review presents an opportunity to make a decisive break with the assumptions and practices of the past. Today’s public policy goals and objectives, not those of the 1980s and 1990s, should shape science and innovation policy. A period where R&I spending is growing presents an opportunity to make changes without damaging existing ‘excellence’ (which in any case is almost certainly far more robust than claimed). The geographical distribution of knowledge about social and economic problems and challenges, and the distribution of knowledge about industrial innovation, is different from the geographical distribution of public R&D effort and the consequent human capital. Broadening out the geography of the latter will require careful sequencing and a willingness to make major investments that will only pay off slowly over time. A new approach to public R&D and the advanced training/teaching that is or should be closely associated with it should incentivise hub and spoke arrangements that connect place-based challenges and opportunities with leading edge research whilst also connecting the local with the global.

We don’t currently have the institutions for understanding, prioritising and signalling local needs for research. Our research-intensive universities are very self-consciously globally focused, and genuine local impacts are mostly incidental. Local interests actually come to the fore more through their role as major employers and property owners/developers (e.g. through science parks) and thus powerful political actors in their places. Meanwhile more ‘local’ teaching focused institutions may lack the critical mass of research activity to really link the local to the global. Hub and spoke relationships between the two are an obvious thing to attempt long-term experiments with, but such experiments will need to mobilise very significant resources in order to lead to meaningful long term cultural and behavioural change.

Experiments with hubs and spokes would also need to keep in mind that the main local impacts of any universities are through students and staff – i.e. people (embodied knowledge transfer, teaching and recruitment links with firms, student and staff entrepreneurship, etc).

Special attention will be required for service sectors. Some service sectors and firms are R&D intensive, but in many cases R&D functions do not exist and innovation is obscured by a project-based form of organising in which innovation and production are co-delivered. Yet many services firms, including so-called Knowledge-Intensive Business Services, which are themselves key vectors and sources of innovation for their clients, may still benefit greatly from science base links.

Effective services innovation/diffusion policies are likely to need to be even more people-focused than innovation policies for manufacturing sectors – efforts such as improved training and professional development, network building to allow the diffusion of knowledge created within temporary project teams, etc. Some existing people-focused instruments, such as KTPs, would also seem to be readily applicable to services sectors.

All of this will require a new approach to R&I funding, and will require a more distributed and devolved implementation, with UKRI ‘boots on the ground’ around the country and working in collaboration with local policy actors in the kinds of experimental joint programmes discussed above.
Informing the Development of a Place-Based Strategy for Regional Growth:

R&D and Innovation as Catalysts for Local Growth by Simon Collinson. WMREDI, University of Birmingham. July 2020

The discussion paper is very stimulative reading which successfully identifies significant issues related to the levelling up agenda from the perspective of R&D and innovation. My comments are aimed to add the missing points or complement the issues raised by the paper.

1. Trade-offs between short term pressures and long term levelling up objectives

The aim of levelling up is hugely relevant in the UK context. However, we should bear in mind that its agenda and response will be strongly shaped by short – term political pressures for job creation. Hence, it may be useful to articulate trade-off between these two policy objectives – innovation-based growth and job creation. Ideally, they should be complementary in a way that short term incentives to job creation represent the favourable basis for innovation-led development in distressed regions. Hence, it is imperative to consider which are those job place policies which are complementary to R&D and innovation agenda that is our primary concern here.

Place-based job policies are about business assistance which most often includes financial incentives to business provided via tax breaks or cash. From R&D and innovation perspective, it would be necessary first to differentiate between sectorally very different multipliers which are higher in the export base and knowledge intensive (not equal to high tech) industries. Second, innovation-based job incentives should also target customized business services, infrastructure, and land development. Third, it would be essential to design these policies not as individual instruments but as policy packages (policy mixes) attuned to local conditions (see below)².

2. ‘Levelling up’ approach to R&D assumes a simplified relationship between R&D, innovation and productivity which probably does not work in falling behind regions

There seems to be no dispute that R&D is a significant source of long-term productivity growth in advanced economies. However, there is empirical uncertainty about the magnitude of the productivity gains from R&D. Also, the effects may be strongly dependent on time lag as well as being weak due to ‘inefficient’ innovation eco-systems.

The Solow Paradox two (McKinsey, 2018), which is explained by still unrealized promises of digitization is just one of the examples of the complex link between R&D and growth. Literature abounds in so-called ‘paradoxes’: situations where a country has a high R&D input

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but low innovation output such as the European paradox (Dosi, Llerena & Labini, 2006), Swedish paradox (Bitard et al., 2008), the Norwegian puzzle (OECD, 2007; Koch, 2007), the ‘Scottish conundrum’ (Coad and Reid, 2012). These examples suggest that the links between R&D, innovation and growth are not trivial and thus assumption that more R&D will automatically lead to growth is even furthermore questionable in the context of lagging regions.

The tenuous link between R&D, innovation and productivity may be related to the issue of scaling up which applies mainly to young innovative companies (YIC) but not necessary to New Technology-Based Firms (NTBFs), which are small, young, and performing R&D but not necessarily growing. Also, it does not apply to small young firms which are solely small and young, without being R&D active (Czarnitzki and Delanote, 2012). Also, the EU cohesion policy which provides regions with substantial resources for developing their research and development (R&D) activity and technological capabilities is a good learning example for the UK. Filippetti & Peyrache (2015) show that in lagging behind EU regions, productivity growth is mainly driven by capital accumulation while the technology gap does not play a role in driving labour productivity growth and remains stable across regions. The cohesion policy seems to be more effective in dealing with physical investment rather than technological capabilities (EC, 2017).

The workhorse model on the relationship between R&D, Innovation and productivity is the so-called CDM model. Proposed initially by Crépon, Duguet and Mairesse (CDM, 1998) it explains productivity by innovation output and innovation output by research investment. Building on the CDM model, a new wave of studies that exploited innovation surveys emerged. Using different indicators of economic performance, such as labour productivity, TFP, sales, profit margins, and market value, studies repeatedly showed that technological innovations (product or process) lead to superior economic performance for the firm. CDM model has been widely used in exploring RD-Innovation-Productivity link in high-income economies (for example, Criscuolo and Haskell, 2003; Griffith et al., 2006). Its results confirm the relevance of the model for developed economies and the effects of innovation on productivity are both statistically and economically very significant in all countries.

However, evidence in studies for emerging economies, including converging EU economies is much less conclusive (Crespi et al., 2016; Fedynina and Radosevic, 2020). Results for these economies are scarce, less robust and sometimes mixed. Bartz et al. (2016) show that high quality of management practices is significantly associated with higher labour productivity than the occurrence of any innovation (two times higher effect). They show that doing R&D does not have a significant impact on labour productivity. Fedynina and Radosevic (2020) show that an alternative model which start from production capability is empirically more relevant as an explanation of productivity differences for emerging and converging economies than the CDM model.

In summary, the positive relationship between RD- Innovation and productivity is a fair reflection of the role of R&D and Innovation in advanced technology environment but not in less developed regions. Given these results, we may assume that lagging UK regions may face similar challenges. A conventional approach which seems to be present in levelling up approach to RD ad innovation is to give priority to investment in R&D and then expect that through 'commercialization push and pull' this will have an impact on innovation and productivity. For lagging regions, this is necessary but far from sufficient policy focus. In lagging regions and economies, a policy should embrace and focus on the two-way model, which gives equal attention to production or manufacturing/service capability and non-R&D
activities. The figure below is a highly stylized picture of the interactive innovation model relevant for lagging regions.

Source: Radosevic and Ciampi (2017)

3. What value-added?: Productivity vs inclusivity, sustainability and resilience

The increased productivity of lagging regions seems to be the principal policy aim of levelling up agenda. The assumption is that innovation-led productivity growth increases income levels and reduces regional inequalities. On the other hand, the evidence from an Industrial Strategy Council (ISC) report (Zymek and Jones, 2020) indicates that innovation-led growth has not been sufficient to reduce productivity and income disparity between UK regions.

Productivity is multi-level phenomena and by itself does not have discernible content though its simplicity makes it a handy proxy. In the post-COVID period, it is becoming increasingly legitimate to question the absolute prioritization of productivity as the policy aim. In that context, it is very timely that the discussion paper raises the issue of *what value-added* given that there are increasing trade-off between productivity, inclusivity and sustainability to which we can now add also resilience. What R&D and innovation can add in this context is an issue which deserves our attention. Could lagging regions develop new alternative modes of innovation which will be oriented towards sustainability? How can innovation in lagging regions also be inclusive? However, it seems pointless to explore these issues as long as metrics of success remains GVA and productivity. It should be very poignant to try to legitimatize these issues as policy-relevant in the context of levelling up agenda.

4. Regional governance ignored

The discussion paper rightly points to ‘variability in the capacity and capability of local institutions in regions to … understand their place-specific challenges and areas of growth potential … collaborate with private sector firms, universities and other local stakeholders... deliver interventions in an effective and timely way…’. All this points to the major importance of regional governance and yet discussion and proposal of policy instruments are entirely devoid of this dimension. Could we at all think of regional technology upgrading without considering the innovation governance at the regional level?

The discussion paper correctly pleads for *system-wide interventions*. Still, it falls short of recognizing the link between the nature of specific regional technology areas and policy mix required and governance that needs to underpin its development. The policy instrument or selected technology area cannot be effectively deployed unless there is not an alignment among objectives of different bodies involved in innovation policy design and implementation. This, in turn, requires understanding where failures or mismatches in the governance system are.
The levelling up approach makes a mistake similar to the EU S3, where the ultimate logic of intervention is based on individual instruments rather than on particular technology priority areas (TPA). The policy mix is considered at the macro level but not at the level of individual TPA. This suggests that there is not policy mix directionality or link between policy orientation on TPA and their conversion into an appropriate portfolio of instruments geared to each TPA (Magro and Wilson, 2019). However, we should bear in mind that this approach requires higher administrative capacities. However, avoiding establishing closer links between policy objectives and their implementation through directional (TPA oriented) policy mixes will lead to weak or not transformative impacts. The task is to develop an integrated approach adapted to specific TPA. Instead of being focused on individual programs (instruments), the aim is to build policy mixes where complementary programs and calls will have the most effects on structural transformation and improved innovativeness of specific TPA. These policy mixes would go beyond only innovation policy instruments and would consider the overall competitive position of specific TPA.

From a governance perspective, regions would need to establish open platforms of cooperation and open, collaborative innovation, bringing together different quadruple helix stakeholders but adjusted to each specific TPA. Within this process, due consideration should be given how to connect TPA platforms to international networks. The overall aim is to implement a TPA specific policy mixes, which in the case of at least some areas should lead to the structural transformation of specific innovation eco-systems.

This shift has implications for monitoring and evaluation (M&E) governance. A change should be from an accountability role of evaluation to a formative, strategic learning one. It should involve a stakeholder-driven assessment. By this, we mean that ‘the evaluation process itself should be governed in a way that is seen by all parties as being valid and leading to impartial strategic intelligence’ (Magro and Wilson, 2013).

This new M&E system should not replace conventional evaluation but should complement them. The aim is to generate collective knowledge about the contribution of policy-mixes to the evolution of the different TPA and how policy-mixes support prioritized projects. This requires stakeholder-driven governance of M&E evaluation where ‘all parties buy into the evaluation process’ which is governed in a way that is seen as legitimate (ibid).

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05. September 2020

Evidence relevant to the development of the UK Place based R&D strategy

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The industrial strategy white paper includes a plan for developing concerted local industrial strategies that tap into ‘local comparative advantages’. The UK Government has further announced the mission of ‘levelling up’ the country (Collinson, 2020). While it is of course vital that innovation does not leave certain people and places behind, it has been argued that the current pleas for local industrial strategy are still very much centred around large city-regions, and risk exacerbating the striking regional inequality in the UK (Rodriguez-Pose, 2017; see also Lee, 2018). In addition, and relatedly, it has been argued that R&D investments are still very much concentrated in structurally successful areas, such as London and the South East. Similarly, the preoccupation around the productivity slow down and puzzle have led to a focus on key sectors, rather than privileging more pervasive interventions to ensure technological upgrading of mature sectors.

Here I argue that the unquestionably positive support for R&D - such as the Government plan of public R&D funding to help the country reach 2.4% of GDP by 2027 and to 3 per cent over a longer time span, the increase of the rate of R&D tax credit to 12 per cent; and investment of £725 million in the new Industrial Strategy Challenge Fund programmes to leverage on the value of innovation (HM Government, 2017) - should be part of a more articulated industrial policy that ensures inclusive structural change of the economy, that pays attention not only to left-behind places, but, relatedly, to mature sectors, non-tradable (essential during the pandemics) services and vulnerable categories of workers.

I base the argument on some of my recent contributions to the regional innovation literature. First, in Ciarli et al., 2018 we quantify the heterogenous effect of R&D on employment and self-employment in the UK local labour markets and found that R&D can be a mixed blessing for different regions, with consequences on employment and skills polarisation. Second, I found evidence on the importance of maintaining a core manufacturing base when it comes to design structural change of sectoral composition of regions towards advanced and Knowledge Intensive Business Services (KIBS), as in Meliciani and Savona, 2015 and Savona, 2018.

Firm spending in R&D and the effects on TTWA’s employment composition: a policy conundrum?

While the positive link between R&D spending and innovation performance has been relatively uncontroversial for many decades (Griliches, 1979), the heterogeneity of this effect across sectors and places, as well as its unintended consequences, are much less so.

Firm R&D spending is a strategic choice that might represent a trade-off with other investments, and certainly requires changes in the organisation, and demand for new types of workers and skills. R&D might have spillover learning effects within the firm and a multiplicative effect in terms of labour demand within the local labour markets in which the firm is located. Much depends on the initial industrial structure and employment composition of local labour markets. Creating incentives (i.e. tax credits) for firms to spend in R&D might have very different effects on the sectoral composition of employment and on the type of employment created depending on the local characteristics.

The evidence provided here is based on the work conducted within the ESRC SDAI Grant ES/N011929/1 TEMPIS, Technical Change, Employment & Inequality. A Spatial Analysis of Household and Plant Data, including Co-Is Drs Tommaso Ciarli, Alberto Marzucchi and Edgar Salgado.
Across the UK’s local labour markets, in Ciarli et al. (2018a) we find that firm spending in R&D has, on average, a low multiplicative effect on employment rates, while it has quite a remarkable effect on the changes in the employment composition, depending mainly on the initial (in 2001) industrial structure of the local labour market. In areas highly dense in non-routinised occupations, which represent about 85 per cent of the UK population (see figure 1), R&D spending does increase the share of the highly educated, working in manufacturing paid employment sectors.

In contrast, when R&D spending occurs in areas with a higher share of routinised jobs, the (positive) boost to employment is concentrated in lower educated workers employed in non-tradable services. A notable, and relatively overlooked phenomenon, is that the creation of employment in highly routinised areas is substantially driven by an increase in self-employment, a long-term trend in the UK, and to a lesser extent in the main European countries (see figure 2). In Ciarli et al., 2019 we specifically look at the growth of self-employment as a result of R&D spending in UK TTWAs and find very consistent
results, which shed light on the real nature of entrepreneurial versus coping self-employment as a result of innovation.

![Figure 2: Self-employment as a % of employed labour force (1995-2016) Reproduced from: Ciarli et al., 2018a](image-url)

R&D seems to counterbalance the national employment trends at the local level: It has a positive employment impact in industries whose share decreases nationally (manufacturing and transport) and a negative on the employment in industries whose share grows nationally (construction, trade, accommodation, where self-employment grows instead). There seems therefore to be a two-speed, innovation-led, structural change in different areas: an increases in manufacturing jobs of the areas that are already highly dense in non-routinised jobs, while areas that are already highly dense in routinised jobs experience a loss of manufacturing and an increase of non-tradeable (hotel and restaurants, trade), lower skilled jobs. It is here that the increase in self-employment is also concentrated: The increase in self-employment in these areas might have little to do with entrepreneurial jobs (Thurik et al., 2008), and instead represent ‘refugee’ self-employment, that is, turning to self-employment as a coping strategy, due to skill mismatches (Vona and Consoli, 2015), extreme skills complementarities (Mazzolari and Ragusa, 2013; Eeckhout et al., 2014) or simply ‘hidden unemployment’ (Blundell et al., 2014).

Overall, R&D might be a mixed blessing, depending on the initial regional industrial structure. While rightly supporting the generation of new ideas, the maintenance and improvement of scientific excellence and the competitiveness of firms, innovation might also have side effects of increasing regional polarization in terms of industrial structure, share of routinised employment and self-employment. Our findings pose a challenging policy conundrum that the R&D place based strategy and the LIS more in general should address more substantially. The potential polarizing effects of innovation on structural changes in the composition of employment and the labour market should be prevented, and actions taken to ‘prepare the ground’ for local investments in R&D. In this context, ensuring a direction to industrial policy that supports innovation and higher quality jobs in non-tradeable services is a necessary complementary measure to harness the beneficial effects of R&D.

**R&D policy and Sector Deals**

In Savona, 2018, I have raised a few questions that could be similarly feed the UK Place Based R&D strategy. First, in the UK context, widely considered as a service-based economy, what type of (further) de-industrialisation would represent a threat? Second, how would a concerted platform of innovation
and industrial policy interventions steer a transformation of the sectoral structure that considers the large differences in sectoral specialisation and technological opportunities across UK regions?

The industrial strategy, through the sector deals, focuses on key, strategic sectors such as automotive and artificial intelligence, and plans to invest in large infrastructures, digital and logistics. As relevant as it is, this mission-oriented logic of investing into specific, potentially frontier areas, is relatively blind as to what the more pervasive impact on related – or unrelated – sectors will be, depending on the initial industrial structure of specific places, when aiming for a more pervasive and spatially balanced industrial upgrading.

One such missing piece of the puzzle that the sector deals aim to tackle is how to prepare the ground, facilitate and support the maintenance and growth of backward linked services (engineering, technical consultancy, etc.) to the more traditional (mature) manufacturing industries. In addition, attention to forward linked sectors would also require a vision that identifies new technological opportunities – not only those offered by frontier technologies such as Artificial Intelligence and Robotization, but those that would help to ‘rejuvenate’ traditional manufacturing and non-tradeable, essential services. The importance of supporting a certain type of sectoral structural change (labour demand) is similar to planning adequate education and training policies for the labour force (labour supply) and directly affects what the future of employment in the UK could be.

More in general, as argued in Ciarli et al. (2019b)\(^5\), within a cross-country comparison with France, Germany, Japan and China, the UK Sectors Deals seems to lack a strategic investment in industries that may lead the future of international competition, when it requires defying comparative advantages, and a thorough reference to industry specificities that shape R&D spillovers and innovation patterns.

**R&D place-based strategy within the industrial strategy.**

The Place Based R&D strategy, and the industrial strategy, should aim at a more substantial integration between innovation and industrial policy to achieve inclusive structural change (Ciarli et al. 2018b). Inclusive structural change should undoubtedly be starting from the recent proposals around inclusive innovation that aim to broaden the access of individuals, industries and places to innovation processes. However, it should also go beyond these, based on a comprehensive, evidence-based understanding of how innovation affects industrial and employment structure, including how it shapes inter-sectoral linkages between the frontier sectors and more mature, linked ones. This knowledge is important when aiming for an inclusive innovation policy that does not leave behind places and achieve a full ‘levelling up’ of the country’s spatial unbalances.

**Selected References**


UKRI Overall comments Helen Lawton Smith

This note addresses the questions with concentrations on innovation/diversity and healthcare.

Discussion 1: The UK research and innovation system:
A better understanding of what kinds of R&D led-growth economic development is appropriate where, is needed. The first question refers to supply-side interventions but other actors or stakeholders should be included. These include entrepreneurs, SMEs, large firms and foreign firms (and their respective functions). Levelling up will not be possible without consortia including demand side actors being developed in key R&D growth areas such as healthcare, biosciences, agritech, IT/Comms and the green agenda.

Analysis needs to take account of potential for inter-regional cooperation including cross-local boundary collaboration as well as international knowledge diffusion (Mewes and Broekel 2020). Currently successful regions and institutions are likely to have an ongoing role in any levelling up processes by their involvement in wider consortia etc. In any case activities should correspond to those highlighted in regional/sub-regional development plans.

The theoretical underpinning adopted and the kinds of normative/positive assumptions being made re research and innovation and the levelling up process need articulation. This includes issues of diversity and equality within innovation systems and potential. The UKRI has made a commitment to “embed equality, diversity and inclusion at all levels and in all we do”. This requires not only looking at protected individual characteristics but also considering systematic aspects of equality and diversity in the design and operation of the UK R&D system. Now is a good time for clear policy rationale for increasing diversity and inclusion in innovation-led initiatives at the regional level.

Evidence-based targeting of under-representative groups and efforts to increase the pool of entrepreneurial talent are needed. Universities have an increasingly important role in leading on capacity for greater collaboration to ensure joined-up policy and approaches across initiatives/agencies, combined with bottom-up co-designed ones (Vorley et al. 2020). Support should be directed at understanding what will make innovation work for and by disabled and BAME people. Policy needs to take account of intersectionality – age, gender, ethnicity to design support, integrate priorities and improve delivery. Sweden provides an example of this approach6. UKRI already works through the Enhancing place-based...

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6 Innovation and Growth Through Systems Intergration and Globalisation
partnerships in public engagement initiative\textsuperscript{7} and the ISCF Transforming Foundation Industries’ programme that will work to accelerate the development and adoption of new technologies and business models within the Foundation Industries.\textsuperscript{8} These potentially provide good practice in inclusive innovation.

\textit{Discussion 2: The Role of the UKRI:}
Understanding what innovation capacity exists within a region and what the trends are is under-researched. While evaluations have been conducted of programmes such as KTNs, Innovation Grants, Innovation Loans for Innovate UK\textsuperscript{9}, they tend not to identify regional impacts. Innovate UK regional fieldworkers should have an important role to play in developing local levelling up strategies\textsuperscript{10}. Without the right kind of data needed to capture impact, direct and indirect, policies are likely to be ineffective. Assessments of how spillovers from innovation investments work need to be built into programmes including addressing conflicts of interest. Tools are needed to identify promising technologies and evaluate spatial context in which they best evolve (Mewes and Broekel 2020). On the impact of R&D policy to regional technological diversification, this needs to be assessed at regional rather than firm level. Evidence from Germany suggests that subsidised joint projects have a larger effect on entry probabilities of technologies than subsidised projects conducted by single organisations. They positively influence regional technological diversification (Mewes and Broekel 2020). The objective is to produce inter-organisational learning.

This is consistent with the UKRI pathfinder \textit{Strength in Places Fund} that invests in research and innovation projects to boost research and innovation capacity in specific areas of the UK in order to drive economic growth in those areas. Consortia of research organisations, businesses and local leadership are funded to do research and innovation that will have an impact on local economic growth. A good example is the \textit{CS Connected} project that focuses on strengthening an emerging regional cluster in advanced semiconductor materials and manufacturing to bring socio-economic benefits to South Wales. The cluster already hosts 1,400 high value manufacturing jobs in the region, and is delivering well above average contributions to productivity, global exports and regional GVA\textsuperscript{11}. Training inclusion aids sustainability. As not all regions have the institutional capacities to design and/or implement place-based policies, this may contribute to divergence between core and peripheral EU regions (Morisson and Doussineau 2019).

Focusing on existing portfolios of scale-ups and the extent to which they are in relevant industries or sectors are a way in which UKRI, government and local leadership can help to level up the country providing this is linked to local strengths\textsuperscript{12}. Start-ups and financing them are rarely the problem. If scale-up capacity and finance are lacking money will be wasted. According to EY (2020), biotech scale ups can accelerate healthcare transformation in an effective and customized way\textsuperscript{13}. These need to be harnessed to specific regional priorities include those of diversity in innovation with appropriate understanding in the lack of diversity in a major source of innovation funding – venture capital (Diversity VC 2019).

\textsuperscript{7} UKRI, \textit{Enhancing place-based partnerships in public engagement}
\textsuperscript{8} UKRI, \textit{ISCF Transforming Foundation Industries Network Plus}
\textsuperscript{9} Innovate UK, \textit{Measuring the impact of our innovation grants}
\textsuperscript{10} Innovate UK, \textit{To the regions and beyond}
\textsuperscript{11} UKRI, \textit{Strength in Places Fund}
\textsuperscript{12} Innovate UK / Innovation Causus / ERC / ERSC, \textit{Innovator’s Breakfast Club}
\textsuperscript{13} EY, \textit{How biotech scale ups can contribute to the health industry transformation}
Policy tools could make more use of scenario building with a plausible range of outcomes, with implications for the different actors, ambitions for the sector in the region, where policy is needed, building in sector forecasts and possible organisational and behavioural changes. We know that sectors behave differently depending on their location, with regional disparities in productivity. There is a need for assessments of the kinds of regional impacts that new investments will have.

In healthcare and in other sectors, there could be more experimental ways of funding projects at the local level – “skunk works” or pilot innovation projects – to see what happens. This could be combined with a strategy to develop soft-start-ups i.e. a business model built on providing R&D based services on a contract basis to paying customers (NESTA 2018). An experimental approach at the local level would enable the possibility of challenging and changing dialogues through public engagement. Working through how experimental governance ‘affords a potential way of implementing regional innovation policies that build on local capabilities by developing new institutional as well as entrepreneurial capacities’ (Wolfe/OECD 2018, 4) involves provisional goal setting and revisions learned from regional experience while recognising limits to institutional capacity.

The UK could follow the example of other countries in targeting specific sectors e.g. healthcare enhanced by bringing locally specific expertise which is directly targeted at levelling up the country. Health and social care are at heart of industrial strategy which calls for greater public engagement (NESTA 2018, 52). NESTA (2018, 43) has identified areas of expertise. These include Manchester/Cheshire – health innovation, clinical trials and health informatics; Liverpool in diagnosis, therapeutics and prevention of infectious diseases and Leeds in medical devices and diagnostics. Canada is interesting in that it allows all regions to take part in an overarching initiative. This can be adopted outside healthcare.

The CAN Health Network is a national partnership of leading Canadian health organizations (e.g. hospitals, care homes, health services, research centres), referred to as Edges, and companies across Canada. Edges are a diverse set of public or private organizations with shared challenges that form the integrated network to collaborate, adopt and procure innovative home-grown solutions. Edges are health care operators who are committed to being early adopters of innovative Canadian health care solutions. They function as a co-op style placement site working as an integrated marketplace for Canadian businesses to test and enhance their technologies in partnership with the end-user and subsequently scale through innovative procurement processes. See https://canhealthnetwork.ca/

COVID 19 has changed priorities for the UK and hence demand for research, analysis and action. UKRI’s regional sector approach should take account of where best activities such as the need to scale up investment in integrated strategies for innovation in health, public health and social care – National Institute for People Powered Health, and be located outside the Golden Triangle (NESTA 2018, 7). NESTA argues that research in the life sciences is concentrated in parts of the country that are the healthiest, rather than the sickest – which skews research priorities. There is potential for building clusters around healthcare as a way of building centres of expertise informed by local knowledge e.g. Public Health Officers. Nationally, in healthcare at least, a UK high level advisory group with representatives from devolved administrations, city region mayors and other regional authorities should be set up to identify inter-linkages of actions and feedback loops (NESTA 2018, 8). All 4 nations should be involved and ways of staying close to Europe are needed. In developing an innovation strategy, UKRI should work with BEIS and the Disability Unit of the Cabinet Office - which has a regional stakeholder group.
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Research England/UKRI and WM-REDI expert evidence roundtable
Elvira Uyarra
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Place based innovation and industrial transition efforts should:
1. adopt a broader view of regional assets that go beyond research strengths.
2. address multiple forms of value creation (not just economic but also social and environmental)
3. consider multiple policy levers from the supply and demand side and coherent policy mixes

acknowledge the importance of local capacity for policy implementation.

Beyond R&D

Modern innovation policies are based on the principles of selectivity, that focus on promising avenues for diversification based on existing regional strengths. Selectivity in smart specialisation typically implies building on unique place-specific characteristics and assets, ‘discovered’ through bottom up ‘entrepreneurial discovery’ processes and supported by vertical interventions besides more horizontal or blanket policies.

However there is a risk that what constitutes ‘strengths’ may be interpreted too narrowly as science strengths or strengths in STEM subjects. This reflects an old-fashioned and linear approach to innovation that considers innovation as arising exclusively from research organisations and taking place in
manufacturing sectors. It neglects broader notions of innovation including experience-driven innovation in different business sectors, user-driven innovations, social innovation and public sector innovation. This is important as service sectors account for over 80% of UK GDP. This approach is also built on a ‘closed system’ fallacy, in which discovery and exploitation are expected to happen in the same place.

This technology or supply side focus in innovation policy thinking overlooks considerable innovation potential in other sectors and places and risks narrowing both the ambitions of policy makers and the repertoire of tools and approaches they might choose to adopt. Broader advantages or assets beyond sectoral and knowledge specialisations tend to be overlooked. Place based innovation requires support and a deep appreciation of not just the productive structure but also other assets. Certain natural conditions may constitute locational advantages for certain emergent industries (climatic conditions and low population density were a locational advantage for the development of drones in Galicia, Spain). Certain institutional assets may make a region better prepared for other industries that build on similar institutional arrangements and practices). Social assets and civic culture can also attract industries as Mary Walshok writes about San Diego. Place based problems and challenges (e.g. the need for retrofitting of social housing in Manchester) also present actual or latent demands with the potential to create or shape markets. They constitute not just a market failure to resolve but a source of entrepreneurial opportunity and innovation. Public spending in areas linked to the foundational economy and of great social need such as health, housing and public transport constitute sizeable markets for innovative goods and services.

**Societal challenges**

Problems related to climate change, migration, or food and energy security are increasingly seen as key drivers for innovation policy. However, these approaches share an implicit assumption that societal challenges are global and thus best dealt with at the national or supranational level. Mission oriented policies have a bias towards large-scale state-led scientific research vis a vis the diffusion or uptake of new solutions. Unlike moon-shot missions, most societal problems are fuzzy and ill-defined, and therefore more likely to face strong problems of contestation and legitimacy. They are also local and situated, shaped by territorial and other contextual conditions. Place dependent conditions and the contested nature of societal challenges mean that they are likely to be differently felt, understood and acted upon in different places. Knowhow required for solving societal challenges is partly tacit and situated, and investments are required to adapt them to the local environment. This in turn makes certain places ideal
testing grounds for novel solutions and experimentation that can help address challenges of both local and even eventually global relevance. The geography or societal challenges is however different to the geography of (R&D) solutions.

The ‘challenge orientation’ of the UK Industrial Strategy puts a greater focus on technological and sectoral priorities than on societal challenges affecting real communities (ageing apart) – i.e. it is a more traditional Industrial Strategy than the discussion about challenges suggests. The context and place specificity of societal challenges tends to be overlooked, and clear mechanisms to engage with place to inform national priorities and choices are missing.

Policy mix

A problem-based approach to innovation policy requires system level responses that considers not just technological advancement but also changes to institutions, laws, regulations, market mechanisms and attitudes associated with adoption.

This requires a broad mix of policy instruments, both directed towards the supply side (firms and resources) and the demand side (i.e demand articulation). This links to the need to put a greater focus on the demand side and particularly on the role of government in driving the demand for innovation, in pursuit of its strategic goals. Public procurement is worth £270bn a year of goods, works and services in the UK – and is a major influence on the private sector productivity and innovation. Governments can shape markets where the private sector cannot, by taking on the role of ‘lead customer’ for new technologies as they are developed.

Industrial policy could be better coordinated with procurement across all relevant fields of government. Societal challenges present actual or latent demands, that if articulated into concrete needs have the potential to create or shape markets. Supply side strategies can then support and strengthen existing place-based advantages to meet that demand and address local but also potentially global solutions and markets. This needs a system level approach and coordination across levels of government and policy areas.

The idea of a policy mix suggests the need to focus on policy coherence, namely to consider complementarities or synergies (and relative lack of tensions) across instruments at different levels and the potential misalignments between policy design and policy implementation (Flanagan et al., 2011).
Implementation

The gap between policy aspirations and the implementation of appropriate instruments is therefore a much-neglected aspect in industrial policy. There is therefore a need to address the ‘missing policy space’ that currently exists between the national level of policy and the local level of implementation. This requires more decentralised spending and sufficient levers and capacity to make relevant local decisions in terms of innovation and infrastructure.

The dismantling of regional governance structures in England since 2010 destroyed analytical, policy and implementation capacity in many places. Industrial policies require long term commitment and institutional stability. There has been a tendency in England to continuously ‘chop and change institutions’ and thus innovation delivery bodies have lacked funding stability and critical mass needed to generate enough industry confidence. Each new government is setting up its own institutions, rather than having a settled and long-term view of what innovation institutions are needed.

Anna Valero

Research England/UKRI and WM-REDI expert evidence forum:

Informing Development of the UK Place-based R&D Strategy

Notes prepared by Anna Valero, Centre for Economic Performance, LSE

- Building on existing and emerging R&D strengths – taking into consideration contributing to the national R&D system as a whole

With the objective of maximising R&D, innovation and associated spillovers at the national level, it is optimal for research funding and support to flow to areas where the impacts are likely to be highest. This will, in general, tend to be the most research-intensive universities / sectors or researchers with strongest track record. With respect to university research activity, the evidence suggests that innovation and economic spillovers tend to be higher for higher quality, research intensive universities and areas where industry is more closely tied with university specialisms (see Azmat et al., (2018) section 4, for a summary). An increased emphasis on place is justified from a national perspective if it helps to address any bias in current resource allocation processes, or lack of information on local strengths or how these can be leveraged, which might prevent support flowing to areas with strong growth potential.

14 This includes Valero (2019) that shows that high tech start up activity is associated with growth in the university sector, but that effects are larger for Russell Group universities and areas with higher initial human capital intensity.
In order to build on existing UK R&D strength, more needs to be done on commercialisation. Business-university collaborations remain challenging to facilitate, with a need to better understand the complex barriers to collaboration, policies which can encourage it and complementarities between these (OECD, 2019). The Catapult network is considered a promising model, though they have been reliant on public funding, and it has been argued that would benefit from more robust evaluation, governance and co-ordination (EY, 2017). More generally, policies on the business “demand” side (e.g. R&D tax credits, better information on the opportunities for businesses) need to be effectively combined with policies on the supply side (e.g. human capital for both innovation and its diffusion, and the career incentives of academics). For a summary of the international evidence on innovation policy see Bloom et al., (2019).

- **Increasing R&D activity in parts of the UK with demonstrable potential for significant growth** – taking into consideration that uniform levels of activity / intensity across the whole country are unlikely to represent value-for-money.

Identifying areas with potential requires careful analysis and understanding of the strengths, opportunities and risks in local areas, the nature of barriers that might be holding them back and the policy levers that might be able to address. A combination of bottom-up and top-down analyses will be valuable. The government’s science and innovation audits could be built upon, together with the knowledge and analyses developed so far in the Local Industrial Strategies; and comparative analysis of data on innovation and productivity across the UK (and overseas) can help build understanding relative potential (these types of metrics are being developed by the Industrial Strategy Council).

Informative analysis can be conducted using patents data. In Rydge et al., (2018) and Unsworth et al., (2020) we have shown how analysis of comparative advantage and spillovers using patents can highlight technologies and geographical areas with current or emerging strengths. This type of analysis can be tied to key societal challenges – such as meeting net zero greenhouse emissions by 2050 – to understand the areas with the potential to generate and market the innovations required to address these. Focusing on technologies related to low carbon passenger vehicles, analysis in Unsworth et al., (2020) highlights areas with potential in terms of “clean” innovations in the auto industry. This type of analysis can be carried out for different types of technology.\(^{15}\)

Not all innovation is patented – in particular in the service sector which dominates the UK economy in terms of GVA and represents much of the UK’s comparative advantage in terms of trade globally. Broader measures of innovation, for example using text from company websites to understand new product development, can also be considered.\(^{16}\) The role of research in the social sciences, arts and humanities disciplines are particularly important here, both in terms of contributing to innovations and their marketability (e.g. in the creative sectors), and in conducting analyses to build an understanding of how to encourage diffusion (e.g. social scientists working with local stakeholders to design and evaluate policies).\(^{17}\)

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\(^{15}\) In a forthcoming paper we consider “clean” technologies more broadly and also look at areas of strength in technologies that are relevant for addressing the health impacts of Covid-19, such as vaccines; and innovations which help the economy to cope with the pandemic, such as remote working technologies.

\(^{16}\) This is an area of current CEP research funded by the ESRC (grant # ES/T002506/1).

\(^{17}\) Owen-Smith (2018) highlights the contribution of numerous disciplines across UC Davis in the development of the Napa Valley wine industry.
• **Targeting R&D investment in a way that is likely to lead to meaningful local impacts and is responsive to communities’ needs** – as compared with focusing on funding inputs

Again, this will require improving knowledge on local economic strengths, weaknesses and societal needs - some of which can be built locally, but much of which requires analysis of comparative data across the UK. Targeted place-based investments, combined with other support policies into recovery should be based on the profiles of local areas, and developed in partnership with local policymakers and other stakeholders where possible as part of the local industrial strategies. This can help ensure that any R&D investments are accompanied by other complementary policies (e.g. skills and infrastructure) and local buy-in that are key for success.

• **How to link with wider government levers to improve the local innovation systems of places with lower potential for R&D** - but focussing on where technology and knowledge adoption / diffusion could have meaningful impacts on local people and businesses

The limited adoption and diffusion of productivity enhancing technologies has held back productivity in the UK, in particular amongst the “long tail” SMEs. Since Covid-19, the adoption of new technologies has been a major lifeline for many businesses (for example digital technologies for remote working and online ordering). However, the viability of these technologies is likely to depend on company and region-specific considerations such as quality of digital infrastructure, the availability of finance, information frictions, workforce and managerial skills.

Given the evidence that R&D investments tend to have greater impact in more research intensive areas, and the fact that R&D activity can be geographically mobile (particularly in firms), a focus on skills and diffusion (into existing businesses) in lagging areas is likely to be the most effective route to achieving levelling up, at least in the short-term. Such policies would also be likely to raise the demand for R&D amongst businesses and individuals in the medium term. The role of less research-intensive universities and FE colleges as “diffusion spokes” (Haldane, 2018) should also be explored further. Using international data from the CEP’s “World Management Survey”, Feng and Valero (2020) find that firms near to universities tend to have better management practices, which appears to be due to better access to skilled managers and workers. We need more evidence at the micro level on how universities can help in the diffusion of best practices technologies and organisational practices, and what general business support policies work (as is being built by the BEIS Business Basics Programme).

• **How to develop clear partnerships between the government / UKRI and local actors**

Key to this is ensuring that there is adequate local capacity (e.g. in LEPs), and the frameworks in place to create long-term partnerships between national and local government, UKRI, universities, businesses and other local stakeholders. “University enterprise zones” seek to strengthen these interactions, but the future of this scheme is unclear. This links to the need for a long-term industrial strategy (at the local and national levels) to reduce policy uncertainty during particularly uncertain times (due to Covid-19 and Brexit). More sharing of information and best practice between local areas is also likely to be beneficial.

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18 Current CEP research in collaboration with the CBI and funded by the ESRC (ES/V011286/1) has conducted a survey on business technological responses to COVID-19. This work seeks to inform appropriate policies for the recovery, and an initial paper describing the data is due shortly.
What are the likely implications of the COVID19 crisis and recovery for the levelling up agenda?

Covid-19 has already exacerbated inequalities in the UK – so far those from worse-off backgrounds have suffered more in health, education and labour market outcomes.\(^\text{19}\) Disruption to businesses and working practices has, in some cases, generated opportunities for re-setting parts of the economy, for example in allowing for more flexible working (which can help improve productivity and the allocation of talent, see Bandiera and Valero, 2016), and reducing business travel which has helped curb emissions. But it is also likely to accelerate automation of certain occupations, and hence displacement of workers, requiring effective programmes of retraining and job creation into recovery. From an innovation perspective, Covid-19 has created additional financial risks for research universities reliant on international fee income\(^\text{20}\), and high-growth firms needing access to finance (Beauchurst, 2020).

At the same time, Brexit is anticipated to harm some regions more than others (depending on sectoral make-up) and also damages the attractiveness of the UK for top international talent, international research collaborations, and as a location for international businesses engaged in global value chains to conduct their R&D- all of which have benefitted the UK economy to date (Azmat et al., 2018; LSE Growth Commission, 2017).

The extent of government support for industry due to Covid-19 presents an opportunity to develop a strong partnership between the public and private sectors with incentives aligned towards innovation-led sustainable growth. A re-emphasised and long-term industrial strategy (at the national and local levels), with clean growth at its core, can help to achieve this.

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