Research England/UKRI and WMREDI expert evidence forum:

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

The West-Midlands Regional Economic Development Institute (WMREDI) at the University of Birmingham hosted a closed-forum for Research England (UKRI) to examine the evidence base for a place-based R&D strategy. The following questions guided discussions:

- **What evidence is available (or is needed) to show that different kinds of regional impact result from different kinds of R&D investments / interventions?**
- **What should the research and innovation system – universities, businesses, research organisation and other intermediaries - do more of to support economic growth in their region?**
- **How can we ensure different parts of the UK have the mix of interventions they need to enable R&D-led growth?**
- **What are the major critical dependencies for R&D policy levers at the national and the local level?**
- **Is there evidence to show which different levers, incentives, mechanisms and critical dependencies make a difference to scale of impact and/or outcomes?**
- **What does UKRI, government and local leadership need to do to ensure research and innovation can play a powerful role in levelling up the country?**
- **How can UKRI better support this activity/what more can UKRI do to support these activities?**

This paper summarises the discussion, supported by fuller briefings from some of the participants and discussants, and a literature review.

Introduction

A strong, central message from our discussions is that understanding the impact of interventions, such as how R&D investments affect subsequent regional growth patterns, requires an understanding of the wider regional system, or ecosystem. More precise and effective targeting of interventions to produce specific outcomes, can be achieved by drawing together research across various levels and types of analysis (micro, macro, quantitative, qualitative), and the following provides a starting point.

The discussion was wide-ranging, but we have structured this paper into the following thematic areas. Given the importance of an innovation-systems approach, Figure 1, shown at the end of this paper depicts these elements.

(1) R&D Investments have a Positive (but mixed) Regional Impact
(2) Place Matters – But Why and How?

(3) Targeted and Connected Innovation Policies Matter
(4) Concentration and Agglomeration Effects… Multipliers, Spillovers and Diffusion Effects
(5) Absorptive Capacity and Human Capital
(6) The Role of Universities
(7) Policy Recommendations and Levers… How to Invest Better?

1. R&D Investments have a Positive (but mixed) Regional Impact

Research generally supports the view that R&D investments have a positive impact on regional economies. This occurs via improvements in innovative capacity and capability which can give rise to productivity improvements, greater levels of firm competitiveness and/or high concentrations of higher-skilled, higher-income workers. Clustering or agglomeration effects can also be generated as further investment in specialised technologies / sectors / firms / skills follow improved local attractiveness.

But there are very mixed effects when we analyse the spatial impacts, effects on industry sectors or consequences for patterns of employment and relative inequality, by advantaging some skill sets or socio-economic groups and disadvantaging others. These are complex and context-specific or contingent on local structural characteristics. Such local characteristics include: the mix of industry sectors, firms, structural diversity, technological relatedness, skills, labour markets and infrastructure, but also institutional and governance structures and social conditions and challenges (see Figure 1). So, in these respects and many others, place matters. Local characteristics shape and are shaped by the impacts of R&D investments and other interventions. Standardised, national policies have limited effect and customising interventions more precisely to fit with local endowments is important to achieve wider and/or longer-term impacts at local level.

2. Place Matters – But Why and How?

Firms select to invest R&D facilities in places where local endowments, including high levels of related skills, technology producers, infrastructure (transport, housing, amenities, schools), supporting firms and universities provide the necessary inputs. This often drives clustering and agglomeration effects. Alternatively, firms may co-locate R&D alongside other internal functions, including in-house production facilities, or alongside suppliers or client firms, to facilitate either intra-firm or inter-firm adoption and exploitation.

The prevalence of specific kinds of input endowments and technology or knowledge adopters determine the attractiveness of a place for particular R&D investments. These same characteristics, alongside others, also influence the evolving impact of these investments on other aspects of the regional economy.

Highly relevant research looks at the links between R&D investment and structural changes in employment.

"…in Ciarli et al., 2018a 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"… "…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."

There is also an impact on the level and composition of self-employment, which is a UK peculiarity compared to some EU countries (Ciarli et al., 2019).

Some studies have taken the next step in the logic chain to connect income from employment to relative changes in spatial inequalities. Add these together and one conclusion is that local trade-offs often exist between increased employment opportunities for high-skilled, high-income employees vs. low-skilled, low-income employees. This lies at the heart of the productivity vs. inclusivity dilemma. While some policy decisions are made with some understanding of this, such trade-offs are difficult to measure and can take effect over the long-term. So, it is likely that the timing of these decisions in the context of changes in the economy (e.g. in times of shock-driven austerity and increased unemployment) and the shifting priorities of government, will dictate the focus.

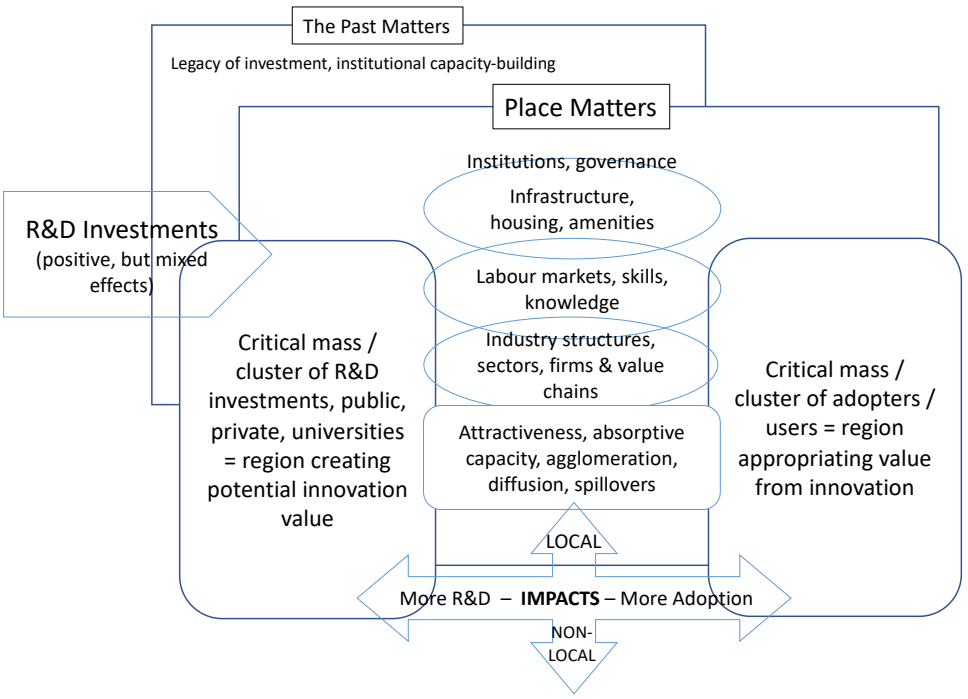
Evidence also suggests that firms that receive R&D or innovation support or subsidies perform better than others and this can translate into positive regional impacts. (Helen Lawton Smith, Warwick Enterprise Research Centre studies). More evidence is needed from longitudinal studies on the short and long-term impacts on individual firms, value chains and spatial geographies, to improve the precision of interventions like these.

More evidence is also needed to understand firm behaviours under certain structural and temporal conditions. For example, are there particular incentives and tipping points for increased or decreased investment in research and/or development, adoption and use of new technologies, processes or knowledge? How does this behaviour link to recruitment and skills training patterns and thereby relate to the demand and supply of particular kinds of labour? The next step is then to link these behaviours to aggregate effects within specific spatial geographies, including labour markets, technology adoption, patterns of investment or relocation (out of or into a region) and subsequent changes in industry structure and growth (Lawton Smith and others).

The location of R&D investments, in terms of promoting further concentrations or wider distribution of public funding (or incentives for the location of private R&D investment) is also an important dimension. One view is that strongly subsidising R&D in lagging regions will lead to new structural problems of pockets of international excellence that are 'locally irrelevant'. One element of the disconnect between R&D centres and local economies is the trade-off with job creation (Glaeser and Hausman, 2019 demonstrate this in the US context). Firm R&D is also relatively mobile and can move if local endowments change or other places offer stronger complementarities. Complementarities between R&D investments, other investments and job-creation should provide the basis for location selection ("we should avoid talking about R&D as a sole driver in lagging regions." Radosevic).

This raises important policy questions, including: how can we channel investments where there are underlying strengths for either leading-edge R&D and/or adoption and leveraging R&D for improved productivity, competitiveness or social benefit? We do not have robust, historical / longitudinal evidence to guide this selection process. Many parts of the UK are far away from the technological frontier. There have been failures in the past from using R&D investments to revitalise lagging areas because the necessary components (skills, infrastructure, universities / specialists, complementary firms etc.), on the supply and/or demand sides have been absent.

Figure 1. Place Matters When Targeting R&D Investment for Regional Growth Outcomes



Collinson and Billing. 2020

3. Targeted and Connected Innovation Policies Matter

As a logical step from the above points, R&D investments need to be connected to the wider components of an innovation policy. This directly relates to the place dimension, but it is also relevant when the spatial impacts are not the primary concern. This includes jointly considering both supply (input)-side and demand (output / adoption)-side components. Investment in the supply-side without considering, and investing in, structures for local commercialisation, adoption, diffusion, value-appropriation and the realisation of benefits is said to be more characteristic of the UK innovation system than for other countries (Flanagan and others?)

If we consider where policy has focused efforts and resources in the past, one view is that there has been an over-emphasis on R&D-intensive firms and technology-based spin-outs and start-ups. Although R&D investment is a relatively simple proxy measure, and patents are a simple proxy output measure, these do not capture the bulk of innovative activity. High-technology manufacturing represents just three percent of the UK economy, so there should be a greater emphasis on firms and sectors that spend less on R&D but excel at incremental innovation and/or creative talent development (Nightingale). This is closely aligned with the call for less of a focus on the small number of firms at the top of the productivity distribution / technology frontier and more on the much larger number that are able to make incremental efficiency gains to improve productivity (Harris). Similarly, the enabling effects of particular technologies (digital), capabilities (management, design, creativity), processes and practices, which promote innovation across many types of firms and sectors, should be more prominent in policy interventions.

There are also 'broader advantages or assets beyond sectoral and knowledge specialisations' and these are often overlooked. Certain natural conditions may constitute locational advantages for certain emergent industries (e.g. climatic conditions and low population density as a locational

advantage for the development of drones in Galicia, Spain; Uyarra). Certain institutional assets, contracting or partnering practices, may also make a region better-prepared and more suitable for some types of R&D or innovation than others. Research shows that this extends to housing stock, social assets and civic culture as well as physical amenities as factors that attract industries and/or certain types of talent. (e.g Mary Walshok on San Diego).

Skills, Employment and Regional Innovation Capacity

Skills, as a location endowment attracting investment and as an outcome of R&D investment, are a critical complementarity. Investments that help regions attract, retain or develop higher-level skills create both direct and indirect effects on productivity and other economic performance measures. Using simple proxy measures of skill levels, both micro-level (project) evaluations and macro-level (input-output econometric) models place the highest multiplier weightings to high-skills employment. High-skill occupations in R&D-intensive enterprises come with higher incomes, driving local consumption-related growth effects and higher direct productivity (GVA) effects at the regional level.

But skills, or a lack of skills, in firms which represent potential innovation adopters in a region also strongly influence the indirect productivity effects from diffusion and spill-overs in regional clusters. This is particularly emphasised in studies which take a broader view of skills as 'innovation-related knowledge and capability' rather than narrowly defined as STEM qualifications. The organisational contexts which develop and direct R&D-related skills and knowledge are also an important component of the system that determines these impacts (Flanagan).

Improving the Targeting of Local Interventions

To improve the targeting of interventions at the regional level, more analytical capacity and capability needs to be developed in regions to better-understand how certain investments align (or do not align) with local strengths and weaknesses. Evaluation frameworks, like the Green Book and other approaches to measuring potential growth outcomes using cost-benefit analysis and specific proxy measures (such as jobs or GVA), often fail to capture place-based barriers or complementarities which would reduce or increase certain kinds of impact. A lack of expertise in regions and gaps in the data on regions, weakens our national ability to invest intelligently at the local level. Some would argue that political drivers (such as a match between central government and the party dominating specific local authorities) has a greater influence on regional R&D investment than a strategy informed by spatial economics.

The consensus from a variety of studies is that the UK, as one of the most highly centralised OECD economies, suffers from a legacy of low levels of investment in regions and that this undermines the capacity and capability of regions to identify and deliver local industrial strategies. This has a direct impact on targeting, attracting and leveraging R&D investment, particularly on places without a track record of success. A self-reinforcing cycle which constrains effective national rebalancing efforts.

A relative 'lack of precision' in UK investment policies, relative to other countries, is said to apply at the national level and local levels. Other countries appear to have industrial strategies which more effectively identify and invest in areas of future comparative advantage (e.g. Mazzucato, 2018), and align interventions more closely to local industry structures and labour markets. Again, weak local institutional capacity and capability for identifying R&D investment opportunities and coherently managing interventions in partnership with local firms, universities and other anchor institutions is implicated. Most studies see this as a major UK weakness, making devolution of funding and decision-making power difficult.

4. Concentration and Agglomeration Effects… Multipliers, Spillovers and Diffusion Effects

The what, where and how to invest are innately linked to the why. This is the first-order challenge; what specific outcomes do we want to see, including who benefits from investments, directly and indirectly? This links to the debate about rewarding success, concentrating investment in places and building on existing strengths, which again is seen as more prevalent in the UK (North and Forth, 2020). Promoting supply-side clustering can reap economies of scale and leading-edge R&D at the international frontier. But a growing counterview with a wider set of outcomes in mind is that investment should be targeted at catalysing new types of growth and/or growth in other places (Valero).

The second main challenge is the incomplete evidence on the spatial impacts of different forms of diffusion and spillover. R&D investments lead to a wide range of international, national and local effects. Taking into account lots of work on spillovers and agglomeration economies too little is still known about which kinds of intervention really benefit the local economy over what timescales and with which beneficiaries. This makes it difficult to robustly identify levers for improving local benefits; multiplier effects in terms of GVA and jobs, new business birth rates and survival rates, scale-ups, and longer-term attractiveness to firm investment and talented workers. These are the outcomes of intermediary or moderating processes of uneven adoption and diffusion which include a complex mix of human capital, knowledge, processes, practices and technology artefacts. Moreover, these combinations have different kinds of added-value depending on the diffusion timing and the spatial context. So, this requires a more systemic and perhaps nuanced approach; are the relevant spillovers human capital, or are they research? (Nightingale). Similarly, successful growth may also result as much from spillovers from adjacent regions and sectors as from direct investments. This is likely to be applicable to investments near London where specific synergies, labour market effects or co-investments would explain part of their success (Ortega Argiles).

This raises a series of important policy questions about generating (more) diffusion from existing concentrations. How do we better utilise the strengths of London and the Golden Triangle of Oxford and Cambridge for local economies or to trigger effects elsewhere. With targeted investment there are clearly possibilities for distributed innovation systems to link centres together and bridge into peripheral regions, via cross-sector collaboration, connecting small firms supply chains or training, skills and employment schemes (Lawton Smith). (See Figure 2).

Services

Not unrelated to this is the scale and importance of the service sector to the UK economy. References to competitive strengths in relation to innovation very often are taken to relate to technological capabilities and/or STEM-related capabilities. This reflects a lack of appropriate emphasis (and research) on innovation in service sectors. It also 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. But it also reflects a 'closed system' fallacy, in which discovery and exploitation are expected to happen in the same place' (Uyarra)

Further, focused attention is needed to understand patterns of innovation, diffusion and outcomes, beyond narrowly defined productivity, in service-based businesses. 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 (KIBS), which are

themselves key vectors and sources of innovation for their clients, may still benefit greatly from science base links' (Flanagan).

Alongside this observation, other studies highlight the 'importance of maintaining a core manufacturing base when it comes to designing structural changes in the sectoral composition of regions towards advanced and Knowledge Intensive Business Services (KIBS)' (Savona). These are often seen as disconnected activities, but often complement each other, creating additional innovation advantages.

5. Absorptive Capacity and Human Capital

Regional absorptive capacity partly determines the degree to which local firms adopt and leverage the benefits of R&D, appropriating the latent value from R&D conducted elsewhere. Improving absorptive capacity includes attracting and retaining skilled people, relevant technology-related expertise as well as innovation management capabilities. Human capital, aligned with sector or technology specialisation in a region, relative to other regions, enhances absorptive capacity, the appropriation of value from R&D and improved greater levels of growth, productivity or competitiveness. But the benefits are not necessarily equally distributed.

Absorptive capacity is determined by the incentives, capabilities and 'fit' between both the supply-side (R&D, technology, processes, knowledge etc.) and demand-side (intermediaries, adopters or users) to appropriate or unlock the latent value in innovation. Research and evidence on the key barriers to adoption have examined both sides and tend to highlight the need for stronger incentives to collaborate, translate and co-produce. Regional (sub-national) evidence is relatively abundant and much focuses on the US context where economic studies benefit from good data for both experimental and non-experimental designs. The evidence does point towards the effects of R&D spending in universities to be much stronger in areas where there is more absorptive capacity. This includes the presence of more high technology firms, concentration, connections and / or relatedness between University specialisms and the industry in the area (Valero).

The presence of the right kinds of skills and capabilities is clearly an advantage. In the UK context some recommend the promotion of local skills / training pathways, involving FE and HE in partnerships which align supply better with local demand. This is seen to be necessary for longer-term improvement in the innovative capacity of regions.

Institutional and cultural factors as well as technological and skills-related factors also play a role. As noted above, the current, hugely varied combinations of local authorities, combined authorities, local enterprise partnerships, alongside a varied range of collaborations with local universities, is more often the root of the problem, than the source of the solution.

Local – Global – Local

Many commentators point to the fact that much innovation diffusion and the leveraging of R&D value takes place along supply chains and value chains. These follow the organisational structures of firms and the sectors in which they operate as well as particular corporate functions (centralised basic R&D, distributed applied development co-located with customers or production sites etc.), cutting across the geographic boundaries of local authorities, LEPs and often national governments.

Larger, R&D intensive firms will connect nationally and globally to compensate for the lack of local capacity, and this can be a source of R&D knowledge, innovative technology or processes which spillover locally. Such networks can also represent routes for diffusing R&D, whereby appropriation

takes place elsewhere, side-stepping local firms and benefitting other locations. Much of this is inevitable, but targeted policies to attract inward investment (particularly FDI) are more effective when taking into account the nature of these value chains.

Brexit and Covid-19 and other systemic shocks demonstrate that some international supply chains are very fragile. 'What this implies is that we should be looking to develop much more localised supply chains (i.e. agglomerations), building on corporate incentives to co-locate activities in response to uncertainty. German policies have lessons for the UK in this regard' (Ortega Argiles).

6. The Role of Universities

Some argue that research intensive universities are both more disconnected from their local economies and collaborate less with firms, local and non-local. The current incentives focus efforts on top-rated journal publications and some international comparisons suggest that this is more dominant in the UK than elsewhere (Rodriguez Pose). This can be exacerbated by the need for top universities to be (seen as) globally engaged and relevant, particularly in terms of the nature and calibre of their research. Some appear to be struggling to address multiple identities, to be globally engaged and locally embedded (Morgan).

But there is also evidence '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; Valero).

University-firm barriers to collaboration have been studied extensively (Rodriguez Pose), but there is recognition that the key problems have evolved and pockets of excellence (projects, funding schemes, collaborative partnerships) exist and provide important lessons. This links to the long-running but still useful discussion on commercialisation, adoption, diffusion, particularly in relation to the University-firm disconnect and ways in which these need to be strengthened to reap the effects of any R&D investment.

There is some evidence to suggest that the UK is increasingly anomalous in comparison to international counterparts in its focus on curiosity-driven research in Universities. This is partly supported by the OECD and other international studies: "*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; Valero). One view is that this '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' (Flanagan).

This is associated with the more general and well-evidenced relative focus on R rather than D in UK spending. The UK R&D Roadmap (p.13) shows comparative data of R&D spending against other major economies illustrating not just the lower level of overall spending but also the relative focus on basic vs. applied R&D spending.

This debate also consistently points to the critical role of the social sciences; science and technology alone are not innovation and have little impact. We know innovation dynamics, adoption, diffusion and subsequent benefits are as much driven by the behaviours of managers, employees, consumers and other adopters, but still overwhelmingly fund engineers and scientists to take responsibility for the innovation entire chain. The social sciences can provide a more inter-disciplinary perspective and practical support, relating to all of the regional components which complement STEM and

technology for leveraging R&D investments (business and management practices, skills, social and institutional systems etc.). Measuring impact and correlating inputs to outcomes is notably more complex and challenging, but this should not undermine recognition of the contribution (Valero).

Research and Teaching

Other commentary identifies gaps in structures, incentives and resources which are seen to weaken universities ability to commercialise and/or analyse and improve the process of commercialisation. Student entrepreneurship and innovation, for example is under-emphasised but important, in terms of volume and in relation to skills development and employability (absorptive capacity). There is little data or analysis on this, but it is likely that student entrepreneurship is a key mechanism for local spillovers. Improving connections between research, teaching programmes and employability development would counter a long-term disconnect which weakens research commercialisation pipelines (Flanagan).

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)" (Valero).

Policy Recommendations and Levers: How to Invest Better?

Here we list some of the specific recommendations to come out of the debates and wider literature. To note at the outset that there was discussion about the overall dual challenge: (1) that the overall volume of R&D spend in the UK is small compared to international counterparts and has a focus on the R rather than D; (2) as several recent analyses have shown, the distribution of these funds is significantly uneven, relative to the distributions of population, economic output and social challenges and notably private R&D investment across UK regions.

Accepting this, the consensus was that, once there is clarity regarding the targeted outcomes, R&D investments can catalyse not just local growth, but a range of positive effects (improved inclusivity, sustainability as well as productivity and competitiveness), if a number of components are in place.

Improving the complementary incentives and structures relating to both inputs (supply-related clusters) and outputs (adoption, value-appropriation and diffusion) as well as the targeting process itself can enable multiple aims, rather than individual trade-offs, to be achieved.

a. University Engagement in Downstream Activities; Structures and Incentives

The UK R&D Roadmap acknowledges the need to improve university commercialisation to 'capture the economic benefit from our research through innovation' (p.31). It cites increases in Higher Education Innovation Funding (HEIF), the new Connecting Capability Fund and the forthcoming Knowledge Exchange Framework (KEF). Clearly, as these are new, there is little or no evidence as to their effectiveness. Moreover, past experience of interventions, such as Catapults have been mixed.

However, these initiatives are appropriately targeted to fill key gaps, for which there is evidence. Larger pots of structural funds, shared-prosperity investments or hoped-for replacements for ESIF and ERDF funds, with more of a focus on innovation and stronger conditions placed on universities

working in collaboration with local private and public sector partners, are likely to improve local alignment and impact.

Early indications show that 'UKRI pathfinder Strength in Places Funds, which invest to boost research and innovation capacity in specific areas of the UK in order to drive economic growth in those areas are good exemplars' (Lawton Smith, Collinson). These, and similar schemes: Connecting Capability Funding, ESRC Impact Acceleration Accounts and Business Boost funding and changes to Research Partnership Investment Funding (RPIF) appear to be having positive impacts in a number of ways:

- More cross-campus interaction and joint-bidding (some inclusion of economists, geographers, business and management expertise and other non-STEM experts in bid proposals). There is also evidence that interdisciplinary projects produce patents quicker or more often and that US universities have better structures and outputs than UK universities (Nightingale).
- More collaboration with local partners, particularly when this is mandatory or strongly advised as part of the bid process.
- Partly as a result of the above, a greater understanding of / attention paid to, local demand and LIS.
- A growing interest in tools and approaches to evaluation, monitoring and measuring local impacts, some in terms of GVA, jobs. In most cases, because this is required as part of the bid process.

There are very positive examples showing how these funding approaches are shaping universities' relationships with local public sector organisations and firms. So, much of the above translate directly into a set of policy recommendations.

Broadly speaking, rewarding 'good and repeated collaboration among the key actors in the local system in order to promote economic dynamism and to generate stronger resilience and more economic and social sustainability' is necessary (Rodiguez Pose). More funding targeted at interdisciplinary approaches to innovation on campus, in collaboration with local adopters.

Alongside this, the debate called for investment in:

- Applied research skills, secondments and other collaboration / co-creation mechanisms
- Targeted schemes extending beyond start-ups and spin-outs, focused on scale-ups and/or sectors and firms that are strategically important to a region's growth profile and/or local multiplier effects.
- Approaches that target and build on existing, strong engagement between University TTOs, student entrepreneurship centres and business schools, with local firms.

b. R&D Investments as Part of an Integrated Innovation System / Strategy

The need for a 'whole-systems approach' was noted in the feedback produced during the UKRI Roundtables on the UK Government R&D Roadmap in July and in our discussions. The rationale is outlined above and prompts a number of recommendations.

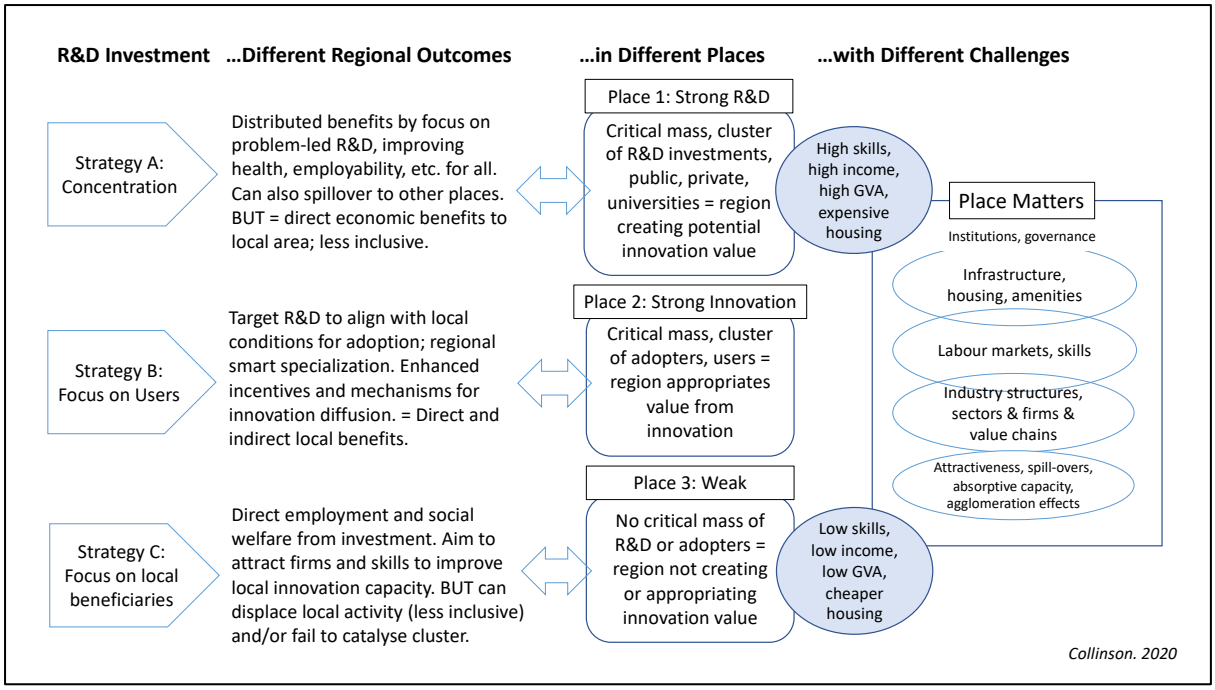
- Improve the precision of investments by: (1) highlighting impacts or outcomes for place and location (including other disadvantaged places) as key factors in selection processes; (2) assessing (e.g. through the bidding process) the 'fit' with other local factors, particularly local skills and absorptive capacity, and; (3) applying evaluation approaches which specify local economic growth impacts alongside other outcomes (see below).

- Increase the sophistication and application of evaluation approaches, impact analyses, logic chains etc. used to assess funding applications and monitor funded programmes.
- Avoid creating 'islands of excellence' because 'pushing for higher R&D intensity in lagging regions can lead to new structural problems of pockets of international excellence which are locally irrelevant (Radosevic). This could be done partly by combining and sequencing interventions and initiatives and providing complementary support' (Flanagan). For example, schemes to promote student entrepreneurship in projects with local firms alongside skills development and business support schemes focused on the adoption of new technologies for improved productivity.
- Related to much of the above, place stronger conditions on universities and firms in receipt of public funding and /or through contracting mechanisms to focus on and evidence local contributions.
- Promote a wider interpretation (in research commissioning processes and applied policies) of commercialisation, innovation and impact to encompass non-tradeable services, KIBs and other sectors which are important to the economy, or to future growth, sustainability, inclusivity or wellbeing.
- Provide more funding for collaborations which combine universities, firms and regional bodes (combined authorities, LEPS, Chambers of Commerce etc.).
- Explore more experimental funding approaches 'skunk-works or pilot innovation projects potentially combined with the development of soft-start-ups i.e. a business model built on providing R&D based services on a contract basis to paying customers. In healthcare and similar sectors this could break through some existing constraints to collaborative local entrepreneurship' (Lawton Smith, cites NESTA 2018, Wolfe/OECD 2018).

Figure 2 below attempts to provide a simplified outline for some of these options and trade-offs. It shows three general archetypes for intervention strategies: (A) concentrate R&D investments in existing, high-performing clusters (input, or supply-side orientation); (B) focus on regions where strong absorptive capacity exists and align investment to regional economic growth potential (demand-side orientation); (C) focus on weaker, lagging regions in an aim to catalyse new growth clusters.

In all three cases there would be direct local impacts, including employment and GVA effects from inward investment, some multipliers and spillovers. These may make less difference (smaller marginal improvements from the baseline) in (A) than in (B) and (C) although in (C) it is likely that displacement effects (pushing out lower-income jobs, increasing housing costs etc.) make these interventions less inclusive than many believe. In all cases, increased funding or structural incentives and mechanisms for more knowledge exchange, commercialisation, innovation and diffusion is likely to be needed. In all cases there could also be a greater focus on problem-led R&D and an explicit remit for investments that clearly lead to outcomes (as well as outputs) which benefit particular spatial or socio-economic communities. Collaborative structures and match-funding hurdles could support this emphasis.

Figure 2. R&D Investment for Regional Growth: Different Strategies, Places, Challenges and Outcomes



c. Identify and Fill Important Research Gaps

There are significant gaps in our understanding of the growth dynamics of regional economic systems. This applies in particular to research that attempts to connect micro-level interventions with aggregate effects across defined spatial geographies, over long periods of time.

There seems to be a consensus that we need:

- More longitudinal studies on the impacts of different kinds of interventions (Lawton Smith and others)
- A better understanding of firm behaviour in response to specific interventions
- Increased focus on non-tradable services and 'low-tech industry'
- To more precisely identify system bottlenecks and constraints on commercialisation, adoption and diffusion in different regional contexts.
    - Many of these relate to incremental or architectural innovation and 'new to the firm' innovation, rather than radical, disruptive or 'new to market' innovation (Crecenzi, Nightingale).
    - '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)' (Valero).
- Understand more about what capacities and capabilities are needed at the local level (LEPs, CA's, Councils etc.) to support more precise and locally appropriate R&D investment and value-appropriation, in the broader context of Local Industrial Strategies (Uyarra).
- Draw on lessons from other places and other 'varieties of capitalism' (not just statistical comparisons). Korea and other international exemplars are not just spending larger amounts but on different things, such as diffusion capability, through dedicated agencies with responsibility for commercialisation and innovation (Nightingale).

In parallel with the above, there are also acknowledged gaps in the portfolio of skills and capabilities to understand and guide policy at the central and local levels. Integrated datasets and analysis, capturing relationships between the different components of regional innovation ecosystems and the links with performance outcomes in economic (GVA, jobs, start-ups etc..) social (employment opportunities, lower local benefits costs, reduced income and health disparities over time etc.) and environmental (reduced carbon emissions, increased recycling, improved air quality, restored natural capital etc.) terms are needed.

This links with the final point in this paper, about the intended beneficiaries of R&D investment. The consensus was that interventions could and should address multiple forms of value creation, not just economic but also social and environmental (Uyarra and others). A narrow focus on productivity, GVA uplift, particularly by considering only high-skills, high-income employment effects (which is where the superior multipliers from impact evaluations of R&D investments come from) can work against rebalancing, levelling up or inclusivity, or sustainability depending on how these are defined and measured.

There are both socioeconomic and spatial dimensions to this challenge. In some cases, R&D investments improve wealth-creation through attracting or retaining or growing higher-income employment but decrease the employment opportunities for lower-skilled employees, thereby widening income differentials. This dynamic has a spatial component within and across UK regions. Other investments, either directly (e.g. healthcare innovation with local beneficiaries, low-carbon technologies adopted locally) or via promoted spillover effects, generate more inclusive outcomes over the medium and long-term. Part of this promotion involves targeting local demand drivers as intrinsic to desired innovation outcomes.

It is the case, however, that many gaps remain in our understanding of the spatial dimension of these impacts and outcomes. Despite significant research on agglomeration economies and spillovers, less is known about which kinds of intervention really benefit which parts of the local economy over what timescales than we would like. This makes it difficult to robustly identify levers for improving these local benefits.

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Note that a list of additional resources, including the individual commentaries from participants are compiled in a separate file: Appendix 1.

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