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Aligning Knowledge Exchange Pathways Between Universities and Local Growth Opportunities

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About the UCI Expert Insights Series on University Knowledge Exchange and Regional Economic Growth

There is significant policy interest in the UK in strengthening local economies to fulfil their economic potential and address long-standing spatial disparities. Universities have a significant role to play in helping to deliver policy ambitions in this area, including through their knowledge exchange (KE) activities.

Funders of KE, including Research England, face increasing pressure to develop approaches to enable universities, through KE, to strengthen contributions to regional economic growth. However, progress is hampered by the lack of fit-for-purpose data and metrics capturing universities' potential to contribute to regional growth outcomes. For Research England – which allocates KE funding to universities through both formula-driven allocations and competitions – this constrains their ability to:

- Allocate funding to enable universities to contribute to regional growth through KE
- Track and evaluate the performance of such funding programmes
- Support learning and improvement by universities around how to deliver effective and impactful regional economic growth initiatives

To address this issue, Research England and the Policy Evidence Unit for University Commercialisation and Innovation (UCI) at the University of Cambridge, are working closely to identify and progress opportunities for better data and metrics in this area.

To guide this work, leading academics with expertise on regional economic growth, universities, and KE, were commissioned to produce a series of *Expert Insights Papers* examining where progress could be made. The papers synthesise the latest insights from research and practice, and offer thoughts on where better data and metrics could be developed to meet funder needs

The topics were shaped by a policy evidence roundtable in September 2024, which brought together national funders, policymakers, and academic and sector experts from across the UK to identify key gaps. Key topics include:

- Approaches, opportunities and challenges to fostering regional economic growth (including theoretical and empirical insights, and latest international practices).
- Opportunities and challenges for where and how universities can contribute to regional economic growth through KE.
- Types of regions or regional contexts and how these shape the role universities should play in enabling economic growth through KE.
- University KE pathways for delivering impacts on regional growth
- The types / scale of capabilities, resources and alignment needed within universities to deliver KE aimed at supporting regional growth, and the ability of universities to adapt and reconfigure to deliver.

Contents

1 Introduction

The UK faces a number of challenges related to regional imbalances in the ability to generate wealth and in the distribution of wealth (Collinson, 2025; Velthuis et al., 2024; Pike et al., 2016). Long term underinvestment in local economies, including physical, human and intangible capital, public and private investment has exacerbated already embedded disadvantages. This reflects both public sector and private sector choices and incentives. UK companies have invested 20% less than those in the US, France and Germany since 2005, and public investment has been concentrated on productive and prosperous regions. This puts Britain in the bottom 10% of OECD countries and is estimated to have cost 4% of GDP (Thwaites and Try, 2023). These and other factors also underlie barriers to the diffusion of new technologies, innovative processes and productivity-enhancing practices between universities, firms and places, despite world-leading science and technology (Coyle et al., 2023).

Structural embeddedness and the longer-term effects of deindustrialisation on particular regions means that some regions are ‘development traps’ with a strong dependence on legacy industries (mining and manufacturing in the UK case). The usual agglomeration dynamics of urban economies appear to be working less well in these UK regions than in other countries. Marshallian externalities, which are the agglomeration benefits that firms experience from being located near to many other similar firms, including access to skills and knowledge, and ‘Jacobs externalities’ are persistently weak (Rossi et al., 2023).

A coordinated, system-wide set of interventions in transport, housing, education and skills, business support and innovation (and other factor endowments), at the national and local levels is needed to underpin targeted interventions for inclusive growth (Bailey et al., 2023; Flanagan et al., 2023). This in turn requires changes in the structure and the quality of the relevant institutions (Tilley et al., 2023; Newman et al., 2023; Rodríguez-Pose, 2020) and relates to both the call for more devolved capacity and capability in regions, and to the need to focus on improving regional innovation systems (RIS) (Belso-Martinez et al., 2024).

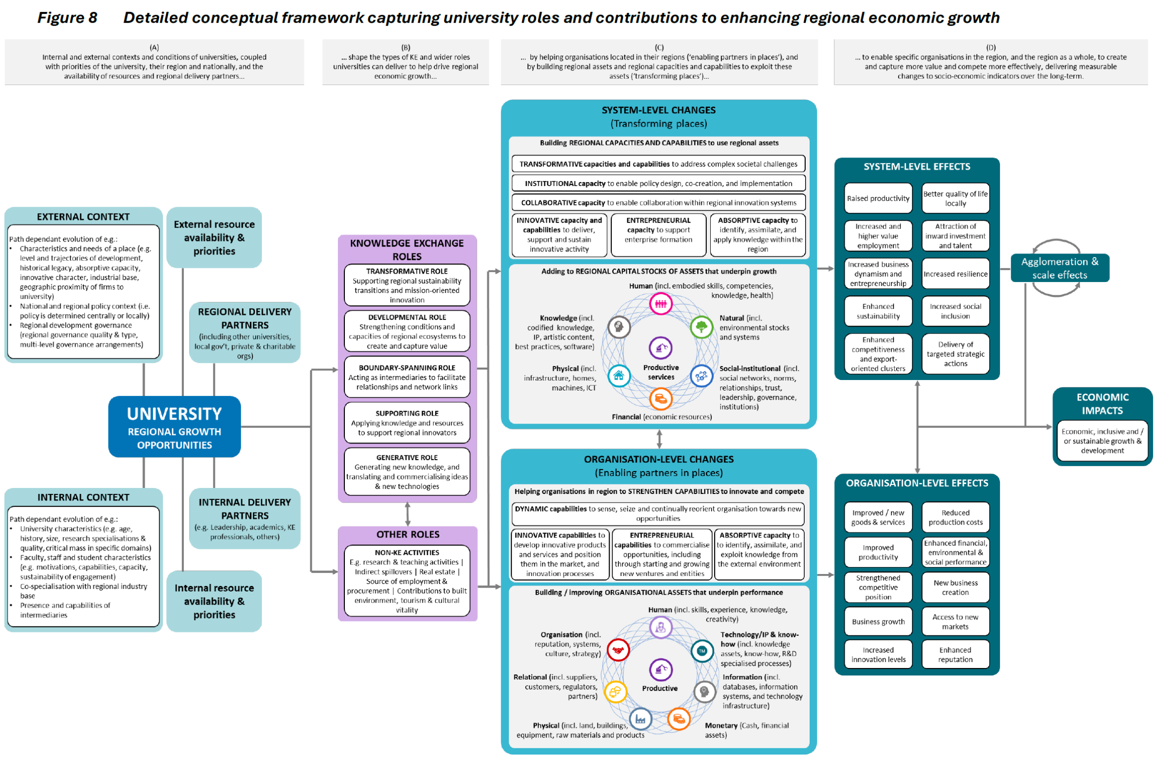
Dealing with each of these challenges benefits from a place-based approach. Not only have London and the South-East of England progressed along different economic and social development pathways, but the challenges and opportunities facing city-regions elsewhere vary by place. There are differences in the (sub-)varieties of capitalism operating at a local level, and a better understanding of their distinctive local opportunities and constraints should drive the customisation of policy interventions needed to address these. Stansbury et al. (2023) cite ‘binding constraints’ including weak transport infrastructure, low relative labour mobility, a regional shortage of STEM degrees, and a failure of public innovation policy to support RIS, as reasons for effective policy interventions to focus on and connect four key policy levers. These are skills and education, infrastructure, access to finance and support for research and development (R&D). This paper focuses on the last of these, but the wider systemic nature of the challenge is significant. For a broader analysis see Collinson (2025), which presents the evidence and the causes of this challenge, and some recommendations for ‘intelligent interventions’ based on better data, evidence and analysis.

This paper looks at a specific component of this system with the aim of improving the alignment of university knowledge exchange (KE) pathways to local growth opportunities. Part of the complexity, when trying to measure and improve the contribution of university knowledge exchange for regional economic growth, comes from the significant regional variation in, (1) the presence of, and local involvement of universities in activities related to growth opportunities, and (2) the kinds of growth opportunities with positive local impacts that can be targeted. The latter depends on a complex combination of local factors, from infrastructure and skills to local industry specialisation. Ultimately the presence of particular kinds of firms, their growth potential and the relative attractiveness of a place for new investment are key. A better understanding of how some interventions create local multipliers and others do not, also needs to be applied. Failure in the past to differentiate regions in this way, as evidenced by very similar local industrial strategies, has limited the customisation of interventions and arguably wasted public funding.

1.1 The positioning and structure of this contribution

Figure 8 (p.27) in Kelleher and Ulrichsen (2024) (reproduced as Figure 1 below) provides a helpful starting point for positioning this contribution in the wider Expert Insights Series initiated by the UCI-UKRI Workshop. A central question is what KE role a university should prioritise (or be incentivised to prioritise) out of the options listed in the purple box. This paper takes the position that we should start with the need or opportunity (the demand side) by assessing the regional system, as outlined under (C) in Figure 1, regional 'assets, capacities and capabilities,' to indicate which KE role(s) have the greatest potential impact.

Figure 1. From Kelleher and Ulrichsen (2024)



Source: Kelleher and Ulrichsen (2024). p.27.

The types of KE roles listed in Figure 1, ‘transformative, developmental, boundary-spanning, supporting, generative’ are drawn from the work of Lester (2005) and link to 4 types of growth and their related pathways. Type 1 involves support for emerging industries, through leading science and technology development, technology transfer and licensing, promoting start-ups and spinouts in emerging sectors. Type 2 focuses on the attraction or transplanting of industries, through skills development and retention, and technical support for local firms. This is linked to Type 3, supporting the diversification of existing industries into technologically related new ones, perhaps using assets and capabilities from mature or legacy industry sectors to create advantage in new sectors. Type 4 is a more incremental pathway, focusing efforts on the upgrading of existing industries by increasing investment and skills and enhancing innovation-related capabilities to move up current industry value chains (Ulrichsen, et al., 2024).

Building from this framework, this paper aims to help improve the precision and effectiveness of regional growth interventions by better aligning the KE role of innovation intermediaries with the specific needs of the host region. We examine (in the second part of this paper) how a particular form of innovation intermediary, typified by the Warwick Manufacturing Group (WMG) and the Manufacturing Technology Centre (MTC), could potentially be adapted to play one or more of these roles. Amongst the various KE delivery pathways, from university-based science parks to technology transfer offices, this one directly supports the development of local, demand-led innovation capability. It also appears to support more inclusive growth.

First, however, to guide the type of role needed from innovation intermediaries we focus on outlining a typology of RIS. This typology prioritises the economic structure and industry sector concentration of a region, alongside local labour force and skills, and universities. This helps us categorise regions according to their type of growth potential and therefore indicates what kinds of interventions are needed. Part of the aim is to create an evaluation framework that tries to capture existing innovation capability and future capability development, as a target for interventions, across identifiable categories of region. Although data gaps remain and simplifying assumptions are still necessary, increasingly better data and a growing range of analytical tools, some AI facilitated, have improved our ability to analyse and differentiate regions as well as track and evaluate policy interventions in regional economies.

Firms are the building blocks of the current and potential future innovation capabilities of a regional system. Supporting improvements in the organisational assets of current and future industry sectors and/or clusters of firms, as outlined in Figure 1, should be the prime focus. This paper connects firms-level capabilities with ‘smart specialisation strategies’ (a long-term favourite of EU policymakers) and with studies of technological complexity. Together these may offer additional proxy measures to underpin regional typologies as well as indicate what roles and contributions universities should prioritise, and which delivery pathways appear to be appropriate.

The current and potential future impacts of universities would need to encompass measures of their relative scale, scope and specialisation, alongside a summary of all local KE pathways (science parks, tech transfer pathways, intermediary innovation organisations etc.). But the ‘logic chain’ of measures for informing interventions should start with the ‘demand-side’ of any

KE pathway. What technologies, processes, skills or assets would enhance the collective productivity and performance of a critical mass of firms in a region? This, 'latent potential' of a particular city-region, should guide the kinds of growth initiatives that public funding should be dedicated to. This is the primary question, before we assess the potential of a local university to provide part of the contribution.

The paper is structured as follows. We begin with regional typologies, as the 'starting point' for growth and an indicator of 'ecosystem maturity'. These should indicate the opportunities and challenges for different kinds of growth, including the relative scale, scope and specialisation. Ideally a typology should also indicate the portfolio of available KE pathways in a region, including science parks, spinout facilities, technology transfer assets and intermediary innovation organisations. We then focus in on a specific pathway, characterised by the WMG and the MTC, to illustrate how we might fill a gap in regional innovation systems.

2 Regional Typologies

The paucity of regional data in the past, linked to the lack of capacity and capability in UK regions to identify local differentiators and current or latent (relative) comparative advantages, is widely acknowledged. This has led, in various past policy cycles, to a tendency for regional authorities to copy the industrial strategies of other regions, and/or follow generic national strategies which often highlight emergent (sometimes faddish) technology areas, rather than locally driven intervention strategies (Pylak et al., 2025).

But in recent years we have seen the development of more comprehensive and sophisticated datasets for characterising regional economies, alongside an evolving portfolio of AI tools for analysing and comparing regions. There are significant gaps and areas where more improvements are needed, but a variety different taxonomies of regional growth conditions can be developed using freely available secondary datasets.

Recent studies provide evidence of this, including Kim et al. (2024), Marrocu et al. (2023) and Velthuis et al. (2025). The latter use a range of economic, demographic and social variables to produce a cluster analysis of NUTS-3 regions in the EU15. They conclude that important differences between three types of 'left behind' regions, strengthen the 'argument for policy responses adapted to local circumstances.' Overall, the consensus on the need for locally appropriate interventions has grown stronger on the basis of improved datasets and analytical tools. This is helped by international evidence showing how other governments intervene to make innovation and shared prosperity mutually reinforcing (Taylor, 2022). Lee (2024) examines Taiwan, Sweden, Austria, and Switzerland which combine highly innovative economies with higher-than-average levels of equality (low GINI coefficients).

Sticking with the UK challenge, Nafizah and Roper (2024) provide insights into what local policies should target in different regions but draw a slightly different spatial divide. Their study reveals four 'baseline' regions (Scotland, North East, Yorks and Humber, East of England) where firms are performing as expected, in that their propensity for innovation is consistent with the enablers and barriers experienced locally. Support in these regions should focus on helping firms become more innovative, reducing the barriers and boosting the enablers. This contrasts a group of ‘over-performing’ regions (including the North West, East Midlands, West Midlands, London, South East, South West) where local firms appear to be much better at ‘translating the enablers into higher innovation propensity’ i.e. their propensity for innovation is significantly greater than that which would be expected given the local enablers (Nafizah and Roper, 2024). In these places the focus should be on generating more value from innovation. Different kinds of financing, such as R&D tax credits, innovation grants, and intellectual property support, plus expert advice on business process, planning and development or product/service development, support for particular kinds of skills are amongst the enablers. But these vary in their importance by region, in parallel to the relevant barriers and this needs to be the basis for localised policy interventions.

A City-REDI project compared 237 UK and European RIS by differentiating R&D inputs from outputs using a principal components analysis (PCA) to produce separate indices (Ioramashvili et al., 2022). It also reveals how some regions are good at basic research and the development of new technologies, and others are good at the commercialisation of these inputs to produce new or improved processes, products or services. Fewer regions appear to be good at both. The UK performs relatively well in terms of innovation inputs across most regions, but apart from the South East, and the East of England, it is lagging international counterparts in terms of applying these commercially.

Various approaches could be followed, to build on this progress. For example, we could compile comprehensive indicators to show relative regional differences across a wide portfolio of relevant characteristics. This might include transport infrastructure, housing, public sector agencies, skills, businesses and a wide range of generic (lower and higher order) factor endowments. There are data sources for most of these regional components and a few studies show how places vary in terms of the relative presence, critical mass, types, strengths, concentrations and combinations of these factors. But most of these are specialised and focus on a sub-set of regional challenges (economic, social, health-related etc.). Recent regional productivity analyses, for example, combine data to produce typologies that are related to the challenges addressed here (Gouma, Menukhin and Ortega-Argiles, 2023). Additional examples, with links to datasets and relevant reference papers are provided in Appendix 1.

The recommendation here is to combine recently developed regional datasets that use proxy measures of innovation and innovation potential at the regional level. These capture a wider range of indicators, and which empirical studies show to be representative of local economic growth potential.

Four with the best prospects are:

1. WIPO’s (2024) regional version of the Global Innovation Index (GII).
2. Harvard Growth Lab’s Atlas of Economic Complexity and the ‘Metroverse’ (https://metroverse.cid.harvard.edu/) comparative dataset.
3. The European Regional Innovation Scoreboard (RIS).
4. The DSIT Clusters mapping project.

Each are described, with references and links in Appendix 2.

There are specific reasons for this selection related to gaps in both the data and the conceptual framing of selected indicators. For example, skills measures and R&D indicators have been separately collected and analysed in the past, and analysis of R&D strength has been too dependent on patents and research income. Patents are a weak proxy for innovation, given that most patents are never commercialised. Patent data sets also give a biased view of industry sector strengths and weaknesses. They work well to track pharmaceuticals firms, for example, but are not helpful for understanding software or e-commerce. Research income indicators also may not reflect where R&D is actually conducted and tells us little about commercialisation patterns.

The WIPO analysis and the Harvard Growth Lab, in particular, have incorporated a wider range of proxy measures, including measures of capability, which to some extent combine innovation-related skills, expertise and knowledge indicators. A more subtle development is the greater focus on proxy measures of (1) complexity (and 'variety' and 'relatedness'), and (2) ('smart') specialisation, as academic studies show the importance of these to economic growth potential and the selection of policy interventions.

We explore this further first and then turn to another data gap that needs more development. This is the lack of comprehensive data on the regional embeddedness and related local multiplier effects across the portfolio of local firms in any region.

2.1 Complexity and Specialisation

Building on earlier analysis by Hausmann, Rodrik, and Velasco (2008) and Hausmann, Klinger and Wagner (2008) more recent studies have focused on regional industry structures and/or technological complexity to differentiate growth potential. This fits within a broader evolutionary framing which analyses regional differences in terms of the local mix (or variety), complexity and relatedness of different industry activities, and across the portfolio of industries in a region. In many ways this is an extension of 'smart specialisation' policy approaches popular for a long time amongst EU policymakers, which led to data gathering and analysis to link current and future potential regional industry specialisation (Balland et al., 2022; Balland et al., 2019; Pinheiro et al., 2022; Iammarino, et al., 2019).

Recent empirical work has shown that technological complexity is an important predictor of regional economic growth. Mewes and Broekel (2022), for example find that a 10% increase in complexity is associated with a 0.45% improvement in GDP. Other studies find other relationships which help us understand which proxy measures are significant, but also how these might guide different policy strategies for different regions. Pintar and Scherngell (2022), for example, develop and apply a set of measures for regional knowledge complexity to a range of European metropolitan regions to create a 'regional knowledge complexity (KCI) index'. This captures the diversity of regional knowledge produced and transferred to other regions and reveals some spatial clustering tendencies. Catalán et al. (2022) develop measures for 'technological density' and 'scientific-technological density' and find that the former is more important for the production of new technologies. Kogler et al. (2023) explore 'regional branching' which describes the process and catalysts of diversification into new technologies. New knowledge from external sources and the degree of relatedness to existing capabilities already present in the region are important factors. This could be a strong focus for policies designed to help regions transition away from legacy industries and into emergent growth areas.

Similar studies (such as Bathelt and Storper, 2023; Hidalgo, 2023; Kogler et al., 2022) have helped bridge the gap between smart specialisation policy ideals and implementable strategies that match local knowledge capabilities and local growth potential. This is the key point of referencing these studies. They demonstrate new and relevant insights from a more sophisticated range of empirical measures that can contribute to the operationalisation of regional smart specialisation policies (Kim, Ferrante, and Kogler, 2024). This in turn has the potential for steering the development of more useful regional typologies and guiding policymakers on the kinds of intervention that might work best in each place. For example, to use Lester's (2005) framework, strategies to support emergent industries developed out of existing local capabilities, or local diversification based on attracting new firms of a particular type to a region to complement the existing industrial base. Kim, Ferrante, and Kogler (2024) examined the 'local knowledge space' of 164 European regions with this in mind, focusing on the extent to which regional smart specialisation policies target 'central' technologies, and to what degree they also target 'potential' sectors of knowledge production in specific regional settings.

Ideally, in regions where legacy industries dominate, interventions should encourage the growth of new and emergent sectors. This requires identifying 'latent' assets and capabilities (or clusters) which relate to particular kinds of competitive advantage for future growth. This can be more difficult to do using industry sector data (such as ISIC codes), or even location quotients (LQ). For example, there is evidence that the East Midlands (UK) region has the potential for developing a local upstream space sector (spacecraft, launch equipment, satellites), given a combination of skills, manufacturing assets, alignment with specialist science, technology and expertise in local universities. But these assets and capabilities are distributed across sectors, firms and other organisations and therefore not easy to identify as a critical mass which could 'pivot' towards a new industry sector. For aspiring local policymakers and industry leaders, this makes it difficult to legitimately promote the region as a potential leader in emergent technologies underlying this sector, which limits private investment and public funding to leverage this potential (Billing et al., 2024).

2.2 Embeddedness and Multipliers

Combinations of the 4 datasets described above would work well as the basis of a regional typology for guiding the better alignment of university KE pathways to local growth opportunities. But there is still a gap in the data which should be addressed. In addition to indicators which capture the industry, size and other characteristics of local firms, it would help to know the relative levels of regional 'embeddedness' because this reveals their economic importance to the local economy (Collinson, 2022).

Local industrial embeddedness is defined as the 'share of regional interindustry economic activity that is anchored to a region' and is a focus of research on smart specialisation and regional economic resilience (Kitsos et al., 2023). Location quotients (LQ), relatedness indicators and industry specialisation data does this to some extent, but it is commonly calculated at the aggregate level using input-output (I-O) models. This approach has been used, for example to calculate the regional economic impacts of universities themselves. London Economics (2023a) applied a multi-regional I-O analysis to calculate the direct, indirect and induced impacts of universities on the UK economy (£115.7bn.) for Universities UK. The key point in relation to this paper is that this provides a mechanism for prioritising the firms and sectors that contribute most added economic value, including GVA per capita and jobs, within the specified region, rather than spillovers and transfers to other regions.

As an illustration, a study of UK student spending patterns by Carrascal-Incera et al. (2021) revealed a significantly different level of economic contribution by region. This depended on local industry structures, including the presence of particular kinds of firms which met the demand triggered by this spending, and the structure of local supply chains. Because of differences in the types and levels of firm embeddedness in different sectors, the contribution to local economic activity also varies considerably. The study showed, for example, that £1 of non-fee student spending generates £0.80 of GVA in Eastern Scotland (UKM7), but only £0.68 in East Yorkshire and Northern Lincolnshire (UKE1). £1 million non-fee-related student expenditure generates >12 jobs in West Central Scotland (UKM8) but only 6 in Inner London – West (UKI3). This variance will similarly apply to all other kinds of spending and investment activity (including, significantly, public sector R&D investments).

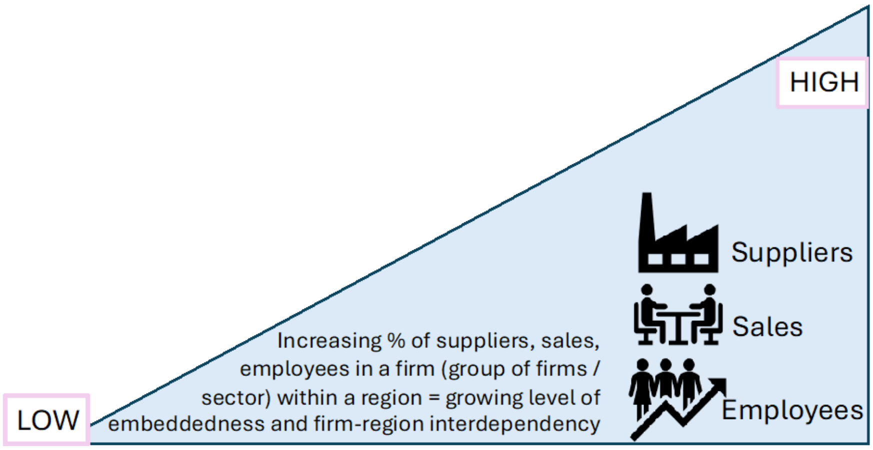
City-REDI complemented this I-O modelling approach with a very different firm-level measure, which more precisely reveals the types and sectors of firms that should be the focus of policy interventions. This has been applied in a questionnaire-based business survey by taking the average of three ratios, the percentage of regional to non-regional (1) suppliers, (2) sales, and (3) employees (Billing et al., 2020). The higher the combined average, the greater the proportion of suppliers, sales and/or employees that are local, rather than non-local, and this indicates a higher level of embeddedness, as shown in Figure 2.

The survey showed that manufacturing firms have the lowest average level localisation for both suppliers and buyers, retailing has a low level of supplier localisation compared to business and financial services, and hospitality services is higher for both, creating the largest multiplier effects compared to the other three industry sectors. The implications for public funding which aims to (1) promote regional growth, or (2) limit the impacts of economic shocks through insolvencies and unemployment, is that a stronger focus on highly embedded firms would maximise the local impact of interventions (investment, business support programmes etc.) through Increased multiplier effects.

Analysing embeddedness in this way helps us evaluate the degree to which a region is relatively more dependent on any specific set of firms or industries, because higher levels of embeddedness result in higher levels of multiplier effects and local economic contribution. More firms and a wider range of businesses and jobs are supported from spending and investment. But the converse results when spending or investment fall. Qamar et al. (2023), for example, showed how dependent the wider West Midlands economy is on the automotive industry following the Covid-19 shock.

Similarly, it follows that a more embedded firm is more dependent on its host region. If suppliers become more expensive, or the pool of skilled employees declines, or if customers leave the region, a highly embedded firm will struggle more, with a greater likelihood of insolvency than less embedded firms (Billing et al., 2020). Using this approach policymakers can rank firms, sub-sectors or industries in terms of their local multiplier effects and their vulnerability in the face of economic shocks.

Figure 2: Embeddedness and Interdependency between Firms and Regions



So, the interregional direct and indirect production and consumption multipliers are important components of any regional typology. We can track these by modelling the relevant interregional effects and/or by applying a firm-level approach. Doing this also helps us understand how, and to what degree, dominant cities like London, or regional cities like Manchester and Birmingham receive larger relative shares of the spillovers from consumption spending and investment in all regions because they host most firms (and headquarters). This complexity is often missing from policy analysis which aims to target regions for investments. Policymakers tend to assume that a £1 million public investment or subsidy into skills, transport infrastructure, science parks, R&D or amenities, exclusively benefits the region receiving the investment. But it does not, and the variations in realised local economic benefit are significant.

This also applies to UKRI funding, where two stages of analysis are needed to distinguish the regional effects of large-scale funding awards. The first involves mapping out the location of partners and sub-contractors which are part of the original consortium alongside any subsequent beneficiaries of either direct funding and/or the outcomes of the funded R&D. The second stage would follow one or both of the approaches above, using a firm-level survey and/or the I-O interregional modelling. Catapult centres, such as WMG or MTC, which we turn to below, provide a useful illustration. One set of data on Innovate UK (UKRI) funding shows they have received significant government funding over the years and have attracted private sector investment as a result. But calculating how much of this funding has subsequently been distributed to partners and sub-contractors in other regions, and how much has created supply-chain multipliers and longer-term impacts to the productivity and performance of local firms, is complicated.

3 Aligning Universities and Firms for Regional Growth

The above observations are relevant considerations when investing public funds to stimulate innovation to benefit specific regions. Government interventions, via various direct and indirect UKRI funding initiatives, to R&D tax subsidies for firms and schemes to attract foreign direct investment (FDI) in R&D, should ideally be linked directly to intelligence about:

- local firms and varied degrees of embeddedness and resilience.
- industry specialisation, technological complexity and latent potential for emergent industries.
- the availability of different levels and types of skills at the local level.
- the presence of universities and degree of alignment between local universities' R&D strengths and local innovation needs.

Connecting FE and HE to local skills needs as part of a wider industrial strategy should also be a priority. This in turn should link up with housing and transport planning. But the key focus is to improve RIS in a way that distributes the benefits locally, ideally reducing inequalities rather than just raising GVA per head or productivity (Collinson et al., 2024; Kitagawa et al., 2024).

3.1 Strengthening Regional Innovation Systems

As providers of skills and R&D, universities are central players in efforts to strengthen RIS.

There is the significant potential to increase the rate of R&D commercialisation and, critically, to support local value appropriation to boost RIS in regions that need it most (Bailey et al., 2018). A common focus for policymakers is university spinouts and start-ups and recent evidence suggests that UK universities are more successful at producing these than previously thought. Similar, in fact to the US, when we take into the much larger size and number of US universities (Ulrichsen and Roupakia, 2024). Key to the focus here, universities outside London and the South East of England generate similar numbers of spinouts per £100million of research income as their larger counterparts inside this region but receive less public R&D investment. Smaller research universities in London and the South East of England actually produce fewer spinouts per £100million than their counterparts in other UK regions the rest of the UK (Ulrichsen and Roupakia, 2024).

There are a number of challenges with university spinouts, however, including a high rate of relocation (often linked to buy-outs), and relatively low levels of local employment multipliers, value appropriation and longer-term clustering in regions. Spinouts alone very often do not have strong regional growth impacts. A significant proportion of the firms that account for the data summarised above, which boost the numbers for Oxford and in even more so for Cambridge (almost twice as much according to London Economics, 2023b) are in this category. Firms like Oxford Nanopore Technologies and Cambridge Epigenetix (renamed Biomodal) have very high financial valuations after rounds of venture capital investment and do have the potential to become global high-tech firms. But if and when they scale up, there is often limited local employment or multiplier effects through local supply chains in the local region. Moreover, in places like Cambridge and to a certain extent Oxford, there are much smaller industrial hinterlands than universities in city-regions like Birmingham and Manchester. There is arguably more local value appropriation from the higher volume of small-scale technology transfer and knowledge exchange activities in these city-regions, although this has yet to be measured robustly. For these reasons and others, we focus on another, less researched pathway for KE between universities innovation intermediaries which combine technology transfer, knowledge exchange and upskilling.

3.2 Innovation Intermediaries to Connect and Align Universities and Firms

Boosting RIS by investing in innovation intermediaries, to connect science, R&D and new technologies to adopters and users, is a long-established way to address the 'innovation gap' or 'valley of death' (Howells, 2006; Knockaert et al., 2014; Rossi et al., 2022). Intermediaries proactively coordinate collaborations between private and public organisations engaged in R&D and lower the barriers for collaboration and novel knowledge recombination. While previous studies show how they adopt different functions (Caloffi et al., 2023), the specific mechanisms linking their structures and incentives to R&D collaboration patterns and networks, and local impact and outcomes are less clear (Janssen et al., 2020).

Alongside the discussions, analysis and subsequent UKRI investments into 'Innovation Accelerators' in Birmingham, Glasgow and Manchester (UKRI, 2025), a City-REDI project examined the role and impacts of 'STEM assets' in the West Midlands region (Ioramashvili, et al., 2024). These are a specific form of innovation intermediary, defined as 'physical facilities dedicated largely to the 'translation, development and transfer of scientific, technological or engineering innovation and knowledge and expertise which relates to new or improved business processes, products or services' (Billing et al., 2023). The project examined and compared the Manufacturing Technology Centre (MTC) and the Warwick Manufacturing Group (WMG), which is part of Warwick University. Both were part of the High-Value Manufacturing Catapult (HVMC), one of a series of themed technology centres established in 2011, partly modelled on the German Frauenhofer Institutes following the Hauser review (Hauser, 2010).

Both these intermediaries are of interest because they combine technology development and technology transfer programmes with skills training and process-improvement projects. This supports innovation capability at the firm level, and innovation capacity at the regional level. They are also, to different degrees, locally embedded and demand-led, as over half of their funding is via contracts with firms looking to improve innovation-related capabilities.

Briefly, WMG has a 50-50 hybrid model with half of its staff from industry and half from academia. Its focus is in the areas of energy storage management, vehicle electrification and connected and autonomous vehicles and it has expanded from automotive manufacturing into aerospace, energy, pharmaceuticals, IT, cyber security and construction. Its primary activities breakdown into capability building, forming and maintaining strategic industrial relationships, supporting small and medium enterprises (SMEs), providing industrial skills, collaborative R&D,

and direct contract research. Fundamental research into energy, materials and manufacturing, digital manufacturing, intelligent vehicles, and societal transformation is funded by Research England. Its annual research portfolio is over £60 million with a third coming from the HVMC core grant. WMG runs industry-linked education and training, including Masters, PhD and executive programmes. It runs two Academies, which are privately managed, publicly funded secondary schools for 14- to 19-year-old students who usually go into apprenticeships and degree courses. It also trains 800 Degree Apprentices annually, combining industry-based internships with bachelor's level degree programmes.

The MTC is an independent RTO (research and technology organisation) established by regional universities, including Loughborough, Birmingham and Nottingham, based at Ansty Park, near Coventry. It has since added three additional locations in Liverpool, Oxford, and London (Havering) and extended from R&D and production and process engineering to include training, factory design and advanced management.

The City-REDI project gathered data on over 1,000 businesses which have worked on technology or knowledge transfer partnerships, or collaborative research with MTC or (occasionally and) WMG. In the final analysis this comprised of 155 projects for WMG and 99 for MTC, with a total of 593 project partners for WMG and 403 for MTC. The team also conducted a series of interviews, including six in each of the two organisations, and others with representatives of collaborating firms. We used this data to assess the types of innovation collaboration, ranging from more incremental, with a set of similar firms or industry sector, vs novel, with an unusual combination of firms, in more diverse technology fields. This was done using conventionality (or C-) scores, which estimate and help compare the level of similarity in two or more samples of innovation projects. A social network analysis and two separate measures of geographical and industry proximity were also used to examine the spatial, sectoral and temporal aspects of the R&D collaborations and the interconnectedness between the firms, universities and the two intermediaries (Ioramashvili, et al., 2024).

The study reveals that MTC has a higher proportion of projects funded by private sector firms than WMG, but while only 9 percent of WMG's collaborators are universities this share is 18 percent for MTC. 54 percent of MTC projects and 45 percent of WMGs projects are in manufacturing. 'Professional, Scientific and Technical Activities' and 'Information and Communication' sectors make up most of the rest. The C-score analysis revealed a distinct focus on more incremental, conventional and market-led innovation projects at MTC compared to more novel, R&D led projects at WMG. As part of this distinctive regional contribution WMGs portfolio includes a higher proportion of smaller scale feasibility studies, which are more experimental and exploratory. There is evidence also to suggest that one category of more commercial, market-driven projects at MTC are those co-funded with DSIT, indicating the role of specific kinds of government funding on shaping the role of the intermediary (Ioramashvili, et al., 2024).

The central aim of this part of the analysis was to understand more about the role of these innovation intermediaries in the local economy. Also, how they may have evolved differently, and why, particularly in terms of their respective contributions to the local RIS. Partly referencing the initial work of Lester (2005) and Figure 1 above, from Kelleher and Ulrichsen

(2024), to what degree and how are they supporting incremental improvements in the innovation capabilities of small or large firms in sectors that already have a strong presence in the region? And/or are they involved in more novel innovation partnerships to develop new capabilities or clusters, in a more ‘transformational’ role?

The other key dimension of interest is the spatial geography of their partnerships and impact, examined through the analysis of geographic proximity. The study tracked the evolution of collaborations for over 20 years and showed a shift in both organisations towards a more geographically dispersed network of partners. But each has evolved differently to end up with a very different pattern of partnerships, in terms of both type and location. By establishing facilities in three additional locations outside the West Midlands, MTC extended its network by changing its formal organisational structure. But as shown in Figure 3 below, WMG has collaborations across most UK regions, with a heavy concentration in the West Midlands and a distinctive cluster of SME partnerships in the city-regions of Birmingham and London (Ioramashvili, et al., 2024).

Further analysis revealed some distinctive patterns of collaboration across partner firms for each intermediary. For WMG projects, we found a positive and significant effect, indicating that WMG partner firms within the same region are more likely to form inter-firm collaborations (an indicator of cluster formation). But for MTC projects this was not the case. Being in the same region did not significantly affect the likelihood of collaboration. MTC also drives more large-small firm collaborations and fewer partnerships between SMEs, whereas WMG drives more collaborations between academic organisations and SMEs.

Finally, a different pattern of university collaboration was confirmed in the interviews. WMG remains structurally tied to Warwick University while MTC has appeared to have reduced its role as a technology transfer ‘agent’ for the group of universities which brought it into being. It has grown by orienting itself more towards market-led, firm-sponsored activities.

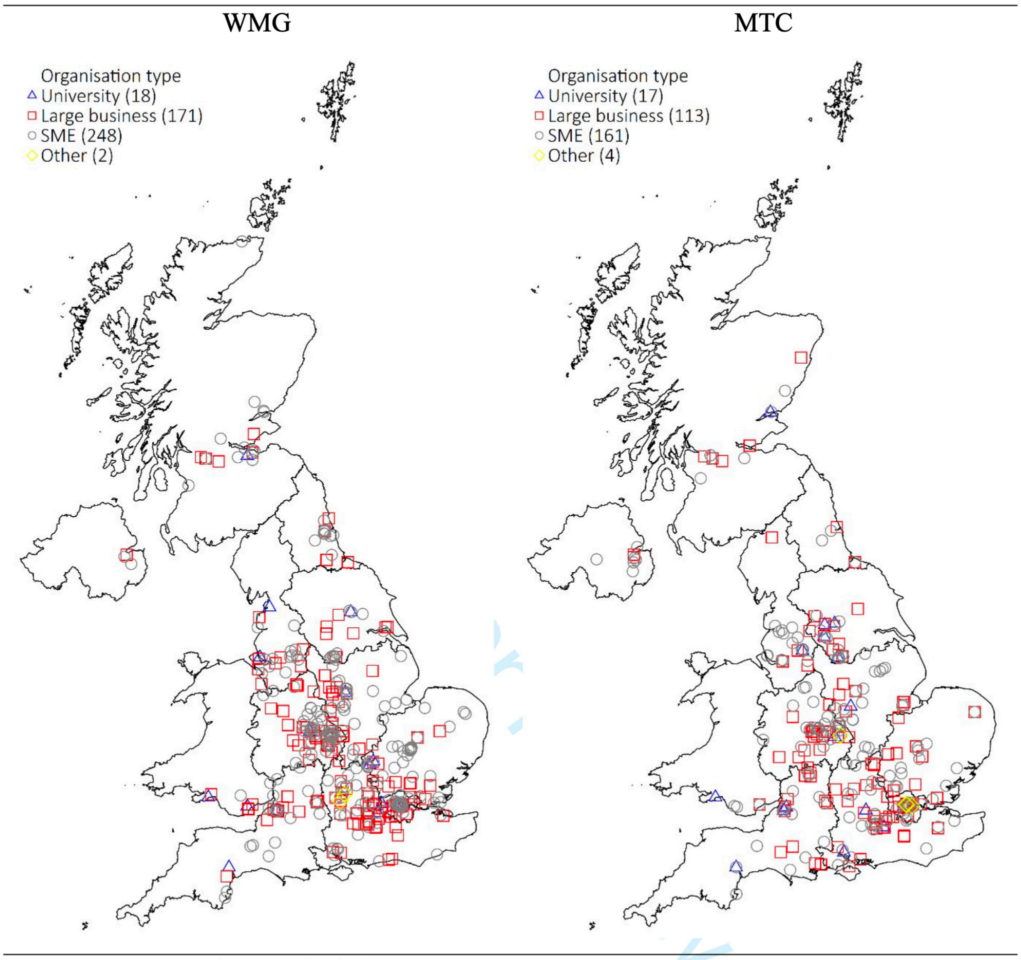
3.3 Measuring and Shaping the Local Contribution Innovation Intermediaries

At the simplest level it is clear that WMG and MTC help improve the innovation capability of local firms and support the development of firms outside the region. This conclusion matches the findings of a study by Vanino and Roper (2023) who take a very different statistical approach to examine the effects of knowledge spillovers from Catapult centres. Their results show that ‘Catapult innovation centres provide a source of knowledge externalities for unsupported businesses located nearby, mainly by increasing the likelihood of firms to collaborate with Catapults and receive public R&D funding’. This increases the start-up birth rate as well as the level of productivity and employment in the region.

What lies behind this effect is partly revealed by the City-REDI study outlined above. By both connecting university R&D and skills and knowledge to local firms, and by engaging in collaborative innovation support programmes independently of universities, these intermediaries enhance the RIS. Where they collaborate with local SMEs the effect is to help these firms move further away from the end of the infamous ‘low productivity tail’ which the

West Midlands and the North are known for, linked to the legacy manufacturing sectors (although by how much, we do not know).

Figure 3: Regional Locations of Different Project Partners for WMG and MTC.



Source: UKRI and authors calculations (Ioramashvili, et al., 2024).

It is also worth noting that this supports a more inclusive form of economic growth. Upskilling workers in these SMEs increases income flows into lower income communities but also makes these firms more resilient in the face of economic shocks, limiting insolvencies and unemployment. Contrast this with strategies to attract R&D-intensive functions to city-regions, which can displace low-income workers by attracting larger numbers of higher-paid R&D workers (Ciarli et al., 2018) and inflating local prices. This is one example of the complex trade-offs between inclusivity and productivity in policy decision-making.

Overall, innovation intermediaries fulfil an important role, alongside and sometimes linked to policy interventions focused on start-ups and spinouts. But because the specific type and level of contribution, over longer time periods, is difficult to measure, certainly using any kind of cost-benefit analysis, we would argue that they have not received the attention they deserve (Rossi et al., 2022). A better understanding of their local impact would help guide more precise investment and monitoring of innovation intermediaries, enabling them to play a more significant role in boosting RIS in the UK.

It is likely that particular combinations of investments, incentives and organisational structures would enhance this contribution, but also allow policymakers to proactively shape the role of innovation intermediaries, aligning them to the growth potential of the host region. This could be to accelerate the transition from legacy industry sectors to emergent, higher-growth industries (Collinson et al., 2024), focus on specific 'latent' regional strengths observable from analyses of RTICS (real-time industrial classifications) rather than SIC codes, or simply lift the productivity and innovative capabilities of local 'laggard' SMEs (DSIT, 2024; Jibril et al., 2024; Billing et al., 2023; Ioramashvili et al., 2022). Finaly, they appear to also have the potential to support the commercialisation of a larger proportion of university-based R&D, better-leveraged to improve local firm-level productivity as well as strengthening the RIS in the hinterlands of research-intensive universities. This would also increase spillovers ('unpriced and unintentional knowledge externalities') which have been shown to support local economic growth, despite the difficulties in measuring how much (Becker et al., 2023).

3.4 Connecting Regional Types to Specific Interventions: Some Practical Steps

Since Valero and Van Reenen (2019) confirmed that universities were the source of 'an increased supply of human capital and greater innovation' in regional economies, there has been a growth in studies estimating the regional economic impacts of universities. These have used increasingly sophisticated data and analytical tools, but almost all are based on aggregate panel data sets (Audretsch et al., 2022; Bonaccorsi et al., 2024; Carillo, 2024; Marrocu et al., 2022; Robbiano, 2022; Meier, 2024). However, they do confirm that innovation intermediaries have a positive effect.

We are still lacking a sufficient depth of understanding about the specific combinations of incentives (different forms of funding), organisational structures (e.g. hybrid, on campus, demand-led off-campus) and mechanisms (joint-projects, contracted R&D, future-oriented training programs etc.) we should target to have specific impacts in different places.

However, the following process and measures would improve the ability of policymakers to customise interventions to different places and achieve a greater level of precision in configuring investments.

1. Identify the type of region, including current industry structure, level and type of industry specialisation, scale and scope of the portfolio of local firms, and ideally some breakdown of embeddedness by size and sector. Include technological complexity and the more complex sectors which the region has a relative advantage in producing.
    a. Data sources and gaps: The four datasets highlighted in this paper have much of the comparative data for this: WIPO's regional version of the Global Innovation Index (GII), Harvard Growth Lab's Atlas of Economic Complexity and the 'Metroverse' comparative dataset, the European Regional Innovation Scoreboard (RIS) and the DSIT Clusters mapping project. There is insufficient data on the specialisation, skills gaps, latent capabilities and regional spatial

‘footprint’ / impact of firms. However, there are private sector firms using web-scraping and data analytics tools to fill part of this gap.

2. Estimate potential future regional growth pathways. This involves significant guesswork, in the absence of many deep dives into the latent capabilities of UK regions.
    a. Data sources and gaps: the Harvard Growth Lab’s Atlas of Economic Complexity and the ‘Metroverse’. Similar to above, more data connecting latent firm-level capabilities and aggregate characteristics of regional economies is needed. But future predictions are always difficult, regardless of data availability!
3. Identify current scale, scope and (S&T) specialisation of regional universities. This relatively straightforward, given available data. Estimating the degree of ‘local orientation’ is more complex, but KEF provides some starting points.
    a. Data sources and gaps: existing REF, KEF and UKRI data sets, alongside DSIT Cluster mapping provide this.
4. Identify current pathways for KE delivery and agents, and obvious gaps or weaknesses.
    a. Data sources and gaps: DSIT Cluster mapping data may have some of this, but it appears to be a data gap which needs attention. A well-defined scoping of what to include, from science parks, start-up incubators, to university-firm partnerships and regional skills retention as well as innovation intermediaries could be included.
5. If innovation intermediaries exist in specific region, these will also fall into different categories, depending on their core activities, incentives and funding and the nature of their partnerships.
    a. Data sources and gaps: in the examples of MTC and WMG, which are probably unusual (certainly compared to other UK Catapults), the descriptive data outlined above, plus UKRI co-funded project details and the portfolio of contracts, are important data sources. These provide indicators of what targeted improvements were set at the start of a partnership, the focus of innovation-related improvements (upskilling, process, product development, new technology development etc.), information on the KE mechanisms and on the size, industry sector and location of the firm. There remains a data gap in terms of the outcomes of the KE activity. The City-REDI project did not follow up with a survey of partner firms to assess productivity improvements, the benefits of new skills or other innovation-related performance measures. A more precise understanding of the role of R&D flows from universities, ‘through’ these organisations (particularly for example in the case of the MTC-type intermediary) would also add value.

Across all of this there will be estimates and guesswork. We are not at the stage yet where data is available or will ever be available to measure all of these characteristics.

There are some key principles to keep in mind, from the studies cited in this paper.

- Reverse the directionality of impact logic chains by starting with the intended and possible outcomes at firm and sector level, in a specific type of region.

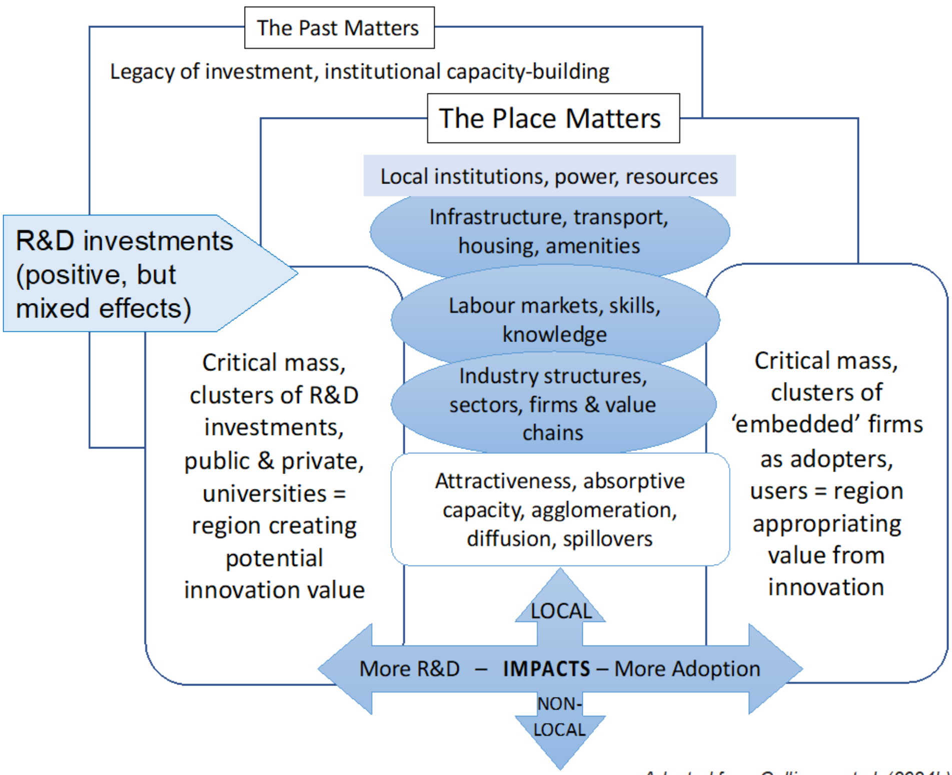
- Focus on developing innovation capability, which means considering demand-led, firm-level skills and technology in combination and alongside other systemic factors.
- Build-in some understanding of local variations in embeddedness and in-region vs. other-region multipliers when considering investments and interventions.

4 Conclusions: Customising Interventions

When developing policy interventions for stronger RIS the key point is that R&D inputs, including investments in university science and technology, do not necessarily boost local growth. More specifically, there is significant variation in the type of growth and the rate of growth which results from different combinations of inputs. The past matters because long-term investments in the basic factor endowments (from transport, housing, amenities and education to industrial assets and local firms) make a difference to a region's propensity to generate and leverage innovation for future local growth. Understanding the place itself matters because each region has a unique combination of endowments, different challenges and different potential, in terms of future growth pathways. So, different combinations of interventions are needed in different places.

Partly to reinforce the message related to Figure 1 above, see Figure 4 below. It also provides a high-level framework which aims to capture the various features and flows of a generic RIS.

Figure 4: Regional Innovation Systems: Place Matters



Adapted from Collinson et al. (2024b)

On one side of Figure 4 a region may have evolved more or less of a critical mass and/or specialised cluster of R&D investments, public and private universities, R&D intensive firms and advanced skills representing a set of inputs with the potential for adding value locally.

Patents are good indicators of this supply-side capacity (Cambridge produces a lot of them) but are often used as proxy measures of innovation, or even the strength of a regional economy, which is misleading because a very small proportion are ever commercialised. Appropriating value from invention requires other factors to be present. Moreover, additional conditions have to be in place for the commercialisation process to benefit the local economy.

The 'demand' side of the framework we have more-or-less of a critical mass or specialised cluster of firms as adopters and users of innovation. This enables a region to appropriate value from innovation inputs. Mechanisms for, and the long run benefits of achieving a better alignment between the supply and demand sides of this framework have not been sufficiently researched. But there is enough evidence to help improve policy interventions. For example, we know a lot more now about how strong partnerships between co-located firms and universities can increase knowledge transfer and the exploitation of 'invention for innovation' to boost local economic growth.

The RIS features a set of 'moderators' between R&D 'supply and demand' which include the complex range of interlinked components of a region which underpin its attractiveness, for investors, firms and skilled workers. The quality of local institutions and infrastructure, the presence of high-level and/or specialist labour, clusters of innovative firms and related value chains are all important. The presence of these, alongside stronger absorptive capacity, mechanisms which support diffusion and/or spillovers, and a tendency towards specialist agglomerations, all help underpin a stronger RIS. As we have discussed above, when firms are more embedded and linked to local value chains, more of the impacts and benefits from the appropriation of value from innovation stay in the region.

Given the level of complexity and variance across RIS there are good reasons why governments often focus on high-tech, R&D-led growth policies, with the assumption that most regions have the potential to be the next silicon-something (valley, glen, fen etc.). But most regions don't have this potential. Moreover, spinouts and R&D-intensive firms tend not to create extensive multiplier effects that benefit the wider economy (Hansen, 2022).

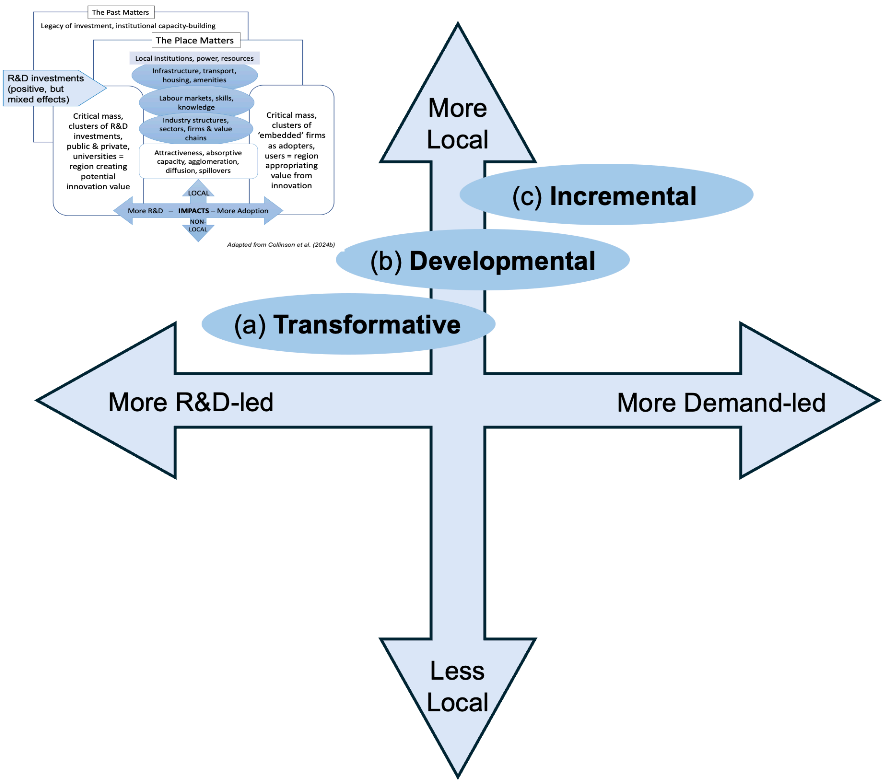
KE pathways, including but beyond the innovation intermediaries presented in this paper, have more potential to enhance local RIS. Some of these already stimulate market-led innovation and improve the capabilities of local firms and their impact could be scaled and targeted more effectively through better alignment with regional growth potential.

A final point is the need to strike a locally appropriate balance between current demand for capabilities, skills, assets or technologies, to meet the current needs of the region, and potential future growth trajectories which might not be expressed in current market demands. Firms know what they need to incrementally improve, and they express this through contracting consultants, universities, intermediaries or other firms, to fill capability gaps. As discussed above, MTC and WMG earn income from these kinds of contracts which represent the strongest indicators of what firms prioritise at a regional level.

In many cases, however, particularly where such firms are in legacy or declining industries, this demand-led innovation is unlikely to help develop the longer-term growth potential of a region. This is more complex and often not demand-led. Markets are imperfect and there is a stronger case for government intervention.

Figure 5 connects this key point with the core themes of this paper. It extends Figure 4 and links to the wider framework in Figure 1.

Figure 5: Regional Innovation Systems: Demand-led Incremental vs. Long-term Transformative Growth Trajectories



Building on Kelleher and Ulrichsen (2024) and Lester (2005), our typology should help us understand whether a region would benefit from, and has the latent capacity for more (a) transformative 'Type 1' support for emerging industries through leading science, technology and R&D, including for example the promotion of spinouts and startups. And / or 'Type 2' focused on attracting new industries, transplanting legacy industries, and upskilling. Or whether a region is best served from a focus on developmental (Lester's 'Type 3') interventions which support the diversification of existing industries into technologically related new ones. Alternatively, some regions will benefit most from more demand-led, incremental (Lester 'Type 4') support, helping existing firms and industries upgrade and move up their respective value chains.

Applying this approach, using new data sources to differentiate regional growth potential, and 'cross-matching' with intelligence about which firms or industries are more embedded, would improve our ability for more precise, place-based policy interventions.

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Appendix 1

Examples of Datasets for Building new Indices of Regional Differences

Obvious datasets include the standard portfolio of economic and business indicators for the UK. Such as the UK Annual Business Survey and the Inter-Departmental Business Register (IDBR), which publishes the annual "UK Business: Activity, Size and Location" and "Business Demography." Newer data on regional skills gaps usefully complement these, given the importance of specific kinds of skills as either a driver or a barrier to industry sector-specific growth opportunities in any region. This includes ‘data on understanding skill and qualification suitability in the labour market, UK’ which provides evidence of regional gaps, indicators of where people have the skills to work in alternative occupations, with regional variances.

Orbis, provided by Bureau van Dijk, is a large database (450 million companies) of firm-level characteristics and includes location indicators for regional comparisons. For example, the proportion and growth rate of high-tech firms in a region, taken from this dataset, can serve as a proxy for the overall innovative potential of a region.

https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/labourproductivity/bulletins/understandingskillandqualificationsuitabilityinthelabourmarketuk/august2024

‘Qualification mismatch estimates in England and Wales: 2021’ – and another set dated Aug. 2024

https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/labourproductivity/datasets/qualificationmismatchestimatesinenglandandwales2021

Add to this recently developed datasets on regional productivity, such as interactive regional TPI dashboards and scorecards (Gouma et al., 2023).

Regional Productivity Data sets

https://www.productivity.ac.uk/the-productivity-lab/how-productive-is-your-region-introducing-the-uk-tpi-productivity-dashboards/

although pub. In 2023 – so dated to 2021 only. E.g.

Gouma, Fokke Reitze; Menukhin, Olga; Ortega-Argiles, Raquel (2023). TPI UK ITL3 Scorecards. University of Manchester.

West Midlands ITL3 Scorecards 2021

ITL Classification	itl	TLG	TLG32	TLG33	TLG13	TLG12	TLG31	TLG21	TLG39	TLG37	TLG24	TLG36	TLG22	TLG38	TLG23	TLG11
	itlname	West Midlands	Solihull	Coventry	Warwick-shire	Worcester-shire	Birmingham	Telford and Wrekin	Wolver-hampton	Sandwell	Stafford-shire	Dudley	Shropshire	Walsall	Stoke-on-Trent	Hereford-shire
Productivity	Taxonomy relative to the UK	Catching up	Losing ground	Losing ground	Falling behind	Catching up	Falling behind	Falling behind	Catching up	Catching up	Falling behind	Falling behind	Falling behind	Catching up	Falling behind	Catching up
	Taxonomy relative to ITL1		Losing ground	Losing ground	Losing ground	Steaming ahead	Falling behind	Falling behind	Catching up	Catching up	Falling behind	Falling behind	Falling behind	Catching up	Falling behind	Catching up
	GVA per hour worked	£33	£43.50	£38.38	£37.52	£33.67	£32.77	£32.34	£32.14	£31.68	£31.06	£30.78	£30.63	£30.36	£29.91	£27.45
Business performance & characteristics	Export Intensity	24.6%	46.3%	33.0%	28.4%	13.0%	23.2%	41.7%	20.7%	16.7%	23.3%	11.0%	13.5%	20.7%	40.4%	10.6%
	New Businesses	14.2%	10.5%	14.4%	12.0%	16.9%	15.9%	11.8%	22.3%	15.2%	12.2%	13.7%	9.3%	16.3%	15.1%	10.3%
Skills	Low Skilled*	17.4%	12.9%	16.0%	14.1%	14.2%	20.0%	20.0%	21.9%	24.5%	15.1%	15.9%	15.5%	21.1%	19.5%	13.8%
	High Skilled	38.8%	43.1%	40.6%	45.0%	43.2%	40.3%	34.9%	35.2%	27.2%	41.7%	35.1%	41.8%	26.9%	29.0%	39.4%
Health & wellbeing	Active	77.6%	80.6%	75.9%	82.3%	81.3%	71.4%	76.1%	75.8%	76.7%	80.3%	82.0%	76.9%	75.6%	79.6%	81.2%
	Inactive due to Illness*	23.4%	16.7%	21.2%	24.8%	20.4%	19.7%	33.6%	25.3%	37.8%	24.1%	18.0%	25.2%	14.5%	35.5%	30.4%
	Working Age	60.8%	58.2%	73.2%	56.6%	57.3%	64.7%	59.7%	61.8%	60.9%	59.5%	59.2%	55.5%	60.7%	60.9%	58.7%
Investment, infrastructure & connectivity	4G connectivity	81.1%	81.8%	84.8%	79.2%	77.2%	90.6%	77.6%	87.2%	93.0%	76.9%	85.4%	62.5%	77.7%	82.3%	65.3%
	Fibre connectivity	25.1%	37.6%	91.5%	17.6%	15.5%	38.7%	11.1%	15.2%	19.4%	18.7%	5.0%	11.2%	11.9%	23.5%	24.5%
	GFCF per job															
	ICT per job															
	Intangibles per job															

Key

- Better: higher than 105% of weighted mean of ITL1 parent region
- Equal: within 95% - 105% of weighted mean of ITL1 parent region
- Worse: lower than 95% of weighted mean of ITL1 parent region
- No data available

* Reverse colour scale, lower values stimulate productivity

Cite as Gouma, F.R.; Menukhin, O.; Ortega-Argiles, R. (2023), TPI UK ITL3 Scorecards, TPI Productivity Lab, The Productivity Institute, University of Manchester.

https://doi.org/10.48420/23791680

Annex: Methods and Sources

ITL 3 scorecards focus on GVA per hour worked, combined with measures including export intensity, new business birth rate, skills (high or low), percentage of active working age population, ICT per job and 4G connectivity.

Comparative EU/OEXD Data

- CIS + UKIS

https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Community_Innovation_Survey_2022_-_key_indicators

- Regional Innovation Survey. Includes UK. Latest is 2023

https://ec.europa.eu/assets/rtd/ris/2023/ec_rtd_ris-regional-profiles-united-kingdom.pdf

uses data for 239 regions across Europe for 21 out of the 32 indicators employed in the European Innovation Scoreboard 2023

indicators listed here

https://projects.research-and-innovation.ec.europa.eu/en/statistics/performance-indicators/european-innovation-scoreboard/eis-2024#/ris/countries/UK?region=UKI

E.g. West Midlands profile:

https://projects.research-and-innovation.ec.europa.eu/en/statistics/performance-indicators/european-innovation-scoreboard/eis-2024#/ris/countries/UK?region=UKG

- Weak S&T Signals

12 thematic clusters: advanced materials and advanced manufacturing, aerospace, artificial intelligence and machine learning, digital twin, e-health, energy, environment and agriculture, ICT, medical imaging, mobility and transport, quantum and cryptography, therapeutics and biotechnologies.

TIM Technology. This system integrates science, technology and innovation data from several data sources including Scopus, PATSTAT and Cordis. Two sets of data have been used to detect early-stage technologies: scientific publications (Scopus database of scientific publications from Elsevier12 covering 01/1996 to 06/2023) and patents (Spring 2023 edition of Patstat13 from the European Patent Office). When signals are reconstructed in TIM Technology (see below), a third database is used in addition to Scopus and Patstat: Cordis14, the repository of EU funded R&D projects and activities.

Includes Revealed Technology Advantage (RTA) alongside other indicators.

https://op.europa.eu/en/publication-detail/-/publication/4cff5301-ece2-11ef-b5e9-01aa75ed71a1/language-en

https://www.timanalytics.eu/TimTechPublic/dashboard/index.jsp#/space/s_2434?ds=330643

interactive dashboard enables searching for specific nodes and networks in sub-tech areas and publications.

Business, Industry datasets

Industry concentration, birth rate etc. by region.

Good EU data – e.g.

https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Structural_business_statistics_at_regional_level

but does not include the UK.

OECD does. Work led by Sara Calligaris.

Note that measures of concentration reveal (1) LQ and industry specialisation, and (2) degree of concentration which is a proxy for (intra-region) competition and often relative (inter-region) competitive advantage.

Good explanation here:

https://www.oecd.org/en/publications/industry-concentration-in-europe_c4c371fb-en.html

also explained here:

https://cepr.org/voxeu/columns/new-approaches-measure-increasing-concentration-europe

Regional cluster mapping approaches which use both innovation indicators and firm – industry location data.

e.g.

https://link.springer.com/article/10.1007/s13132-023-01481-9

The co-located concentration of manufacturing and patenting activity at the regional (NUTS 2) level. For manufacturing data, we utilise Eurostat's Structural Business Statistics database. For patents, we use the OECD REGPAT database, which contains detailed regionalised patent data

Uses the (manufacturing employment) location quotient (LQ) as an index of spatial concentration. Plus the patent LQ. Using OECD REGPAT database.

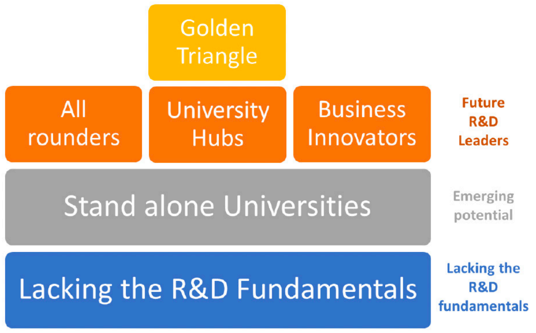
UK regions score highly in the computer cluster indicator. The top 3 regions are located in the UK and specifically in the area surrounding London (Surrey, East and West Sussex, Hampshire, and Isle of Wight, Essex). We can observe the presence of metropolitan centres in other top regions, such as Edinburgh (in Eastern Scotland) and Wien, as well as other established clusters of high-tech economic activity, such as Eindhoven (in the Noord-Brabant region).

Data lists available here:

https://link.springer.com/article/10.1007/s13132-023-01481-9/tables/6

https://access-research-development-spatial-data.beis.gov.uk/indicators/eurostat_berd_data

...used to identify West Midlands, Greater Manchester and Glasgow City Region all identified as University Hubs which are defined as: 'University presence and talent pipeline that are being translated into university innovation and Knowledge Exchange (excluding SMEs). However, poor performance the R&D workforce and private R&D spend suggest KE may not be with the local economy.'



Appendix 2

Four Proxy-Based innovation datasets with the best potential:

1. WIPO's (2024) regional version of the Global Innovation Index (GII)
2. The Harvard Growth Lab's Atlas of Economic Complexity and the 'Metroverse' https://metroverse.cid.harvard.edu/ comparative dataset
3. European Regional Innovation Scoreboard (RIS)
4. DSIT Clusters mapping

WIPO

(2024) Enabling Innovation Measurement at the Sub-National Level. A WIPO toolkit

This guides the application of national indicators, used since 2007 in the annual 'Global Innovation Index' (GII) report on relative national innovation strengths and weaknesses, to the sub-national level. It provides a 'complexity rating' to estimate the probable level of difficulty collecting data at the local level across the GII 'pillars' of which there are 7 as follows.

Table 1. Complexity analysis for GII pillar 1

	Indicator	How straightforward
1. Institutions	1.1.1 Political and operational stability	
	1.1.2 Government effectiveness	
	1.2.1 Regulatory quality	
	1.2.2 Rule of law	
	1.2.3 Cost of redundancy dismissal	
	1.3.1 Policies for doing business	Country-specific
	1.3.2 Entrepreneurship policies and culture	

Table 2. Complexity analysis for GII pillar 2

	Indicator	How straightforward
2. Human capital and research	2.1.1 Expenditure on education, % GDP	
	2.1.2 Government funding/pupil, secondary, % GDP/cap	
	2.1.3 School life expectancy, years	
	2.1.4 PISA scales in reading, maths and science	
	2.1.5 Pupil–teacher ratio, secondary	
	2.2.1 Tertiary enrolment, % gross	
	2.2.2 Graduates in science and engineering, %	
	2.2.3 Tertiary inbound mobility, %	
	2.3.1 Researchers, FTE/mn pop.	
	2.3.2 Gross expenditure on R&D, % GDP	
	2.3.3 Global corporate R&D investors, top 3, mn USD	
	2.3.4 QS university ranking, top 3	

Table 3. Complexity analysis for GII pillar 3

	Indicator	How straightforward
3. Infrastructure	3.1.1 ICT access	
	3.1.2 ICT use	
	3.1.3 Government's online service	
	3.1.4 E-participation	
	3.2.1 Electricity output, GWh/mn pop.	
	3.2.2 Logistics performance	
	3.2.3 Gross capital formation, % GDP	
	3.3.1 GDP/unit of energy use	
	3.3.2 Environmental performance	
	3.3.3 ISO 14001 environmental certificates/bn PPP$ GDP	

Table 4. Complexity analysis for GII pillar 4

	Indicator	How straightforward
4. Market sophistication	4.1.1 Finance for startups and scaleups	
	4.1.2 Domestic credit to private sector, % GDP	
	4.1.3 Loans from microfinance institutions, % GDP	
	4.2.1 Market capitalization, % GDP	
	4.2.2 Venture capital investors, deals/bn PPP$ GDP	
	4.2.3 Venture capital recipients, deals/bn PPP$ GDP	
	4.2.3 Venture capital received, value, % GDP	
	4.3.1 Applied tariff rate, weighted avg., %	
	4.3.2 Domestic industry diversification	
	4.3.3 Domestic market scale, bn PPP$	

Table 5. Complexity analysis for GII pillar 5

	Indicator	How straightforward
5. Business sophistication	5.1.1 Knowledge-intensive employment, %	
	5.1.2 Firms offering formal training, %	
	5.1.3 GERD performed by business, % GDP	
	5.1.4 GERD financed by business, %	
	5.1.5 Females employed w/advanced degrees, %	
	5.2.1 University–industry R&D collaboration	
	5.2.2 State of cluster development and depth	
	5.2.3 GERD financed by abroad, % GDP	
	5.2.4 Joint venture/strategic alliance deals/bn PPP$ GDP	
	5.2.5 Patent families/bn PPP$ GDP	
	5.3.1 Intellectual property payments, % total trade	
	5.3.2 High-tech imports, % total trade	
	5.3.3 ICT services imports, % total trade	
	5.3.4 FDI net inflows, % GDP	
	5.3.5 Research talent, % in businesses	

Table 6. Complexity analysis for GII pillar 6

	Indicator	How straightforward
6. Knowledge and technology outputs	6.1.1 Patents by origin/bn PPP$ GDP	
	6.1.2 PCT patents by origin/bn PPP$ GDP	
	6.1.3 Utility models by origin/bn PPP$ GDP	
	6.1.4 Scientific and technical articles/bn PPP$ GDP	
	6.1.5 Citable documents H-index	
	6.2.1 Labor productivity growth, %	
	6.2.2 New businesses/th pop. 15–64	
	6.2.3 Software spending, % GDP	
	6.2.4 ISO 9001 quality certificates/bn PPP$ GDP	
	6.2.5 High-tech manufacturing, %	
	6.3.1 Intellectual property receipts, % total trade	
	6.3.2 Production and export complexity	
	6.3.3 High-tech exports, % total trade	
	6.3.4 ICT services exports, % total trade	

Table 7. Complexity analysis for GII pillar 7

	Indicator	How straightforward
7. Creative outputs	7.1.1 Intangible asset intensity, top 15, %	
	7.1.2 Trademarks by origin/bn PPP$ GDP	
	7.1.3 Global brand value, top 5,000, % GDP	
	7.1.4 Industrial designs by origin/bn PPP$ GDP	
	7.2.1 Cultural and creative services exports, % total trade	
	7.2.2 National feature films/mn pop. 15–69	
	7.2.3 Entertainment and media market/th pop. 15–69	
	7.2.4 Printing and other media, % manufacturing	
	7.2.5 Creative goods exports, % total trade	
	7.3.1 Generic top-level domains (TLDs)/th pop. 15–69	
	7.3.2 Country-code TLDs/th pop. 15–69	
	7.3.3 GitHub commit pushes received/mn pop. 15–69	
	7.3.4 Mobile app creation/bn PPP$ GDP	

There are numerous insights from attempts to apply the first three in other countries. In particular WIPO (2024) draws on indices that are under development in China (the China Regional Innovation Capability Index), Colombia (the Colombian Departmental Innovation Index), India (the India Innovation Index (III)), and Viet Nam (the Provincial Innovation Index (PII). It also reviews and incorporates some metrics from the EU's European Regional Innovation Scoreboard (RIS), which follows the method of the European Innovation Scoreboard, and assesses innovation systems across 240 regions (out of 22 countries) across the EU.

This WIPO report provides additional insights into other promising datasets. These include an approach developed by Scott Stern and colleagues from MIT, using business registration records analyse both the quantity of entrepreneurial activity (the number of startups) and the quality, defined as the 'likelihood that a startup will achieve growth through an Initial Public Offering, IPO, or significant acquisition.' This allows us to estimate the probability of future growth and identify clusters of high-growth startups in specific regions.

The MIT approach fed into MIT REAP – Regional Entrepreneurship Acceleration Program (https://reap.mit.edu) – which has extensive experience of addressing entrepreneurship and growth challenges in a very wide range of regions. Up to 8 regions work with MIT in each cohort for two years, and it is now recruiting its 12th cohort. This was further developed by the Startup Cartography Project (SCP) by Andrews et al. (2022), focusing on four entrepreneurial ecosystem statistics: the Startup Formation Rate (SFR), the Entrepreneurship Quality Index (EQI), the Regional Entrepreneurship Cohort Potential Index (RECPI) and the Regional Ecosystem Acceleration Index (REAI). Together they provide relative measures of the scale and performance of entrepreneurial ecosystems at the regional level.

Sources: WIPO (2024) Enabling Innovation Measurement at the Sub-National Level. A WIPO toolkit https://www.wipo.int/publications/en/details.jsp?id=4746&plang=EN

The Harvard Growth Lab's Atlas of Economic Complexity and the 'Metroverse' Dataset

https://metroverse.cid.harvard.edu/city/1800/growth-opportunities

Direct city region comparisons show relative specialisation, strengths and opportunities. Uses NAICS.

- E.g. Birmingham (primary metal manuf., mining – except oil and gas extraction, fabricated metal manuf.) and Manchester (Chemical manuf., oil and gas extraction, paper manufacturing – amongst many services).
- Knowledge clusters group according to technological relatedness. Birmingham = education and research, Healthcare, construction, fabricated metals knowledge clusters Manchester = hand tool manufacturing, printed ink manufacturing

- The Product Complexity Index (PCI) ranks the diversity and sophistication of the productive know-how required to produce a product. Products with a high PCI value (the most complex products that only a few countries can produce) include electronics and chemicals. Products with a low PCI value (the least complex product that nearly all countries can produce) include raw materials and simple agricultural products

- Diversity = A measure of how many different types of products a country is able to make. The production of a good requires a specific set of know-how; therefore, a country's total diversity is another way of expressing the amount of collective know-how held within that country.
- Know-how = The tacit ability to produce a product. Also known as productive capability, know-how refers to the productive knowledge that goes into making products.
- Revealed Comparative Advantage (RCA). A measure of whether a country is an exporter of a product, based on the relative advantage or disadvantage a country has in the export of a certain good.
- Opportunity Outlook Gain = Measures how much a location could benefit in opening future diversification opportunities by developing a particular product. Opportunity outlook gain quantifies how a new product can open up links to more, and more complex, products. Opportunity outlook gain classifies the strategic value of a product based on the new paths to diversification in more complex sectors that it opens up. Opportunity outlook gain accounts for the complexity of the products not being produced in a location and the distance or how close to existing capabilities that new product is.

Lists of the indicators used in these mapping exercises are available here... - but the suggestion is to base a typology on this existing map.

Sources:

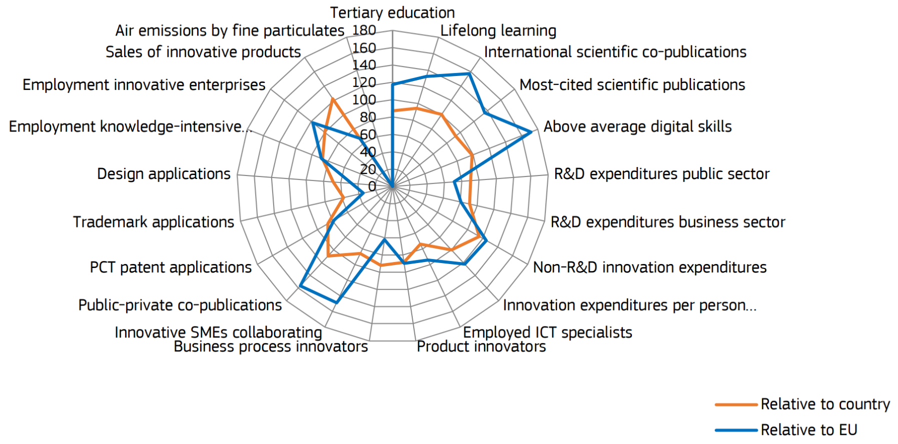
https://metroverse.cid.harvard.edu/ comparative dataset

The European Regional Innovation Scoreboard (RIS)

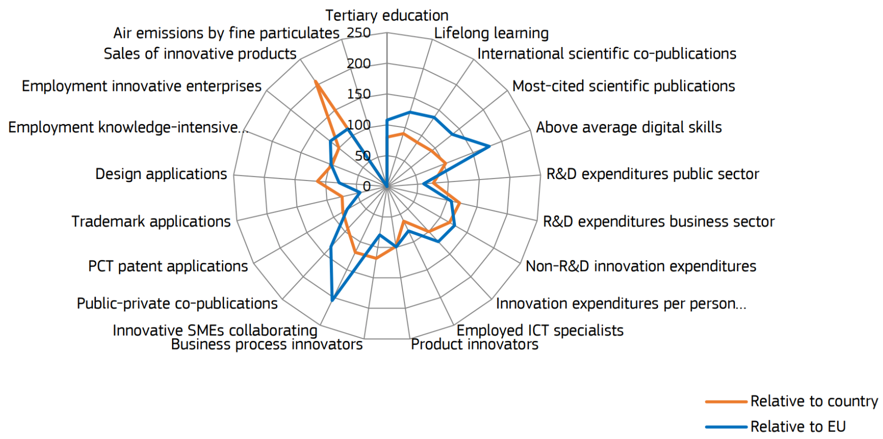
The regional innovation scoreboard (RIS) is a regional extension of the European innovation scoreboard (EIS), assessing the innovation performance of European regions on a limited number of indicators. The RIS 2023 provides a comparative assessment of the performance of innovation systems across 239 regions of 22 EU countries, Norway, Serbia, Switzerland, and the United Kingdom.

NUTS	Region	RII	Rank	Group	Change
UK	United Kingdom	113.9	--	Strong Innovator	2.7
UKC	North East	101.9	97	Strong Innovator -	-0.6
UKD	North West	104.9	89	Strong Innovator -	3.9
UKE	Yorkshire and The Humber	107.9	75	Strong Innovator -	5.6
UKF	East Midlands	112.9	62	Strong Innovator	6.6
UKG	West Midlands	112.5	64	Strong Innovator	6.8
UKH	East of England	121.2	50	Strong Innovator +	7.4
UKI	London	131.1	16	Innovation Leader -	5.5
UKJ	South East	130.3	22	Innovation Leader -	6.2
UKK	South West	117.7	54	Strong Innovator +	9.3
UKL	Wales	105.8	82	Strong Innovator -	10.9
UKM	Scotland	107.3	76	Strong Innovator -	5.8
UKN	Northern Ireland	94.8	120	Moderate Innovator +	8.6

North-West UKD



West Midlands UKG



Sources:

Hollanders, H. (2024) Regional Innovation Scoreboard 2023. Regional profiles: United Kingdom. European Commission, Directorate-General for Research and Innovation

https://ec.europa.eu/assets/rtd/ris/2023/ec_rtd_ris-regional-profiles-united-kingdom.pdf

DSIT

The DSIT Clusters mapping tool (DSIT, 2024) identified (at the simplest level) 4 types of clusters: diverse, specialised, R&D collaborating, and dispersed. To do this it combined 5 different datasets (IDBR, RTIC, IUK and UKRI) to classify groups of organisations based on four criteria, depending on whether they were RD&I active, co-located, specialised and internally collaborative.

7 technology families...

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1009577/uk-innovation-strategy.pdf

Innovation Clusters

https://assets.publishing.service.gov.uk/media/65c4dee39c5b7f0012951b36/uk-innovation-clusters-analytical-report.pdf

See Annex A for full methodology.

This combined 5 different datasets to classify groups of organisations based on the four criteria:

- IDBR – 2018 Inter-Departmental Business Register dataset: 3.1 million business sites classified by 32 broad Standard Industrial Classification (SIC) code sectors.
- RTIC – 2023 Real-Time Industrial Classifications dataset: 5 million firms classified by 46 emerging RTIC sectors identified by The Data City.
- IUK – Innovate UK dataset: 46 thousand collaborators and 111 thousand project funding applications from innovative firms and other organisations from Sep 2016 to Jan 2023.
- UKRI – UK Research and Innovation dataset: 24 thousand funded project from Sep 2016 to Jan 2023. MAKG – Microsoft Academic Knowledge Graph dataset: 239 million scientific publications with co-authors.

Shows co-location (which presumably matches LQs) and networks, by thematic area – e.g. automotive.

Table 2.6 summary is useful, and on p.34 – specific regional strengths is not a bad starting point.

Table 2.1 Four types of clusters and the criteria they satisfy

Innovation Clusters	RD&I-active	Co-located	Specialised	Internally Collaborative
Diverse	✓	✓	✗	✗
Specialised	✓	✓	✓	✗
R&D Collaborating	✓	✓	✓/✗*	✓
Dispersed	✓	✗	✓/✗*	✓

*While R&D Collaborating clusters and Dispersed communities may or may not meet the Specialised criterion, due to their cross-sector collaborations they warrant further exploration for their unique relationships.

Sources:

Department for Science, Innovation and Technology. DSIT Research Paper Number 2024/001. Analytical Report. Identifying and describing UK Innovation clusters. Cambridge Econometrics and partners.

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