Comparative advantage & productivity

Comparative advantage is a core pillar of the original Porter definition of clusters,[xix,xx]. In economic theory, comparative advantage stems from a country or industry enjoying an advantage over competitors thanks to a natural endowment of some factor of production (for example, natural resources or labour). Porter takes this a step further, arguing that the greater productivity gained from the clustering – through features such as knowledge transfers, innovation creation, and shared resources – gives the agents within these clusters a comparative advantage[xxi].

Productivity is the focus of several papers on clusters and is a traditional measure of the strength of a cluster. There are two common ways productivity is measured within studies, either by comparing output with the sector median (e.g.: median GVA/employee compared to sector average) or by comparing wages with the regional average (e.g.: average wage per employee, full-time employment)[xxii].

Additional cluster characteristics

The above themes capture the essence of clusters, but they are not an exhaustive list of what defines a cluster. There are several other key themes that recur in the literature. It has been suggested more recently that clusters typically have four broad characteristics: a spatial focus, a sectoral focus, a critical mass of firms, and a management unit[xxiii]. Alongside this, there are several other, often inter-related themes which link back to the core themes of clusters and provide more colour around how clusters operate, grow, and draw benefits from agglomeration effects.

Innovation

Whilst clusters may form across a wide range of industries, a special focus has been placed on the common theme of innovation in clusters. The cross-sectoral nature of most clusters makes transfer of innovation more complex, but also allows for the development of more advanced innovations beyond the needs of a particular sector[xxiv].

Innovation is closely linked to the theme of comparative advantage. Understanding the scale of comparative advantage an industry or region enjoys is a way of measuring the presence and impact of innovation. Innovation allows the cluster or the industry to continue to grow, attract new talent, and to retain its competitive advantage, a concept that is explored later in this report.

Innovation "ecosystems" have been highlighted as a foundational ingredient for a successful cluster by numerous authors, including academics at the MIT Lab for Innovation Science and Policy,[xxv, xxvi, xxvii,xxviii]. Alongside comparative advantage, they use foundational institutions and innovation and entrepreneurship capacities to measure these innovation ecosystems.

Foundational institutions influence the ability of an innovation ecosystem through factors such as ease of doing business, property rights, and labour market flexibility. However, these are predominantly determined at the national level in the UK.

Innovation and entrepreneurship capacities are more specific to regions and local areas, and they play a key role in attracting investment. These capacities are divided into five main categories that are then measured to understand the extent to which a region has the potential to foster innovation and entrepreneurship, which, in turn, can extend to clusters. The five categories considered are: human capital, funding (public and private), infrastructure, level and nature of specialised demand, culture and incentives[xxix].

Anchor tenants

Linked to the key theme of business scale and concentration is the idea of an anchor tenant. Usually a major single company or educational institution, these are R&D-focused public and private institutions that generate and apply specialised knowledge within a particular technological field[xxx]. The presence of an anchor tenant can signal the potential for links between businesses or between academia and business, which can both feed the talent pipeline and contribute to R&D and innovation potential.

Universities are particularly well known for their ability to create spin-out businesses. For example, the University of Cambridge has been the source of several high profile spin-outs such as ARM Holdings and Abcam Plc[xxxi,] both of which are still headquartered in Cambridge,[xxxii,xxxiii.] These companies form part of a wider cluster of technology and life science companies within the Oxford-Cambridge Arc.

Workforce talent (labour, skills, roles) is a key theme that expands on the topic of employment concentration. Talent also relates to the comparative advantage and innovation, with human capital being one of the five categories of measuring innovation and entrepreneurship capacity suggested by MIT. Equally, clusters act as signals around opportunity and stability for employees, meaning it can be easier to attract more people, and more talented people, to the cluster[xxxiv].

Strength of business community activity

The core industry (or industries) of the cluster is not the only one supported by its existence. Key stakeholders outside of the supply chain are also important for the innovation ecosystems of clusters, including the wider entrepreneurial community and risk capital providers[xxxv]. These are the organisations that help create, assess, and fund these new enterprises, thus supporting further growth.

There is also the recurring theme of cluster management and organisation with the cluster literature, especially that which is focused on policy. There is more attention being placed on specific entities which can take on the management, development, and promotion of clusters, such as in innovation parks. Cluster organisations and agencies are considered as being able to play an important role in developing business, with some suggestions that they could potentially substitute for anchor organisations in some clusters.

Investment

Finally, the scale and type of activity in clusters naturally lends itself to investment, especially given their comparative advantage and innovation potential. There are several ways to understanding how investment can indicate the presence and strength of a cluster.

Looking at both the total investment levels, as well as the presence of investors (such as investment or venture capital firms), can provide insights to the health of a cluster as well as helping to understand whether the level of surrounding activity can support investment.

FDI & clusters

There are clear theoretical reasons explaining why clusters should attract FDI. However, empirical evidence suggests that the relationships between FDI investment and clusters are more complex than the theoretical studies may suggest.

Cluster attractiveness

There is no prescriptive list of what characteristics of a cluster best encourage FDI to occur. Despite having many similar features, clusters are all unique business ecosystems and must be treated as such. Some studies have attempted to understand the characteristics of clusters attracting FDI; however, there are limited conclusions that can be drawn.

More established clusters, and larger clusters, tend to have a better chance at attracting FDI. One study of clusters in Indiana, USA, looked at the role of growth clusters in attracting FDI. While the presence of a growth cluster[7] was found to increase FDI flows into a region, the size of the cluster – measured using employment location quotients[8] – was a better predictor of the variation of FDI flows (into growth clusters)[xxxvvii]. This suggests that the agglomeration of human capital plays an important role in the ability of an existing cluster to attract FDI.

Different industries may also attract FDI differently. This was found not only in the USA study mentioned above, but also in a UK study of manufacturing industry versus to non-manufacturing industry FDI. It was found that regional-level factors (as opposed to national-level factors) influenced manufacturing industry FDI location motives in four UK regions[9], whereas, in other regions, this was more likely to influence non-manufacturing industry FDI location moves[xxxviii].

Practical relationship between FDI and clusters

One of the practical ways that FDI appears in clusters is through the presence of foreign-owned firms. Understanding location patterns of foreign versus domestic firms forms a subset of the literature in this area. In the UK, one study found that foreign-owned firms tended to agglomerate in (existing) clusters with leading domestic firms. In some industries, foreign-owned firms were observed to be clustered to an even greater extent (as measured by geographical metrics) than domestic firms. However, there were a small number of industries[10] that bucked this trend, possibly due to policy incentives or other local characteristics[xxxv]. Another study, with a more global focus, found that multinational firm headquarters tend to be the most agglomerative type of establishment, followed by multinational subsidiaries and then domestic firms[xxxvi].

Looking at the manufacturing sector, specifically, several studies have found that foreign-owned plants have a tendency to co-locate with other foreign-owned plants, with more agglomerated employment than domestically owned plants,[xxxvii,xxxviii].

Additionally, several highly agglomerated clusters within the manufacturing industry occurred within industries that typically had well-known historical clusters, illustrating the potential for persistence over time of industry agglomeration[xxxix].

Several authors have found evidence of spillover benefits from FDI for both regions and the firms within clusters. These benefits include both horizontal (i.e., between the same industry) and vertical (i.e., up and down the value chain) spillovers, which have been found to improve the productivity of domestic firms and the host country overal[lxl]. For example, one recent study found that foreign-owned firms helped increase the number of patent registrations in different regions[xli]. However, UK researchers found that the total factor productivity benefits associated with FDI are limited to pre-existing clusters, with non-cluster areas seeing no spillover effects. This implies that efforts to attract foreign-owned firms and FDI should be focused on existing clusters, while domestic policy should seek to support domestic firms elsewhere to develop the foundations for future clusters,[xlii,xliii].

Challenges of successful FDI attraction

While attempts to attract FDI are generally seen as a positive and worthwhile, this is not always the case. Many cluster internationalisation efforts fail due to being too focused on quick wins, rather than the long-term outcome. This is because foreign investment may end up creating geographical concentrations of activities that may not be true clusters. This may result in domestic firms providing low-added value support to single large foreign subsidies with high import intensities.

Knowledge spillovers are one of the key benefits of both clustering and FDI but attracting the most innovative firms may not produce the expected or desired results in some instances. Highly innovative firms can potentially have the least to gain (and the most to lose) from collaboration with local industries, such as through greater leakages of information and knowledge, compared to the potential extent of gains from knowledge they receive[xliv], whereas marginally less innovative firms may be more willing to collaborate. Therefore, it has been suggested that policymakers should focus on policies which promote knowledge transfers alongside any FDI[xlv].

There are also some challenges in ensuring that anchor tenants support the sustainable growth of a cluster. In particular, it has been suggested that clusters which try to replicate or re-create the conditions generated by natural anchor tenants with artificially created anchor tenants can end up being fragile and short-term focused. Consequently, multi-national enterprises may choose to simply leave these clusters when economic conditions become unfavourable (due to limited long-term commitments to the area)[xlvi].

[7]Presence of a growth cluster was defined as a region that has an employment concentration greater than the national average (i.e., a location quotient).
[8]Location quotients assess concentration of a variable (here employment) relative to the regional or national average for that variable.
[9] Regional-level factors drove manufacturing FDI location moves in London, Wales, the West Midlands, and Scotland. Regional-level factors drove non-manufacturing FDI location moves in the South East, Wales, and the North West. (Fallon and Cook (2013))
[10] Industries found to be more dispersed were assembly industries such as manufacture of electronic valves and tubes, manufacture of computers and manufacture of televisions and radios (Duranton and Overman (2006).

Further considerations

It's important that cluster management organisations and investment promotion agencies specifically focus on attracting foreign investment, in addition to the promotion and development of the cluster. There is some evidence that good management does help to reach foreign target markets, and that business network dynamics can be important in influencing firms' internationalisation behaviours[xlviii].There is also evidence supporting the activity of regional investment promotion agencies (compared to national investment promotion agencies), with a recent study finding that these had a statistically significant positive effect on FDI attraction in regions across the EU Single Market. This study also noted that for these agencies to be successful, they were required to select specific sectors to target: the creation of these agencies alone was insufficient to attract additional FDI. Finally, it was also found that these agencies are more successful at attracting FDI from 'occasional' investors (those who do not typically engage in multiple foreign investments), as 'serial' investors are more likely to be able to leverage existing intra-corporate networks they have previously developed[xlix].

Appendix II – Methodological notes

APPENDIX II

1.0 Cluster selection and aggregation

Data City Methodology

Mapping the clusters

The Data City applied Real-Time Industrial Classification (RTIC) methodology to map a series of sectors refined from the 100 declared clusters, within the boundaries of the 65 Local Authorities represented by Midlands Engine. RTIC methodology is a new approach to industrial classification based on web-crawling technology and supervised machine learning. Companies are classified according to common language patterns in their website text, making it possible to quantify the size and value of new economic sectors. This approach has been used by public sector institutions, such as the Department of Culture, Media and Sport (DCMS) or the Department for Business, Energy and Industrial Strategy, to uncover the geography if these economies and understand their performance. Likewise, academic institutions are increasingly adopting the methodology to create new knowledge for these industries. The University of Edinburgh and the Bennett Institute have used RTICs to answer questions about sectors for which data is not directly accessible. The RTIC approach makes possible the production of datasets addressing non-traditional industrial sectors that are not well-classified by traditional frameworks for industrial classification, such as the System of National Accounts.

The Data City's mapping exercise for this project captured 86,816 companies[11] across 31 different sectors in the UK. Of this population, 16,140 companies were located within the boundaries covered by the Midlands Engine.

[11]The values represent the number of companies classed as active in Companies House that were captured in one or more of the sectors of interest. From this population, a URL match was available for all companies but for a segment classified in Textiles. To address the textiles industry, machine learning and SIC-based searches were combined. The Data City's data joins company financial information (including turnover and employee numbers) sourced from Companies House, Credit Safe, Redflag Alert, Dealroom, InnovateUK and 360Giving data with website-text insights and registered and operating addresses. This creates a dataset with information at the company level that can be queried and processed to understand the performance of industrial sectors. Both the raw sector data and processed metrics provided by The Data City's platform have been used in this report.

Cluster review method

The Data City used location quotients for three metrics – business counts, employee numbers, and turnover – to review the existence of significant clusters in any of the 65 Local Authorities relevant to Midlands Engine area (see Annex 2). Location quotients were used as they can help identify the degree of industrial specialisation in a given region compared to the nation as a whole.

The Data City gave more weight in their methodology to the location quotient values for employees and turnover. This is because they were judged to be a more direct representation of the concentration of human and economic capital in a region. The location quotient values resulting from absolute business counts, by comparison, were viewed as less illustrative of clustering. This is because it is not clear what sort of activity occurs at a given trading address from business counts alone. For example, this metric does not distinguish between a firm's headquarters and their warehouse or call centre.

To be considered, a sectoral cluster needed to have at least three Local Authorities consistently ranked in the top 20 Local Authorities from across the UK for location quotient values across the three variables investigated, prioritising location quotient values of employee number and turnover for the reasons stated above.

The next step for cluster review was based on projections for net worth and/or turnover. These projections were calculated as the observed annual growth rate of net worth and turnover for a sector in the Local Authorities represented by the Midlands Engine Partnership. The Data City measured the growth trends based on time-series data from Companies House and CreditSafe[12]. The Data City identified sectors that showed a positive growth trend for both the observed and projected values for net worth and/or turnover across the 65 Local Authorities relevant to Midlands Engine area.

The final review criterion was based on historical sector growth rates. Growth rates have been identified as an effective measure to identify clustering[l]. This metric measured the growth of the sector based on company counts per company foundation year. Specifically, a declared cluster needed to have a minimum sector growth rate of 125% for the period 2012-2021. The sector growth rate was calculated using company foundation date data sourced from Companies House. The Data City selected 125% growth rate as the boundary because it indicates that the sector has more than doubled its size in a region in the last 10 years.

The Data City Location Quotient methodology

The Data City based the review of clusters on the analysis of location quotient values at the national scale. Location quotients represent whether the industry share of variable X is greater in the region in comparison to the U.K. as a whole.

Location quotients are frequently used in industrial and geographical cluster analysis internationally[li,lii,liii] to measure the overrepresentation of a characteristic in a region against the whole. Location quotients have also been used by the public sector as a measure for specialisation and concentration of industrial assets[liv] .

[12] CreditSafe is a financial insights company and credit checker.

Location quotients have widely replaced the use of absolute, observed metrics, such as business counts, as a means to quantify the level of concentration or specialisation of industrial activity in an area[iv]. This is because large business counts of a specific sector in a densely populated area may reflect a larger number of inhabitants, rather than pointing to a specialisation or clustering.

The Data City calculates location quotient values applying the equation below, which is used by the Office of National Statistics

$$LQ = \frac{\frac{Xi,r}{Xr}}{\frac{Xi}{X}}$$

Where:
Xi,r is the value of a variable for industry i in region r
Xr is the total value of X in region r
Xi is the total value of X for industry i for the U.K.
X is the total value for variable X for the U.K. (adapted from ONS, 2021)

The results of location quotients can be interpreted as follows: a value below 1 indicates that the region has a lower share than the U.K., 1 indicates that both the region and the U.K. have the same share, and values over 1 indicate that the region has a larger share than the U.K.

The Data City applied the location quotient methodology to three different statistics for this project: business counts per Local Authority, aggregated turnover per Local Authority, and the total number of employees per Local Authority. The formulas look as follows:

$$LQ = \frac{\frac{Bi,r}{Br}}{\frac{Bi}{B}}$$

Where:
Bi,r is the business count for sector i in region r
Br is the total number of businesses in region r
Bi is the total business count for industry i for the U.K.
B is the total business count for the U.K. (adapted from ONS, 2021)

$$LQ = \frac{\frac{Ti,r}{Tr}}{\frac{Ti}{T}}$$

Where:
Ti,r is the aggregated turnover for sector i in region r
Tr is the total aggregated turnover in region r
Ti is the total aggregated turnover for industry i for the U.K.
T is the total turnover for the U.K. (adapted from ONS, 2021)

$$LQ = \frac{\frac{Ei,r}{Er}}{\frac{Ei}{E}}$$

Where:
Ei,r is the number of employees in sector i in region r
Er is the total number of employed people r
Ei is the number of people employed in industry i for the U.K.
E is the total number of employees in the U.K. (ONS, 2021)

The Data City used Local Authorities as the region (r in the formulas) to understand if a sector has a degree of specialisation higher than the U.K. overall, and to compare location quotients across different national clusters.

Beauhurst methodology

Mapping the clusters

For each cluster provided by the Midlands Engine partners, Beauhurst created a sectoral and geographic definition of the cluster. This definition was then used to identify businesses in Beauhurst's database of all five million active companies in the UK (plus the c. 50,000 high-growth businesses that Beauhurst actively monitors).

For the sectoral definitions, Beauhurst identified which of their proprietary sector and "buzzword" classifiers best described each of the clusters provided. For each cluster, the definition could correspond to one of Beauhurst's sector / "buzzword" classifiers, or a group of those classifiers on an AND or OR basis. In other words, some definitions required the companies to be active in two (or more) sectors, while other definitions allowed the companies to be active in either sector. For the geographic definitions, Beauhurst identified which of their available geographic "containers" best described each of the clusters provided at the regional, county, local authority, or LEP level.

For the geographical definition, locations were assigned on the basis of the business's functional headquarters (not its registered address). Sectoral and buzzword classifiers were assigned according to a proprietary matrix and publicly available information about the company. Each company was tagged with as many classifiers as are relevant to the company's business model.

Cluster review method

Once the businesses matching both the geographic and sectoral cluster definitions were identified, the total population of high-growth businesses as a share of national and local populations was calculated.

This ratio was then used as the review criterion for the list of declared clusters. A cluster has a population of high-growth businesses (matching both the geographic and sectoral cluster definitions) of greater than 1% of the national population of high-growth businesses in the relevant sector(s), or greater than 1% of the high-growth businesses in the region.

Identification of potential/new clusters

Beauhurst methodology

In order to check for the presence of clusters that had not been previously identified (by Midlands Engine partners), Beauhurst calculated the high-growth business populations of every sectoral and local authority combination. If the population of high-growth businesses matching both the geographic and sectoral criteria was more than 1% of the national population of high-growth businesses in the relevant sector(s), or more than 1% of the high-growth businesses in the region, it was manually reviewed for its potential as a cluster.

Results of identification and review of clusters

The Data City results

The Data City found 16 sectors that met the criteria for cluster review. These clusters included sectors such as aerospace, data driven healthcare technologies, and net zero transport.

Beauhurst results

If the population of high-growth businesses matching both the geographic and sectoral cluster definitions was less than 1% of the national population of high-growth businesses in the relevant sector(s), or less than 1% of the high-growth businesses in the region, its potential as a cluster was called into question. Using the threshold of 1%, there were 23 clusters that fell below this ratio. Of these 23 clusters, only two (fell below the 1% threshold on both counts (share of sectoral high-growth population and share of regional high-growth population).

2.0 Exploring investment potential – analytical framework

Overview

Following a literature review, a number of key metrics that describe the talent (labour force and pipeline), business population, support environment, innovation, and investment characteristics of each cluster were defined. Beauhurst, the Data City, Wavteq and the Midlands Engine Observatory compiled data for each of these metrics from proprietary and public sources. These metrics were collected at Local Authority level, where possible, to allow deeper interrogation by Midlands Engine partners. The data were then aggregated into 30 pan-regional scorecards and supplemented with relevant commentary and mapping of key cluster locations across the Midlands Engine area.

These scorecards present 25 characteristics of the pan-regional clusters that are factors in the attraction of inward investment, such as talent pipeline or strength of relevant research in the region, and associated commentary to provide further context.

In short, the investment potential of each cluster is inferred through demonstration of growth, comparative advantage, or disproportionate market share of investment, across these metrics.

Selection of scorecard metrics

How to evaluate clusters – metric identification

There was no individual metric found during the literature review to be a stand-out indicator of whether a cluster could attract investment, foreign or otherwise. Therefore, a list of metrics was created against which to evaluate the clusters, to try and build up a picture of investment potential.

How to pick key metrics – scoring & shortlisting

An initial (exhaustive) list of metrics was gathered following the literature review and organised into five categories. These categories aligned with the high-level themes highlighted in the literature review: Access to Talent and Skills, Business Population, Cluster Support Environment, Innovation and R&D, and Investment and FDI. To ensure the metrics chosen for the scorecards were both specifically related to cluster theory as well as being indicators of investment potential, this initial list was narrowed down using a scoring system. The highest scoring metrics represented those indicators which were both good indicators of

cluster presence and potential (i.e., "concept score") and could be evaluated comparatively for each cluster (i.e., "data score").

Concept score

The concept score referred to how closely a metric was linked to cluster theory. Specifically, the metrics were evaluated against the different characteristics highlighted in the literature review as important for defining clusters. A high scoring metric was one that was either explicitly mentioned in the literature or was a clear proxy indicator of one of the main key themes above.

Metrics related to the idea of FDI attraction, even if these were not specific to cluster FDI attraction, were also considered to help provide a rounded insight into FDI investment potential.

Cutting across all these categories were the core themes of comparative advantage and geographical boundaries. Metrics around innovation (such as patents), talent (such as qualified workforce[13]), and business growth (such as incorporation rates) helped to paint a picture of the strength and location of a given cluster.

Data score

The data score referred to how easily available the data required for the metric was, including considering the geographical scale, to allow for accurate cluster comparisons. Metrics with a high data score were, typically, available at specific geographical levels such as local authority district, as well as for specific industries. The data were sourced from Beauhurst, The Data City, and Wavteq, as well as from publicly available sources such as the Office of National Statistics.

Metric selection

The concept score (how closely a metric was linked to cluster theory) and data score (ease of access to data) were then combined to produce one overall score for each metric. Those metrics with very low scores were discounted, whilst those with very high scores were marked for inclusion. Any metric which had a score in the middle of the range was subject to further scrutiny. Where there was a low concept score bringing down the overall score, the merits for inclusion based on the additional colour that it could provide to the overall narrative were taken into account. Where there was a low data score bringing down the overall score, the potential for either different data sources or measurement techniques were discussed. The metrics were then marked for inclusion or exclusion. This process provided the finalised list of scorecard metrics.

Aggregation of scorecard data

The Data City methodology

The Data City provided 30 sector-specific datasets that aggregated all of the companies classified in each sector. The sector data was generated using The Data City's proprietary machine learning technology, which groups companies according to how they describe themselves in their website text. The metrics, which were gathered at the local authority level, included the location quotients, net worth / turnover data by sector, and historical growth rates by sector.

Beauhurst methodology

Beauhurst utilised its database of all five million active companies in the UK (including the high-growth subset) to collate metrics that matched the sectoral and/or geographic definitions of the reviewed cluster set. The metrics that Beauhurst provided can be broken into two main categories: sector-agnostic and sector-specific. Sector-agnostic metrics included figures like the number of companies incorporated in 2021 and the count of funds/organised investors headquartered in a local authority. Meanwhile, sector-specific metrics included the number of high-growth companies and the number of seed/venture-stage investments.

Scorecard methodology

Where possible the Midlands Engine Observatory, Beauhurst, The Data City and Wavteq have provided data at Local Authority level, with the rest provided at a regional (West/East Midlands or whole Midlands) level. Compiling the metrics for the scorecards at this level allows the Midlands Engine Partnership to provide detailed insights at a relevant geography to be useful to our Local Authority and Local Enterprise Partnership partners, for deeper interrogation of the findings of this project beyond the regional scorecards.

The scorecards themselves have been created by agglomerating these local authority level data to Midlands Engine area regional figures for each regional specialism – presenting key characteristics of each to build a full picture of their significance and strengths. Key clusters within the specialisms, and possible clusters (where review requirements are met), are reported on the scorecards for further partner interrogation, and useful insights and commentary around their investment trends have been included to provide a comprehensive description of each cluster.

[13]Measured through proxies of current employees, and higher and further education graduates in relevant fields.

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