

London's Economic Relationship with the Rest of the UK

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01

Purpose of the project

This research project was commissioned by the Greater London Authority to improve its understanding of the economic interdependencies that exist between London and the rest of the country.

Through this study, we ask ourselves how the sectors and industries in which London specializes interact with clusters of activity in other UK city regions and selected cities. Based on these sectoral flows, we are able to dig deeper into these interdependencies, studying the functional specializations that are at play across the UK.

Data limitations have traditionally restricted empirical research of supply chains and internal trade flows within the UK. This research project uses novel data sources such as the EUREGIO Input-Output tables and secure ONS data to add evidence as to how UK regions and cities – and the firms that are based within them – interact.

The project aims to assist the Greater London Authority in its aims to ensure London leverages its contribution to nationwide employment, productivity and growth and identifies opportunities for city-region collaboration where sectoral complementarities align.

02

Executive summary – EUREGIO

In the first section of the report, we analyse the EUREGIO dataset, the first time-series Input-Output tables for the European Union at a regional level. The dataset's format permits us to study the intermediated goods and services that flow in between different sectors and NUTS 2 regions in the UK, which leads us to the following conclusions:

1. Some 60% of intermediary output in London is produced in 3 high value sectors, mainly real estate, financial intermediation and non-market services;
2. In 2010, London's Intermediary outputs represented approximately 24% of the UK total. This share grew only slightly over the 2000-2010 period. Its growth can be explained by the fact that the production of intermediary goods and services decreased less rapidly in London than in other UK regions in the aftermath of the 2008 Global Financial Crisis;
3. The Welsh and Scottish Regions are much more integrated than any other region, perhaps due to their special administrative status. Approximately 72% of all intermediate outputs in each of these regions are consumed within the same region;
4. Intermediate output trade in other regions tends to support the literature review finding that regions tend to trade more with themselves or neighbouring regions due to reduced trade costs

(see section 3). Whilst the extensive academic literature shows that this is the case in between countries, our data suggest that this is also the case regionally within the UK;

5. London, due to its economic weight, defies that theory as it has strong trade linkages with regions that are furthest away from the capital such as Eastern Scotland;
6. Overall, it seems that London is consistently one of the largest consumers of intermediary goods produced in UK regions and exported to other regions. On average, the capital consumes 3% or more of intermediate outputs produced in each region of the UK. These seem to be mostly lower value goods and services. The data suggest that these goods and services may go through a 'value adding' mechanism in the capital as they are then exported as higher value goods and services to other UK regions;
7. Trade flows become even stronger when we look at specific sectors such as Financial Intermediation and Non-Market Services. For example, two regions, namely West Wales & The Valleys and Eastern Scotland, consume approximately 12% of all London's intermediary output in the financial intermediation sector, showing the strong links that exist between the capital and the regions.

Overall, these findings indicate that trade linkages in the

UK seem to be driven by city relationships, rather than merely regional linkages. This is supported by the academic findings presented in the literature review. Indeed, the specific regions that are London's intermediary output largest recipients seem to host some of the UK's largest cities (in terms of population and GVA). In turn, these cities are the main centres of economic activity in their respective regions. In other words, our findings reflect the predominance of cities in the economic makeup of the UK, which reflects the agglomeration effects explored in the literature review.

Our findings reflect the predominance of cities in the economic makeup of the UK.

3% €27bn 7-9%

Of intermediary outputs produced in different UK regions were consumed in London (on average in 2010, respectively for each region).

The value of London's Intermediary outputs consumed in the five regions in our sample in 2010. This is equivalent to 10% of total intermediary output produced in London and over 30% of all non-London consumption in the same year.

Of intermediary output produced by non-London UK regions in sectors such as construction and equipment were consumed in London in 2010.

02

Executive summary – BSD

In the second section of this report, we explore the intra-firm linkages that exist between firms located in the different cities in our selection (namely Greater London, Swansea, Leeds, Birmingham and Greater Manchester) through an analysis of the ONS' Business Structure Database. We find that:

1. In 2018, 20% of UK enterprises were headquartered in London. This highlights one aspect of the economic dominance of the capital, which is discussed in the literature review. We find that firms are highly integrated geographically in the finance and hotels and restaurants sectors.
2. Our evidence supports the findings in the literature review, that headquarters from different sectors will cluster in few large cities to enjoy the (larger) benefits of agglomeration for business services.
3. It is worth noting that firms in other UK cities are much more concentrated spatially than the cities in our sample. On average, some 98% of subsidiaries have their headquarters in the same city when looking at cities not included in our analysis. This suggests that the cities which trade most with London are also more integrated at a firm level.
4. Overall, across all sectors and all enterprises in the UK over the 2007-2018 period, the share of enterprises with subsidiaries has increased by 10%. Over the same period, this share has increased by 124% in the finance sector, while decreasing slightly by 20% and 15% in the real estate and hotel sectors

(from 29% to 23% and 24% to 21% respectively). Enterprises have therefore become more spread out geographically speaking – hiring more employees in other cities of the UK and setting up more subsidiaries across the country. This is certainly true for the financial sector.

5. Subsidiary employment in each city relies primarily on headquarters in the same city. On average, this ratio is estimated at 62%, being highest in London at around 83% and lowest in Leeds at around 31% (i.e. 83% of subsidiary employment in London have a HQ in London). This also means that approximately 40% of subsidiary employment relies on enterprises headquartered elsewhere in the UK. Again, while this is true for the cities in our sample, it does not appear to be the case for the rest of the country.
6. Subsidiaries headquartered in London employ, on average, two to three times more employees than subsidiaries headquartered somewhere else and situated in the same city.
7. When focusing on functions more specifically, we find evidence supporting the outsourcing of some activities from London to other cities in our sample. A few examples include the outsourcing of research activities to Edinburgh, data processing activities to Edinburgh, Leeds and Manchester, and finance and insurance activities to all cities in our sample. This indicates the importance of London-headquartered enterprises as key employers in the regions as well

as the dependence on the cities in our sample on activity in London.

Our findings highlight the importance of intra-firm linkages in driving economic activity in the UK and indicate that a substantial number of UK firms extend further than their headquarter location. This appears to be the case specifically in the finance and hotels and restaurants sectors, where important inter-firm linkages were found. The links explored in this study may well be useful in informing policies designed to help facilitate business growth and employment spillover from London to other city regions.

20% 124% 2-3x

of UK enterprises were headquartered in London in 2018

The share of enterprises with subsidiaries has increased by 124% in the finance sector over the 2007-2018 period, indicating the importance of the sector as a source of intra-firm linkages across the UK.

Subsidiaries headquartered in London employ, on average, two to three times more employees than subsidiaries headquartered somewhere else and situated in the same city

03 Literature Review

Literature Review

Summary

Agglomeration and specialisation forces have played a relevant role in the unequal distribution of economic activities across space. In the UK and elsewhere, these forces have favoured the clustering of high-skills intensive and high-added value service industries in large metropolitan areas, some times at the expense of peripheral areas and cities.

Recent theoretical contributions have shown that these forces are evolving thanks to a reduction in transport and communication costs, pushing cities away from sectoral specialisation towards increasing functional specialisation, with important consequences for the within-firm vertical integration in supply chains of tasks scattered across different cities.

[...] the reduction in transport and communication cost, [have pushed] cities away from sectoral specialisation towards an increasing functional specialisation, with important consequences for the within-firm vertical integration in supply chains of tasks scattered across different cities.

Functional specialisation and the integration of cities in a complex system of supply chains could have mutually beneficial effects for all participants, with potential positive externalities in terms of spatial economic rebalancing between cities.

This phenomenon could be particularly relevant for the UK, where economic divergence between London and the rest of the country means the UK experiences a significant level of economic inequality (depending on the measures used). Policy initiatives should take into account these recent evolutions, working along these forces rather than against them in order to achieve inclusive growth.

Arguably to date, minimal attention has been paid to the different

economic relationships or how interlinked UK cities are, or the identification of the main sources of positive externalities between the core and peripheries. This is mainly due to the lack of available data, but recent developments in urban economics and trade analysis have indicated possible interesting venues for future research, namely:

1. Analysis of latest available region input-output tables used in order to provide a more detailed analysis of the supply linkages between regions and industries across the UK, and;
2. Identification of functional specialisation across UK cities by using data on the location, industrial classification and economic growth of headquarters and subsidiaries.

We attempted to address both points through the analyses of the EUREGIO dataset and Business Structural Database (BSD) in this report..

Literature Review

Introduction

Despite industrial specialization and clustering continue to be important features of urban economies, over the last few decades there has been a shift in the dimension along which cities specialise, from a sectoral specialisation to a functional one. In particular, cities are increasingly distinguished by specialisation in their tasks (i.e. in managerial services versus production or R&D processes and so on) rather than by their industrial specialisation.

This ongoing shift in the specialization process is reflected as well in a change in the related theoretical paradigm in the urban economics literature, starting from the traditional agglomeration and urbanization economies proposed in the last century to the more recent model of new economic geography and trade.

In order to understand the implications of cities' functional specialization and the development of integrated systems of cities, we critically assess several strands of the literature, including economic geography, firms' organization, urban economics and trade theory. We use this foundational literature as a basis to attempt to build an up-to-date theoretical framework and to discuss its main predictions.

Theoretical Framework

Specialization has always played a central role in economic and geography theories in order to explain economic growth and the development of interconnected urban systems. Since the predictions of Smith's (1776) labour division and specialization and of Marshall's (1890) agglomeration forces, the economic theory has recognised that decreasing spatial transaction and trade costs have given rise to growing economic specialization of regions and cities.

As a consequence of both centripetal and centrifugal forces, urban

specialization emerges and evolves from a complex interplay of economic externalities, favouring the uneven spatial distribution of economic activities across cities (Krugman 1991; Krugman and Venables 1996; Henderson 1997; Fujita et al. 1999; Duranton and Puga, 2001; Desmet and Fafchamps 2005). However, while most of the previous studies on these topics focused on the spatial distribution and agglomeration of industries as the primary manifestation of regional specialization, and the relative inter-regional trade in final good or service produced, a growing body of literature has started looking at the spatial and organizational fragmentation of functions across countries and cities, highlighting the growing specialization in activities and tasks performed within a given industry or firm (Duranton and Puga, 2005; Brunelle, 2013).

The rapid adoption of new technologies reducing distances and spatial transaction costs, has favoured the functional fragmentation of firms' production processes, resulting in new spatial divisions of functions in parallel with industrial specialization across countries and regions (Gereffi et al., 2005).

Agglomeration, Trade and the Location of Economic Activity

Economies of agglomeration have been extensively analysed in the urban economics literature in order to understand the cost savings effects arising from urban agglomeration and to explain the tendency of firms to locate near to each other. Most of this literature has focused its attention on the concepts of economies of scale and network effects in order to understand the main factors driving industrial agglomeration and specialization. Starting from the seminal Marshall-Arrow-Romer model (Glaeser et al., 1992), agglomeration economies studies have shown how by clustering together, firms within the same sector could significantly reduce their costs of production, mainly through the presence of specialised suppliers, greater specialization and division of labour and the flow

and cross-fertilization of knowledge and ideas. Even at the cost of increasing competition, there would be advantages for agglomerated firms, since the cluster would attract more suppliers and customers than a single firm could achieve alone.

[...] agglomeration economies studies have shown how by clustering together, firms within the same sector could significantly reduce their costs of production, mainly through the presence of specialised suppliers

The existence of agglomeration economies is central to the explanation of how cities specialise in certain sectors and plays a key role in explaining how increased productivity related to the concentration of economic activity in cities fosters their development and growth (Combes and Gobillon, 2015). In particular, not all sectors benefit from agglomeration to the same extent. Evidence suggests that it is service industries, particularly high-skilled service industries, which benefit most from agglomeration. For example, the effect of agglomeration is over three times as high for an industry such as finance and insurance as it is for manufacturing (Cheshire et al. 2014). Nor is the effect necessarily consistent across all large metropolitan areas. Glaeser and Rensinger (2010) showed that for metropolitan areas in the United States, agglomeration impacts were far less pronounced for cities with a large proportion of low-skilled workers than for cities with a higher proportion of high-skilled workers. In the UK, that is increasingly reliant on services rather than manufacturing, this will clearly have a bigger impact on the level of rural/urban disparity than would otherwise be the case.

Evidence suggests that it is service industries, particularly high-skilled service industries, which benefit most from agglomeration

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Agglomeration economies however should not be considered as static phenomena but are instead characterised by a dynamic evolution driven by self-reinforcing forces. In fact, as new technologies have created enormous potential and realised efficiency gains through the geographic splitting and relocation of production across national borders, the same phenomenon has taken place within national borders re-shaping the allocation of economic activities across cities.

In an economy like the UK that is increasingly reliant on services rather than manufacturing, [agglomeration forces] will clearly have a bigger impact on the level of rural/urban disparity

This approach to understanding the spatial distribution of economic activities within national borders has started to be analysed by the “New Economic Geography” (NEG) theories using previous models of international trade, emphasising the interaction of supply chain and demand linkages (Krugman, 1991; Fujita et al. 1999).

NEG theories predict that if a firm expands or locates in a given city, it can increase demand for the goods and services produced by firms elsewhere and reduce their costs because of increased competition. But firms will also compete for the customers of firms in other cities. So in theory there can be positive or negative links between different cities, based on the trade costs incurred in moving inputs of production between cities. If the agglomeration economies in one city are particularly strong, to the extent that people migrate or commute to the growing city from other cities, it will appear as if the former is benefiting at the expense of other cities. When trade costs fall due to technological development of infrastructural development, economic activities tend to agglomerate in “core” regions where firms can enjoy scale economies and cost saving due to proximity to larger markets and better intermediate inputs.

On the other hand, this integration also exposes the less competitive firms in “peripheral” regions to intense competition from firms in “core” regions which will be serving the peripheral market with trade, posing threats to the economic development of lagging regions and creating winners and losers from spatial integration (Fujita et al. 1999). This is particularly relevant for high-skilled intensive firms, which could sell their products to many different markets outside the local area, and so are “footloose”, meaning they could locate anywhere. However, they do require large markets, knowledge and high-skilled workers, and therefore they cluster in areas with good access to all of these things. These theories help explaining the reasons why many professional services and other knowledge-intensive service firms locate in large metropolitan areas, to access a large local market, a pool of high-skilled graduates and tap into the local knowledge base (Muller and Zenker, 2001; Meliciani and Savona, 2015).

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Despite the theoretical predictions of these seminal models on the geographic location of activity between cities, recent studies have started analysing how new technological developments, especially in the ICTs fields, have pushed firms towards a further geographical fragmentation of production within their boundaries, leading to a joint location of the production and resource mix across different cities, based not on “sectoral” but on “functional” comparative advantages. This new approach does not displace the arguments based on agglomeration economies and the self-reinforcing dynamics that result. However, it offers a potentially richer approach to the analysis of economic geography and the interactions between different functions across cities (Coyle and Rosewell, 2014). This new strand

of economic geography literature tries to bridge together the traditional agglomeration economies studies and the insights from the Product Life-Cycle and the Global Value Chains (GVCs) literatures.

From this strand of the literature, one of the main perspectives about specialization over space is derived from the product life-cycle theory (Vernon, 1966), which stipulates that new products will emerge where local demand for novelty is the highest and where technology is the most advanced. As products become standardized, production shifts towards second tier markets where production costs are lower. Drawing on product-cycle theory, Henderson (1997) notes that larger cities have a product-incubating function. In contrast, product-cycle theory suggests that smaller centres will specialize in the production of standardized goods. When products are fully developed and production processes standardized, mass production will move out of the urban core. The constant crowding out of routine-like activities away from the urban core in turn reinforces the role of cities as centres of innovation.

However, the international trade literature suggests that specialization patterns may not be straightforward. Much of the literature is concerned with analysing the increasing complexity of the organization of production. Complexity involves the international unbundling of production and the spatial clustering of given segments of the production process. Krugman et al. (1995) note that the international fragmentation of value chains is one of the chief tendencies characterizing modern international trade.

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While product-cycle theory focuses on the location and relocation of the making of products, value chain decomposition describes the production of goods through a number of different stages scattered across several locations based on their comparative advantage (Krugman et al. 1995). The economic integration of cities and regions around the world has resulted in two seemingly opposite, but in reality complementary, directions: a growing fragmentation of activities and a process of spatial–functional agglomeration (Dean et al. 2007; Dicken 2007; Hummels et al., 2001; Storper 1997). Through processes such as offshoring, outsourcing, and merging, firms have increasingly adopted localized multi-unit structures where similar units agglomerate in the same places reflected both in “global value chains” (Gereffi et al., 2005; Sturgeon and Gereffi 2009) and the spatial unbundling of the firm at the international level.

The economic integration of cities and regions around the world has resulted in two seemingly opposite, but in reality complementary, directions: a growing fragmentation of activities and a process of spatial–functional agglomeration

Just as new technologies have created enormous potential and realised efficiency gains through the geographic splitting up and relocation of value chains across national borders, they will have done the same within national borders. This ‘task-based’ approach to understanding supply chain decisions and productivity growth has begun to be analysed in terms of international trade, and there is a growing interest in the urban economics literature regarding its implications for national economic geographies.

From Sectoral to Functional Specializations across the Cities System

Over the last few decades there has been a shift in the main dimension along which cities specialise, from a specialisation by sector to a specialisation by function. Urban economists have traditionally paid much attention to the specialisation of individual cities in a small number of sectors (Henderson, 1987; 1988).

While specialisation continues to be an important feature of the urban system, cities are becoming increasingly distinguished by their functional specialisation (i.e. in management and services versus production) rather than by their sectoral specialisation. Growing evidence suggests that functional fragmentation and specialization are taking place at a regional or urban level (Kim, 1999; Bade et al., 2003). Functionally distinct segments within value chains would increasingly cluster in specific cities and regions, fostering functional specializations and potentially decreasing sectoral specializations. The production of final products and services typically requires a number of functions to be performed, and there might be spatial differences across cities in the efficiency with which such functions can be supplied, resulting into a pattern of cities with different functional comparative advantages (Davis and Dingel, 2019).

Functionally distinct segments within value chains would increasingly cluster in specific cities and regions, fostering functional specializations and potentially decreasing sectoral specializations

The concept of “function” has been developed initially in the literature at a rather aggregate level, distinguishing between headquarters and production functions within the firm operations, as developed in some of the literature on foreign direct investment (Helpman, 1984; Markusen, 2002) and other works in the urban

economics context (Duranton and Puga, 2005; Rossi-Hansburg et al. 2009). Further studies have analysed functions and tasks at a much finer level, often considering it as a much narrower stage of the production processes, and modelling them as a continuum (Grossman and Rossi-Hansburg 2008, 2012; Autor et al. 2013). Alternatively, functions could be synonymous with occupations, dividing workforce into production “blue-collar” and non-production “white-collar” workers (Gervais et al., 2018).

The increased specialisation in tasks in each location would allow a growth in productivity with a corresponding surge in trade in intermediate goods and services across a system of cities. The decline in the cost of communications and transactions experienced in the last decades has made it substantially cheaper for firms to coordinate complex production activities across different locations, enabling production to be divided into different tasks or functions, each benefiting from increased specialisation. Earlier findings have already highlighted the importance of specialisation in urban labour markets, showing evidence that especially in professional services occupations, there is a growing specialisation in cities undertaking a narrower range of activities (Puga, 2010). More generally, the role of generation and exchange of tasks and ideas is emphasized by Davis and Dingel (2019), who develop a “system of cities” model in which costly idea exchange is the agglomeration force. Rossi-Hansberg et al. (2009) developed a model in which firms choose the locations of their headquarters and production facilities, arguing that the increased separation of these locations accounts for observed changes in patterns of residential and business activity across cities.

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Several theoretical contributions have tried to model the relationship between the distribution of tasks and sectors across locations, featuring elements from economic geography, multinationals' vertical integration, urban economics, and external economies of scale, in order to understand the implications of this distribution of tasks across space for the overall economic performance of system of cities.

In their seminal paper, Duranton and Puga (2005) develop a theoretical framework to explain the transformation in cities' specialisation, from sectoral to functional specialisation, focusing in particular on the changes in firms' internal organisation. In particular, they highlight the increasing separation of management and production facilities within firms, and the reliance on outside suppliers at the arm's length. Focusing in particular on the first aspect, the authors analyse under which conditions firms gain from integrating headquarter and production in a single location or from becoming a multi-location firms with headquarter and production establishments in different cities. This decision is driven by the fact that cities with a wider range of business service suppliers are less costly places in which to operate a headquarter, while sharing intermediate suppliers by production plants reduces productions costs in cities with more same-sector suppliers. Their model predicts that when the costs associated with managing production from a remote headquarter are high, firms remain integrated, pushing towards the specialisation of cities by sectors. On the contrary, when managing costs decrease, firms become multi-plants placing their headquarters in cities with abundant business service employment while their production plants in cities with a greater same-sector specialisation. As a result, headquarters from different sectors will cluster in few large cities to enjoy from the larger benefits of agglomeration for business services, while manufacturing plants, for which localisation economies are weaker, would cluster in smaller

separate cities.

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Anas and Xiong (2003) explain specialization in tasks by focusing on the intercity transport costs for manufactures and services. They extend existing models first by allowing differentiated intermediate goods and services to be tradable among cities, introducing in this way pecuniary links among cities and positive intercity production externalities. Secondly, they assume that the intercity movement of final goods and intermediate services incur different transport costs, the first based on physical movement, the latter through telecommunication or face-to-face contact. As a consequence, the ICT revolution improved intercity information flows, making services transport cost relatively lower in respect to manufacturing goods. Their model predicts that a decrease in manufacturing goods transport cost favours the specialization of cities, while decreases in intercity services transport cost lead to the diversification of cities. In addition, they predict that diversified cities are particularly favoured in larger economies, when there are pecuniary spillovers among cities, based on their specialization or diversification.

The ICT revolution improved intercity information flows making services transport cost relatively lower in respect to manufacturing goods

Similarly, Venables (2017) has analysed how improvements in communications affect the distribution of activities between cities. In particular, the model predicts that better inter-city communications enable cities to specialise in production of particular tasks, mainly

through economies of scale at the city-task level (Fujita et al. 1999; Tabuchi and Thisse, 2006; Grossman and Rossi-Hansberg, 2012). Clusters of service tasks would be particularly relevant for business services such as finance, law, advertising, and media for which agglomeration forces are stronger, enabling firms in one city to develop their own specialisms and import the specialisms of other cities, raising productivity in both cities if localisation economies are at play.

Finally, Gervais et al. (2018) model the interaction between fragmentation costs, the function intensity of different sectors and tasks efficiency differences between cities, trying to understand why firms in some sectors tend to integrate production in one place, while in others firms fragment it between cities. In addition, they investigate how changes in fragmentation costs, such as communication or transport improvement would then affect the production structure and economic growth of cities. Their model includes identical workers who are mobile between jobs within and between cities, many final sectors produced using two functions and free trade in final products between cities embedded in an integrated market. The authors introduce Ricardian differences in the productivity of functions between cities, showing that by reducing fragmentation costs, firms would fragment and causes cities to move from sectoral towards functional specialisation. However, the authors stress how functional comparative advantage would more likely lead to economies of scale which are external to the firm and sector, occurring at the city-function level. Thus, economies of scale large enough to overcome fragmentation costs are achieved only if a wide range of sectors fragment, pushing towards the functional specialisation of cities. As a result, the model predicts that welfare gains from reductions in fragmentation costs would be particularly large if they induce spatial reorganisation and the move from sectoral to functional specialisation.

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Academic Empirical Evidence

Several studies have tried to test empirically the theoretical predictions reviewed above, providing evidence of the increasing shift from specialization in industries to specialization in task across cities and on the implications of this phenomenon for cities economic growth and regional inequalities.

In one of the first empirical evidence on this issue, Kolko (1999) using historical data on US cities has shown how over time there has been a growing concentration of manufacturing functions in small and medium-sized cities and of business services in larger cities, to the extent that the ratio of manufacturing to business service employment is now 4.5 times higher in non-metropolitan areas than in metropolitan areas with over 2.5 million people.

[in] US cities [...] there has been a growing concentration of manufacturing functions in small and medium-sized cities and of business services in larger cities

Analysing employment in the manufacturing sector, Duranton and Puga (2005) offer evidence of a decreasing concentration in US cities, overshadowed by an increasing functional urban specialization, defined as the ratio of managers to blue-collar workers, where large cities systematically showed growing ratios of managers to blue-collar workers while smaller and medium size cities conversely had falling ratios. Using the same methodology, Bade et al. (2004) note the increasing functional specialization of German cities, where ratios of R&D to blue-collar workers increased in larger cities while decreasing in smaller places. For Canada, Brunelle and Polèse (2008) show that functional fragmentation is not limited to the manufacturing sector, but involves also the energy industry. Michaels et al. (2019) provide new evidence on the detailed tasks undertaken by workers in different urban areas over a long

historical time period in the United States. Their findings show an increase in the employment share of interactive occupations within sectors over time that is larger in metropolitan areas relative to smaller urban centres. The authors demonstrate that this phenomenon is indeed driven by improvements in transport and communication technologies, highlighting a change in the nature of agglomeration over time toward an increased emphasis on human interaction intensive tasks in larger metropolitan areas.

Other studies have investigated how sectoral and functional specializations are both occurring at the urban level using occupational data, but exhibiting different patterns (Barbour and Markusen, 2007; Koo, 2005). For instance, Barbour and Markusen (2007) find that occupational specialisations across cities in California diverged markedly from sectoral specialisation only for knowledge-intensive occupations while not varying substantially for others. Along this line, Hendricks (2011) observes that 80% of inter-urban skill gaps are because of within-industry variations, using the ratio of skilled to unskilled labour. An explanation may lie in the increasing spatial division of functions within industries.

Similar evidence has been found in the literature looking at value chains and intra-firm trade. For instance, Beugelsdijk et al. (2009) have offered evidence of a growing vertical specialization of the value chain within US affiliates, characterised by decreasing inter-firm flows as opposed to growing intra-firm trade. Similarly, Defever (2006) observes increasing functional fragmentation in Europe as well, where local wages and education levels have a positive effect on headquarter function but a negative effect on the location of production facilities. The author also highlights the relevance of sectoral specialization in attracting specific functions: while production facilities tend to be associated with a strong presence of same-sector establishments, service functions are not affected by same sector co-location.

[...] the relevance of sectoral specialization in attracting specific functions: while production facilities tend to be associated with a strong presence of same-sector establishments, service functions are not affected by this

Furthermore, by focusing on the location of headquarters, Shilton and Stanley (1999) have analysed the location of over 5,000 headquarters in the US, finding that 40% of them are clustered in just 20 major urban counties. A similar trend has been identified in Japan, where headquarters are increasingly concentrated in Tokyo and Osaka, while mass-production activities have been gradually displaced outside the major metropolitan areas (Fujita and Tabuchi, 1997). Other empirical studies have found patterns in the location of headquarters and business services that match the predictions of previous theories. For instance, Aarland et al. (2007) highlight how US headquarters have a strong propensity to outsource business services, which account on average for more than two thirds of their wage bill. This is confirmed by Ono (2003), confirming that the propensity of firms to rely on business services outsourcing increases with the size of the market surrounding them. In addition, Davis and Henderson (2008) using US Census data have shown that headquarter location is mostly driven by the existence of a large and diverse local supply of business services rather than by the presence of a large number of other headquarters, finding evidence that agglomeration forces linking headquarters and business services are much larger relative to those estimated for manufacturing

Literature Review

.This is corroborated by the findings of Strauss-Khan and Vives (2009), showing how this is a dynamic process where headquarters move away from locations with relatively few other headquarters and business service producers towards locations with a greater presence of both. Similarly, Duranton et al. (2014) have previously considered the effects of interstate highways on the level and composition of trade for US cities. Giroud (2013) has instead shown that within-firm proximity to plants makes it easier for headquarters to monitor plants, increasing plant-level investment and productivity when new airline routes reduce travel time between headquarters and plants in the US.

[...] headquarters move away from locations with relatively few other headquarters and business service producers towards locations with a greater presence of both

Finally, a more recent strand of the literature has tried to identify the causal implications of this emerging phenomenon for firms' productivity, cities' economic growth and regional inequalities. For instance, Bernard et al. (2019) have examined the relevance of buyer-supplier relationships across different cities for overall firm performance. First, they develop a theoretical model in which firms outsource tasks and search for suppliers across different cities within the same country. Even within a country, geographic proximity plays an important role in the matching of suppliers and customers, since for firms most linkages are local. As predicted in the previous models, lower search and outsourcing costs lead firms to search more and find better suppliers, which in turn drives down the marginal costs of production. Secondly, they test their theory by exploiting the opening of a high-speed train line in Japan, which lowered the cost of passenger travel but left shipping costs unchanged, and using a comprehensive dataset on firms' buyer-seller linkages. The results show a significant improvement in firm performance as well as creation of buyer-seller linkages for firms

near the new stations, suggesting that face-to-face interaction between individuals across the supply chain improves firm outcomes because firms are more likely to find a better supplier and/or because firms work more efficiently with their existing suppliers across different cities.

Even within a country, geographic proximity plays an important role in the matching of suppliers and customers, since for firms most linkages are local

Literature Review

The UK Context

In this section we summarise the main findings and evidence about the topics explored on previous pages concerning the UK system of cities. One of the main debates about the British economy in the last decades has been focused on the growing spatial inequality in the distribution of economic activities across cities and regions, in particular differentiating between London and the rest of the country (Martin et al. 2016). Decades of productivity divergence among British firms, and an increasing concentration of highly productive businesses and industries in south east regions of England, mean the UK experiences a not insignificant degree of regional inequality (Esteve et al., 2019).

This trend has been coupled with a decline in innovation and infrastructure spending in peripheral areas, a concentration of knowledge and market shares in fewer firms and industries, weakening of local government, and a rapid growth of the financial and business service sectors mainly clustered in the capital. London's rapid growth following the great recession of the late 2000s has prompted further debate about the role it plays in the UK economy. London makes a much larger and growing contribution to the UK economy relatively to its size, and it accounts for around 17% of jobs, 23% of businesses and 24% of economic output (ONS, 2018; Centre for Cities, 2019). London shows a much higher productivity than the rest of the UK, 18% higher than the UK average and even 43% higher than Sheffield (Centre for Cities, 2019). Agglomeration economies and the positive spillovers from locating in larger cities played an important role in explaining these results, since economic mass is clearly associated with higher productivity. Skills are another important factor, and transportation played a role as well, although smaller in magnitude (Coyle and Rosewell, 2014). Furthermore, these divergences between London and the rest of the

UK have grown over time, due to the shift from manufacturing to services, where agglomeration forces are stronger, and to the impact of the ICT revolution.

Agglomeration economies and the positive spillovers from locating in larger cities played an important role [...]. These divergences between London and the rest of the UK have grown over time, due to the shift from manufacturing to services [...] and to the impact of the ICT revolution

Several voices in the political debate claim that London has become too dominant, hindering the ability of other cities to achieve success, calling for a general rebalancing of the UK economy away from the capital (Esteve et al., 2019; UK2070 Commission, 2019). On the contrary, many argue that London is critical for the UK economy, following the arguments previously analysed of spatial specialisation and agglomeration (Ormerod et al. 2006), and plays a pivotal role in attracting foreign investment and distributing positive spillovers to the rest of the UK through supply linkages, knowledge flow and fiscal redistribution (Lucci and Hildreth, 2008; Centre for Cities, 2014; GLA Economics, 2014; BEIS, 2018). Several policies have been proposed in order to tackle these increasing spatial inequalities, focusing mainly on the decentralisation of the UK economy in terms of economic activity, political governance, knowledge, finance, and capital in the UK (Esteve et al., 2019; UK2070 Commission, 2019). However, these policy interventions should be designed in such a way to work along with the agglomeration and specialisation forces rather than against them in order to re-balance economic growth across UK cities.

London is critical for the UK economy, following the arguments previously analysed of spatial specialisation and agglomeration [...] and plays a pivotal role in attracting foreign investment and distributing positive spillovers to the rest of the UK through

supply linkages, knowledge flow and fiscal redistribution

Several British cities have experienced significant population growth in the last 20 years, not only London, but also Birmingham, Manchester and Newcastle after long periods of declining population in the 1990s. However, this phenomenon has not been uniform across the country.

The improvement in the economic performance of some British cities is essentially driven by two interconnected phenomena. First, the structure of the economy has shifted towards activities that tend to benefit more from urban locations, driven by both the shift from manufacturing to services industries and by shifts in tasks within these sectors. Second, cities have also become more important as places of consumption (Overman, 2013). These structural shifts have tended to benefit mainly skilled workers, triggering a self-reinforcing process where successful cities attract higher skilled workers, who in turn have made those places more successful. This is confirmed by several findings in the literature, for instance showing that area differences in wages are mainly driven by “people effects”, the kind of people that live in an area, rather than “area effects”, or where people live (Gibbons et al. 2013). This research suggests that wage disparities across local areas in Britain are pronounced and very persistent, but that many of these disparities are driven by “people” rather than “places”. In this sense, policies aiming at encouraging the specialisation of cities in different tasks, and the distribution of people across different places based on their skills, could be beneficial for inclusive growth in London and other main UK urban centres as an integrated network of cities.

[...] policies aiming at encouraging the specialisation of cities in different tasks, and the distribution of people across different places based on their skills, could be beneficial for an inclusive growth of London and other main UK urban centres

Literature Review

Previous studies have looked at the UK system of cities as a set of different specialisations, for instance considering London focused on business services and finance, with other cities specialising in manufacturing industries (Coyle and Rosewell, 2014). However, from the above review of the existing literature, we know that the last decades have seen a structural shift in the industrial structure of the economy, where cities tend to specialise in tasks and functions within industries, forming supply chain relationships between integrated cities. In this regard, we could consider the UK as a system of cities where London specialises in headquarters and business management services, while other UK cities focus on other interlinked manufacturing and services functions. In this regard, we should rethink the frequent assumption that there is harmful competition between London and other UK cities, and instead focus on whether further positive externalities could emerge from the economic linkages between London and other UK cities (Coyle and Rosewell, 2014).

[...] we should rethink the frequent assumption that there is a harmful competition between London and other UK cities, and instead focus on whether positive externalities could emerge from the economic linkages between London and other UK cities

Several studies have shown that UK cities could grow faster benefiting from positive spillovers if they collaborate with each other in integrated and improved supply chains (Coyle and Rosewell, 2014). In this sense, the system of UK cities is still under-performing its potential, in particular considering the size gap between London and other cities. In this regard, the UK is an outlier in international terms, since its second tier cities are relatively small to the capital size, where according to the Zipf's law the second largest city should be half the size of the capital, the third biggest city should have a third of the capital's population, and so on (Overman, 2013; Arshad

et al. 2018).

the system of UK cities is still under-performing its potential, in particular considering the size gap between London and other cities

In addition, London's status as a global city could be highly beneficial for the rest of the UK cities network, in particular in the context of the globalised world economy and how London could play an important role in linking other UK cities and the rest of the world. Outside finance, which is largely centred on London and its links to the other major global financial centres, there are already examples of existing growing trade and foreign investment linkages, for example in education, R&D activities or professional services and through the attraction of inward FDIs mainly establishing the regional HQ in London, but then opening new plants and offices across different UK cities (Crescenzi et al., 2017; Ascani and Iammarino, 2018; Bosetti and Brown, 2019).

Unfortunately, there is still very limited evidence about the economic linkages between London and the rest of the UK's cities. Limitations on the availability of data at the city-industry level mean that the empirical literature on UK cities interlinkages is still relatively small.

For instance, there is limited data available on supply chains at the regional level or on inter-regional trade flows within the UK. London does not just trade internationally, but there are significant trade flows with other UK regions. The more international trade London engages in, the more trade there is likely to be for the rest of the UK as well. Few exceptions that tried to estimate UK inter-regional trade flows include the survey-based data on intra-UK linkages commissioned for the Manchester Independent Economic Review in 2009, which however provides only a snapshot at a given point in time and at a relatively agglomerated level in terms of industries and

regions (Overman et al., 2009).

The more international trade London engages in, the more trade there is likely to be for the rest of the UK as well

Similarly, GLA Economics (2014) have tried to estimate London's trade balance with the rest of the UK, relying on annual national input-output tables published by the ONS and the distribution of the GVA per industry for London and the rest of the UK. This exercise provided an illustrative view of interregional trade between London and the rest of the UK, highlighting how London imports a significant level of goods and services from the rest of the UK, for instance showing how office developments in central London generate almost twice as much GVA and jobs outside London as they do inside London (GLA Economics, 2014). However, this analysis is based on very strong assumptions about the allocation of supply linkages and makes the distinction only between London and the rest of the UK as a whole. Recently, new input-output database with regional detail for Europe have been released, providing some evidence about supply linkages between UK regions as we explore in the first section of this report, but again at a relatively aggregated level both in terms of regions and industries (Thissen et al., 2018).

Literature Review

Potentially, newly developed techniques integrating national input-output tables, spatial location of supply and demand and regional trade flows across regions could be used in order to provide a much more granular analysis of the supply linkages between cities and industries across the UK, as already shown using US data (Boero, 2018).

The most reliable and available data on UK cities linkages at the moment is through the use of the transport system where detailed time series are available, although they are still limited and with little information on trip purposes (Hincks et al., 2018; Gibbons et al., 2019; Fingleton and Szumilo, 2019). However, these data would give only information regarding the commuting patterns between cities, with limited meaningful economic interpretation for the more general economic relationship between cities.

Other attempts have been made in order to evaluate the economic linkages and possible spillovers between London and other UK cities. Following the previous economic theory reviewed above, one possible way to analyse these relationships is to look at the within-firm vertical integration between headquarters and subsidiaries located across different UK cities. Ideally, information about intra-firm trade would be used, but data about this phenomenon are very limited. The Centre for Cities (2014) has tried to understand if London's performance correlates with that of other cities and regions in the UK by ranking UK cities based on their proportion of private sector employment linked to London-headquartered businesses. For the highest – mainly in the greater South East, York, Cardiff and Southampton – this accounts for around one in five private sector jobs, while the lowest is the North West but still significantly positive. However, this does not answer the causation question. Firms may site their headquarters in London because of its dominance, rather than the other way around. Nevertheless, these figures demonstrate

the existence of significant economic links between London and other cities.

[...] one possible way to analyse these relationships is to look at the within firms vertical integration between headquarters and subsidiaries located across different UK cities

Similarly, Taylor et al. (2009) have analysed the relationship between English core cities and the Northern Powerhouse through a qualitative case-study analysing the commercial relationships of multi-city law firms. This sector has been considered as an interesting case-study for the more general industry of professional services, particularly relevant in the contemporary UK space economy. Analysing the location strategies of law firms confirm the increasing relevance of the Northern Powerhouse and core cities ties as part of a larger UK metropolitan space of flows. This analysis identifies hints of a rebalancing between London and other UK metropolitan centres, in particular the emergence of a Manchester polycentric mega-city region. In addition, the authors highlight how London still plays a dominant role as a global city, but a mutuality between London and provincial cities is beginning to emerge replacing past negative dependency relations (Taylor et al. 2009; 2011).

Furthermore, in a report on the relationship between London and the rest of the UK, GLA Economics (2014; 2019) has analysed the main economic forces driving the process of specialisation and agglomeration which have led to the current industrial structure in London and the rest of the UK. In particular, this report assesses the positive economic relationship between growth in London and other parts of the UK by examining the overall correlation between employment and turnover growth rates in London and elsewhere in the UK. Overall, the report finds evidence of a positive correlation between London and other UK regions' growth rates, providing

robustness tests for this result by using alternative sources and methodologies. Moreover, results show that, even when excluding London, other UK cities and regions have experienced a strong level of economic growth between 1999 and 2011 in comparison to foreign competitors such as second-tier cities in other EU countries. These findings identify significant positive economic relationships between London and other UK regions, suggesting that as London grows, so the rest of the UK does.

These findings identify significant positive economic relationships between London and other UK regions, suggesting that as London grows, so the rest of the UK does

Finally, recent attempts have tried to map knowledge flows between industries scattered across cities and regions in the UK in order to identify a potential source of positive externalities between London and other UK cities. For instance, the Welsh innovation map performed by NESTA has used data on R&D collaborations, patents citations and professional meeting platform discussions to build visualizations of local networks and knowledge transfers (NESTA, 2017). Similarly, it is possible to measure proxies for knowledge flows using data from website platforms and social networks as done by NESTA (2019) mapping spatial diffusion of knowledge flows between tech start-ups in the UK using data from the online platform Meetup, identifying "topic networks" between meet-ups across space. Moreover, it is possible to exploit publicly-available data about R&D projects publicly-funded by UK Research Councils combined with data on patents application in order to proxy for the spatial diffusion of knowledge and technological innovation (Vanino et al. 2019).

04 EUREGIO Analysis

In this first section of the report, we analyse the EUREGIO dataset, the first time-series Input-Output tables for the European Union at a regional level. The dataset's format permits us to study the intermediated (non-finished) goods and services that flow between different sectors and NUTS2 regions in the UK.

Through this analysis, we are able to:

1. Determine the sectors in which each UK NUTS2 region has a relative comparative advantage, in comparison to the UK's average sectoral makeup;
2. Identify the five NUTS2 (and NUTS1) regions outside of London that are the capital's largest recipients of intermediate goods and services;
3. Repeat this exercise for the five regions that were identified in order to understand the largest recipients of intermediate goods and services for

each of these five regions and in the sectors in which they specialize.

These three steps give us an important indication of the trade relationships between London and the rest of the UK (in terms of intermediary goods) and show that while most trade is geographically concentrated within each region, London remains a key recipient of other UK regions' outputs. Trade flows become even stronger when we focus on specific sectors such as Financial Intermediation and Non-Market Services.

We present a summary of the findings at the end of this section.

EUREGIO Database

Database Description

The EUREGIO database is the first time-series Input-Output tables for the European Union at a regional level. The dataset has been produced and published in 2018 by researchers led by the Netherlands Environmental Assessment Agency (PBL¹).

Traditionally Input-Output tables have been constructed at country level and “the construction of such tables with regional detail is still in its infancy” (Thissen et al., 2018). The value of the PBL-led team’s study is therefore that it allows us to analyse sectoral linkages between all NUTS2 regions in the European Union between 2000 and 2010.

Construction of input-output tables is not trivial and we suggest referring to the original EUREGIO working paper for methodology details. In general, it uses three key sources of data and a mix of estimation and optimization procedures:

- World Input-Output Database (WIOD) realised in 2013;
- Eurostat regional accounts (2014 release);
- PBL regional trade data (Thissen et al., 2013).

As an Input-Output table the EUREGIO database describes how sectoral inputs are used to produce further products and satisfy final demand. In other words, it provides a picture of the flows of products and services in the economy, providing measurement of the composition of uses and resources across institutional sectors. Analysis of this dataset permits us to study the interdependence of industries in the economy in a given year.

The EUREGIO database is split into two main tables:

1. An **Intermediate demand table**, that allows us to study differences in how intermediate (or non-finished) goods and services flow between regions and sectors. For example, the dataset permits to study the total value of goods and services exported from the textile sector in Greater Manchester and used in the automotive industry in London to produce a final (or finished) product, and;
2. A **final demand table**, that presents the value of final outputs of a specific sector in a specific region and consumed by mainly households and public sector organizations in another region. For example, this table provides the value of final (finished products) automobiles exported from the West Midlands and consumed by households in Eastern Scotland.

EUREGIO highlights:

14

High Level
Sectors

37

NUTS2 regions in
the UK

2000-
2010

Period included in
EUREGIO

Database Limitations

While the EUREGIO dataset permits analysis at a more granular level geographically speaking, data remain highly aggregated at a sectoral level. As we describe in the following pages, the EUREGIO database is based on a simplified version of the 2002 European Classification of Products by Activity (CPA) and groups sectors in fourteen high level groups. This classification makes it difficult to draw rigorous conclusions when analysing sectors. For example, the category non-market services include a large range of services from activities of trade unions to veterinary activities and defence activities. The level of aggregation therefore limits the ability to infer robust conclusions from the data analysis. For a more in depth description of each sector, please refer to the following [link](#).

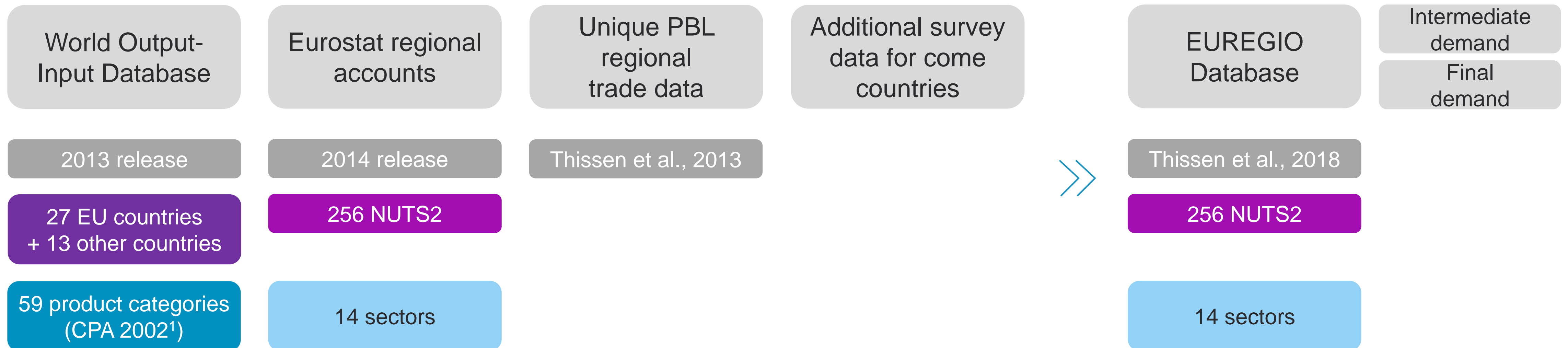
Furthermore, the EUREGIO dataset was only constructed for the years 2000 to 2010 inclusive, making the dataset relatively outdated.

Although the dataset presents these limitations, it is much more detailed than any other data used for the purpose of inter-regional trade analysis. Moreover, the analysis of the EUREGIO dataset is used to inform the more in depth analysis conducted using ONS’ Business Structure Database (BSD) in Section 5. The EUREGIO dataset is therefore highly informative in nature and is complemented by more granular BSD data later on in this report.

¹ PBL stands for *Planbureau voor de Leefomgeving*, the name for the Netherlands Environmental Assessment Agency.

Data sources used in EUREGIO study

EUREGIO dataset sources

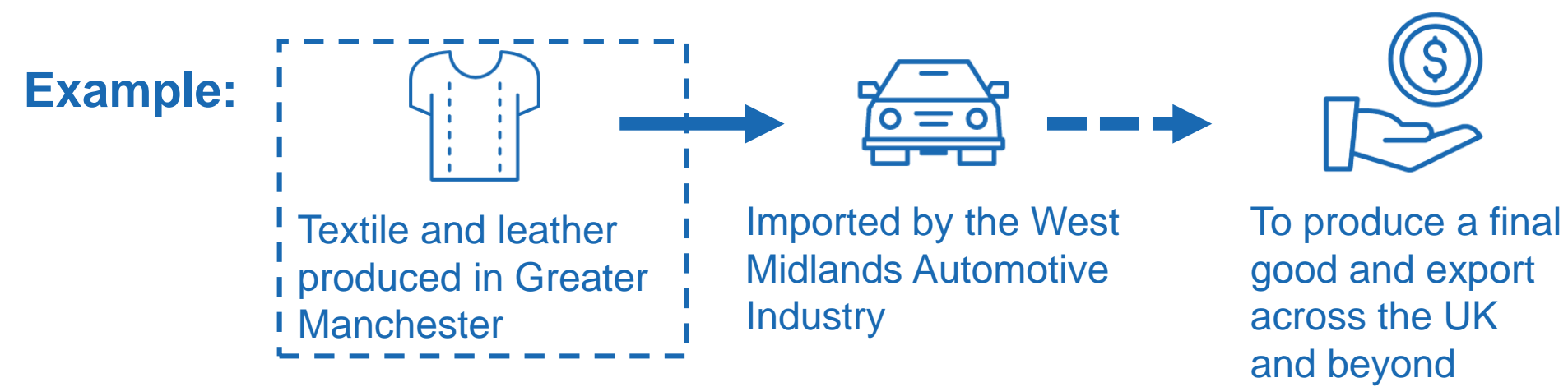


Source: Arup analysis, 2019

¹ European Classification of Products by Activity (CPA)

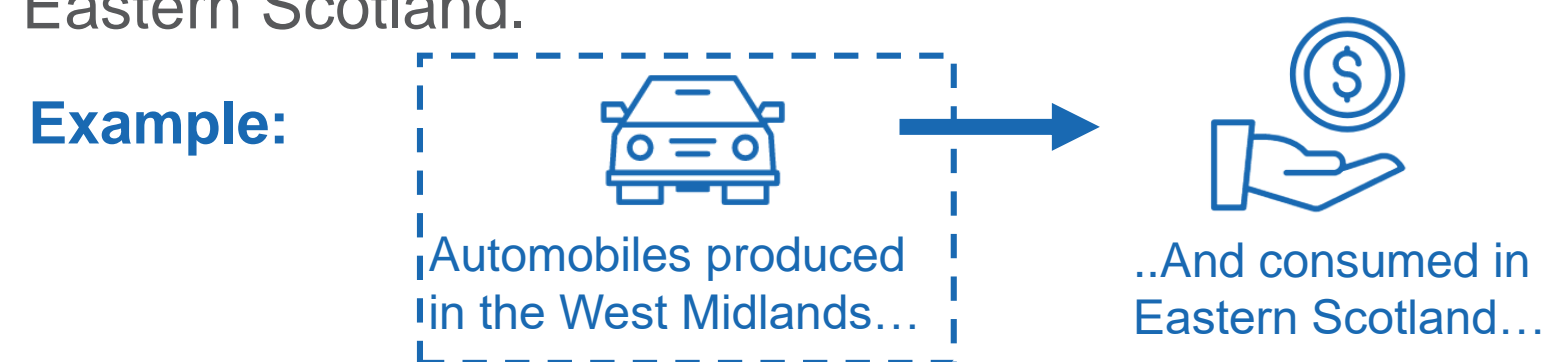
Estimates produced in EUREGIO study

Analysis of **intermediate demand** data allows us to study the flow of non-finished goods and services and therefore differences in regional specialization and multiregional supplier-user linkages. For example, the value of goods and services exported from the textile and leather sector in Greater Manchester (take leather materials) and used in the automotive industry in the West Midlands to produce a final (or finished) product.



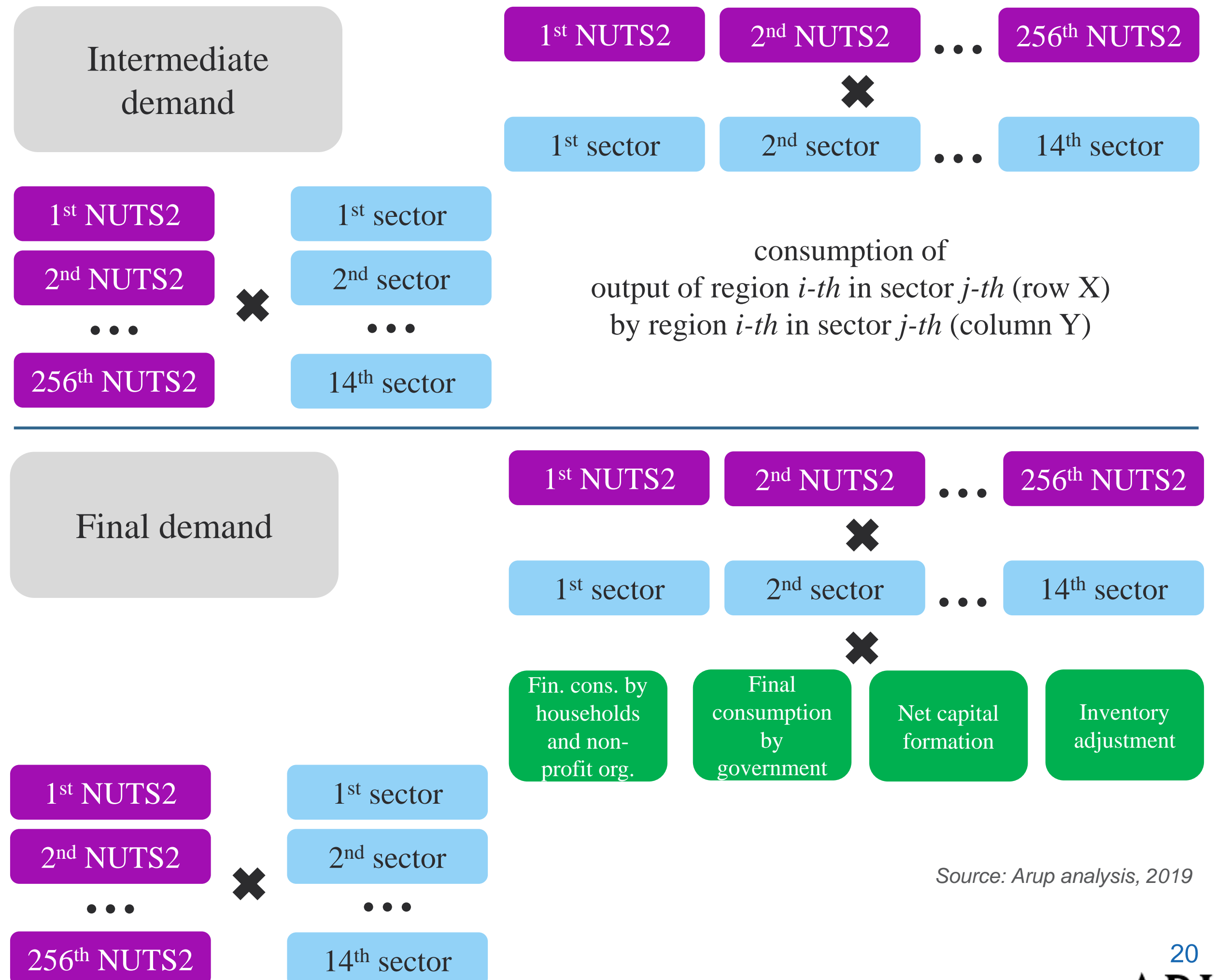
Source: Arup analysis, 2019

Analysis of **final demand** data allows to study the flow of finished goods and services consumed mainly by households and public sector organizations. For example, the table provides the value of goods and services in the manufacturing sector (take automobiles) exported from the West Midlands and consumed by households in Eastern Scotland.



Source: Arup analysis, 2019

EUREGIO dataset format



Source: Arup analysis, 2019

Sectoral classifications in EUREGIO study

Sector name	CPA 2002 Reference	Description
Agriculture	A+B	Agriculture, hunting, forestry, fishing
Mining quarrying and energy supply	C+E	Mining and quarrying, energy, gas and water supply
Food beverages and tobacco	DA	Manufacture of food, beverage and tobacco
Textiles and leather	DB+DC	Manufacture of textile and textile products, leather and leather products
Coke refined petroleum nuclear fuel and chemicals	DF+DG	Manufacture of coke, refined petroleum, nuclear fuel and chemicals
Electrical and optical equipment and transport equipment	DL+DM	Manufacture of electrical equipment and transport equipment
Other manufacturing	DD+DE+DH+DI+ +DL+DK+DN	Other manufacturing
Construction	F	Construction
Distribution	G	Wholesale and retail trade, repair of motor vehicles, motorcycles and other personal household goods
Hotels and restaurant	H	Hotels and restaurants
Transport storage and communication	I	Transport storage and communication
Financial intermediation	J	Financial intermediation
Real estate renting and business activities	K	Real estate renting and business activities
Non-Market services	L to P	Non-Market Services

Source: Arup analysis, 2019

4.1 Intermediary Goods and Services Produced in London and Exported to Other Regions

Now that we have presented the format and organization of the EUREGIO database, we start this section by analysing the intermediate goods and services produced in London (a combination of Inner and Outer London at the NUTS2 level) that are exported to other regions of the UK.

In this analysis, we:

- 1) Present the largest recipients (at NUTS1 and NUTS levels) of total London intermediate outputs. We identify the five largest recipients of London's intermediate outputs, which we use throughout this report's analysis,
- 2) Analyse the sectors in which London holds a relative comparative advantage (RCA), and;
- 3) Breakdown intermediate output flows based on these five sectors.



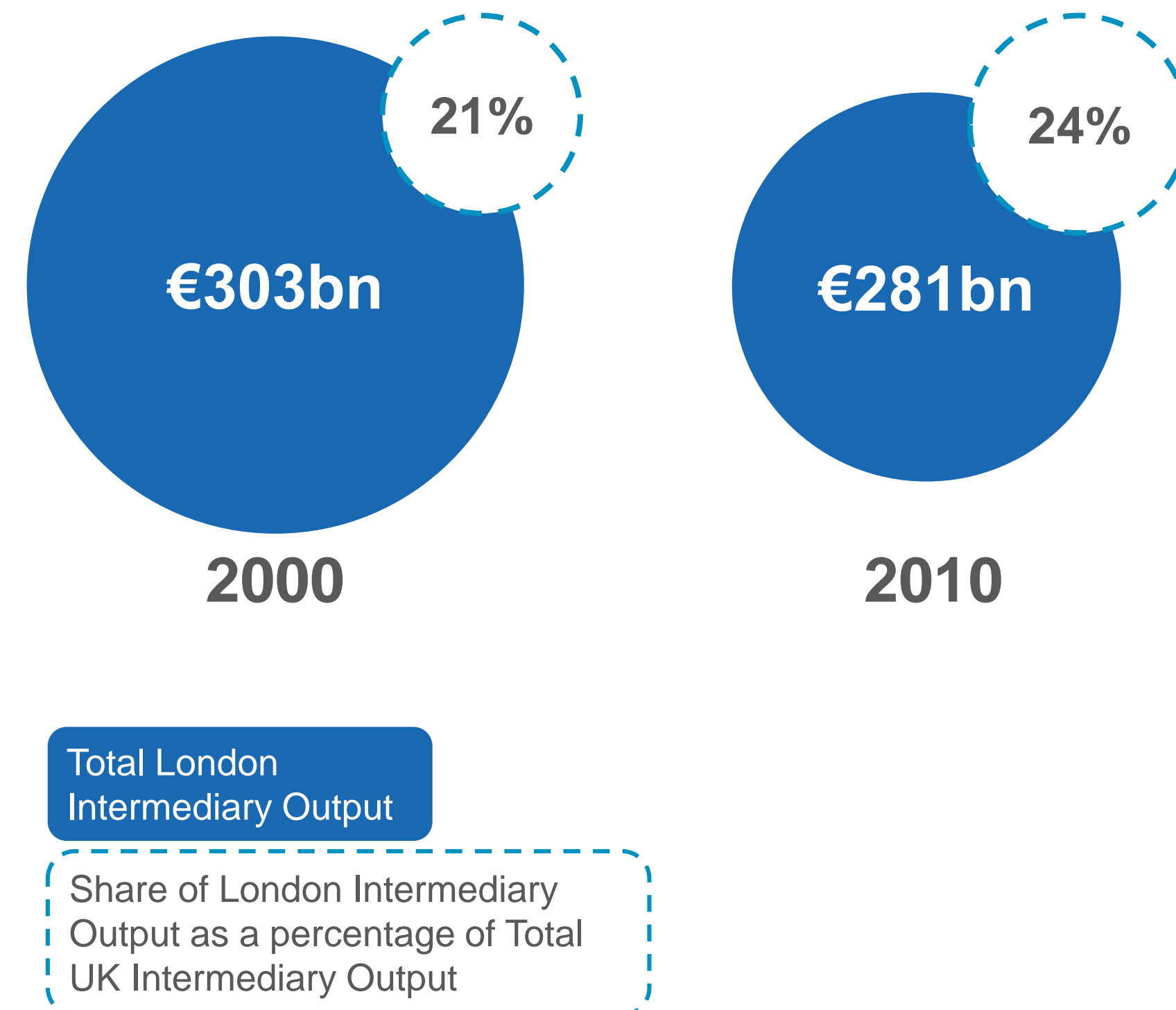
London intermediate output

London's total intermediary output (used to produce further products in different regions in the UK) in 2010 was estimated at 281 billion euros (in 2010 prices). This represented approximately 24% of the UK's total intermediary outputs in the same year. While the absolute value of intermediate outputs decreased between 2000 and 2010 for the UK as a whole, London's share as a percentage of total UK intermediary outputs slightly increased over the same period.

In the year 2000, London's intermediary output was estimated at 303 billion euros (in 2010 prices), which represented approximately 21% of the UK total. The absolute drop yet relative increase in London's intermediate output share (as a share of UK's total) can be explained by the fact that the average production and export of intermediary outputs in London decreased at a slower pace than in the rest of the UK.

Data suggest that the 2008 Global Financial Crisis (GFC) was the driving force behind the decrease in outputs observed over the 2000-2010 period. Indeed, absolute intermediate output increased until 2007, followed by a UK-wide decrease in the subsequent years.

London total intermediary output (billion euros) in 2000 and 2010 and share as a percentage of the UK's total intermediary output



Source: Arup analysis, 2019

Intermediate output produced in London and exported to other UK regions

NUTS1 Regions receiving the highest share of London intermediate output:

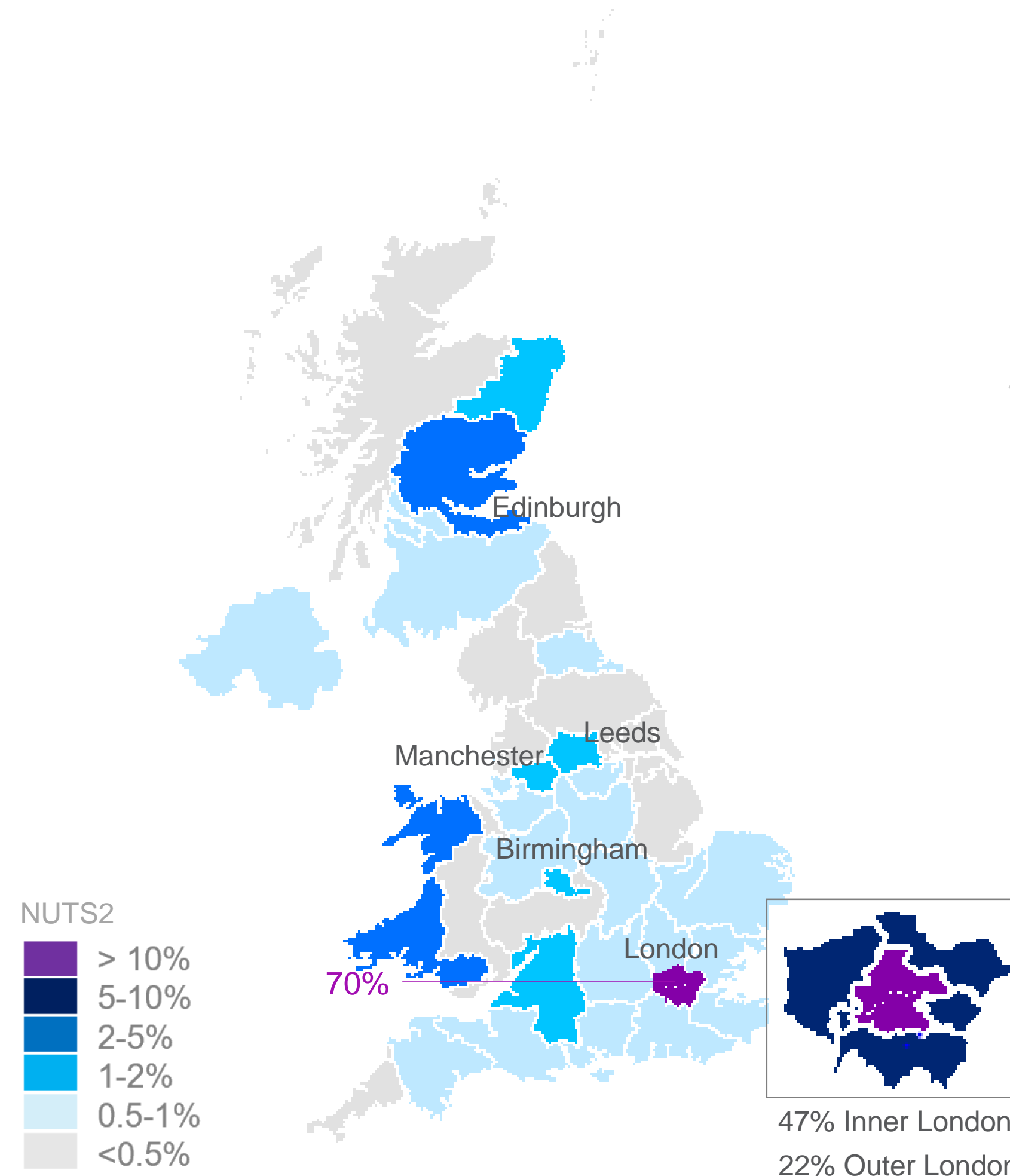
- Almost 70% of London's intermediate output in 2010 was consumed in London. Inner London is the largest recipient, consuming 47% of all of London's intermediate outputs, while Outer London consumed approximately 22% in 2010.
- Scotland was the largest non-London recipient of London intermediate goods, at 7%, followed by the South East and North West, accounting for 4% of intermediate demand respectively.
- The North East and Northern Ireland were the smallest recipients of London's intermediate output, consuming a mere 1% respectively.

NUTS2 Regions receiving the highest share of London intermediate output:

- Eastern Scotland (3%)
- West Wales & The Valleys (2%)
- West Midlands (1%)
- Greater Manchester (1%)
- West Yorkshire (1%)

These five regions, which are the largest recipients of London's intermediate outputs, have been selected for further detailed analysis using in this section as well as in our ONS microdata analysis.

Recipients of London intermediate outputs, 2010, NUTS 2 Level



Recipients of London intermediate outputs, 2010, NUTS 1 Level



Source: Arup analysis, 2019

London intermediate output and sectoral relative comparative advantage (RCA)

This table shows that London tends to specialize in higher value goods and services, and that non-market services, real estate and financial intermediation represent more than 60% of its intermediate output.

CPA 2002 Sector	London		United Kingdom		RCA (B/D)
	Total output (A) <i>(In millions of euros, rounded to nearest hundred million)</i>	Share (B)	Total output (C) <i>(In millions of euros, rounded to nearest hundred million)</i>	Share (D)	
Hotels and restaurant	2,800	1.0%	4,600	0.2%	5.0
Non-market services	44,000	15.6%	131,600	5.6%	2.8
Real estate renting and business activities	105,900	37.6%	351,800	15.0%	2.5
Financial intermediation	29,000	10.3%	96,400	4.1%	2.5
Transport storage and communication	34,700	12.3%	139,400	5.9%	2.1
Distribution	32,800	11.7%	141,900	6.1%	1.9
Construction	15,100	5.4%	94,600	4.0%	1.3
Mining quarrying and energy supply	9,600	3.4%	77,700	3.3%	1.0
Food beverages and tobacco	2,300	0.8%	32,500	1.4%	0.6
Other manufacturing	5,000	1.8%	73,700	3.1%	0.6
Textiles and leather	18	0.0%	810	0.0%	0.2
Electrical and optical equipment and transport equipment	112	0.0%	14,000	0.6%	0.1
Coke refined petroleum nuclear fuel and chemicals	4	0.0%	19,200	0.8%	0.0
Agriculture	41	0.0%	1,166,300	49.7%	0.0
Total	281,400	100.0%	2,344,500	100.0%	

RCA = Relative Comparative Advantage is calculated by dividing the share of sectoral output at the region or city level (B) by the share of sectoral output at the national level (D), measuring the concentration of a specific sector in comparison to the UK average

For further analysis we chose the five sectors in which London has the highest RCA.

Source: Arup analysis, 2019

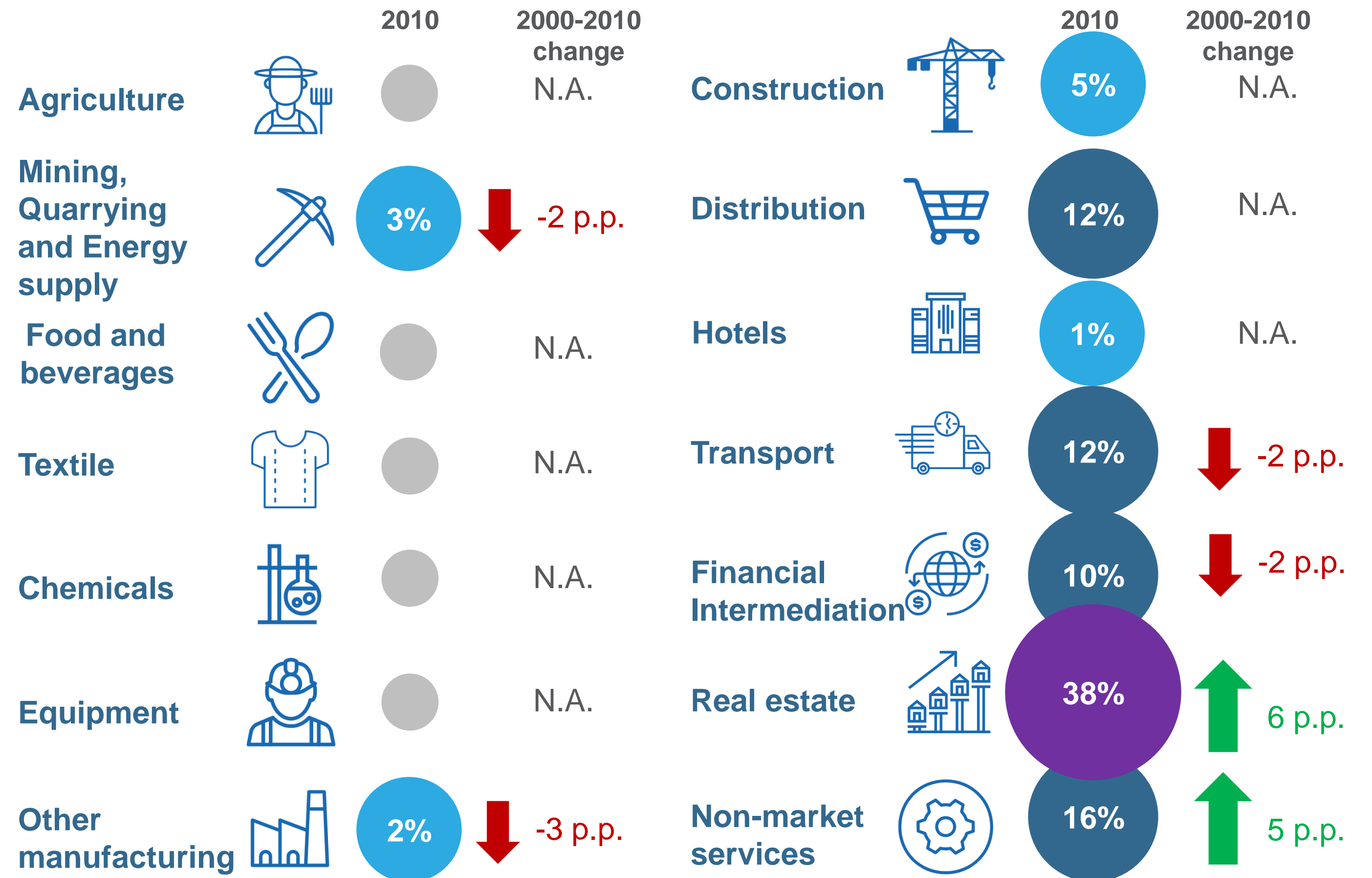
London intermediate output by sector

The majority of London's intermediate outputs are higher value goods and services. In 2010, more than half (56%) came from the real estate non-market service sectors, while finance accounted for approximately 10% of total output. The share of higher value services as a percentage of total intermediary outputs grew by 6 percentage points on average in the real estate and non-market services sectors in between 2000 and 2010, while declining slightly for the financial sector over the same period.

The capital's finance, real estate and non-market service outputs represented approximately one third of the country's total intermediary output in these three sectors respectively.

N.A.s in the table represent sectors that saw little to no variation (in terms of their share of intermediate outputs) over the 2000 to 2010 period.

Intermediate output produced in London, per sector, 2010 value and 2000-2010 change



Legend:

Numbers in circles: share in 2010; Grey circle: share less than 1%;

Arrows: change in share between 2000 and 2010; No arrow: marginal relative change

Source: Arup analysis, 2019

Intermediate output produced in London and exported to other UK regions, by sector

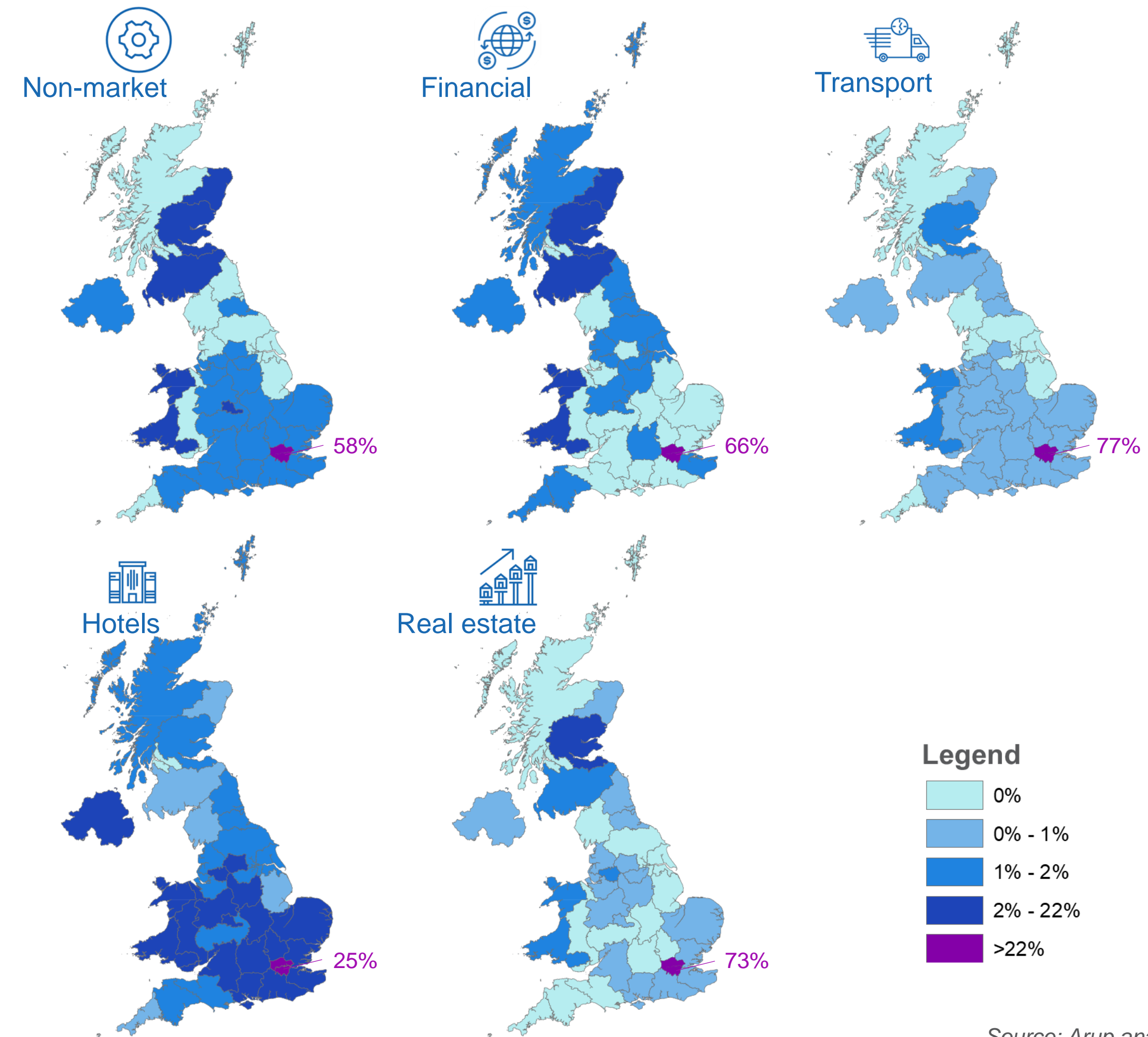
The five sectors in which London has the largest relative comparative advantage are the following:

- Real Estate (38% of total intermediary outputs)
- Non-Market Services (16%)
- Financial Intermediation (10%)
- Transportation (12%)
- Hotels and Restaurants (1%)

These five sectors are depicted in the following images and illustrate trade linkages between London and the rest of the UK. On average, approximately 68% of all intermediate outputs produced in London are consumed internally in the London market across these five sectors.

Wales and Eastern Scotland appear to be the largest consumers of London's intermediate outputs across the non-market services, real estate and finance sectors while trade in the hotels and restaurants sector seems to be more geographically concentrated in the South East of England.

Recipients of London intermediate outputs by sector, 2010, NUTS 2 Level



Source: Arup analysis, 2019

4.2 Intermediary Goods and Services Produced in our Sample Regions and Exported to Other Regions

Now that we have identified the five largest recipients (at the NUTS1 and NUTS2 levels) of London intermediate output, we replicate the analysis performed for the London region for our selected regions elsewhere in the UK.

In this subsection, we:

- 1) Present the largest recipients (at NUTS1 and NUTS2 level) of total intermediate output, produced in each of the five regions of interest.
- 2) Analyse the sectors in which each region holds a relative comparative advantage (RCA), and;
- 3) Breakdown intermediate output flows based on these five sectors.



Intermediate output produced by the West Midlands and exported to other UK regions

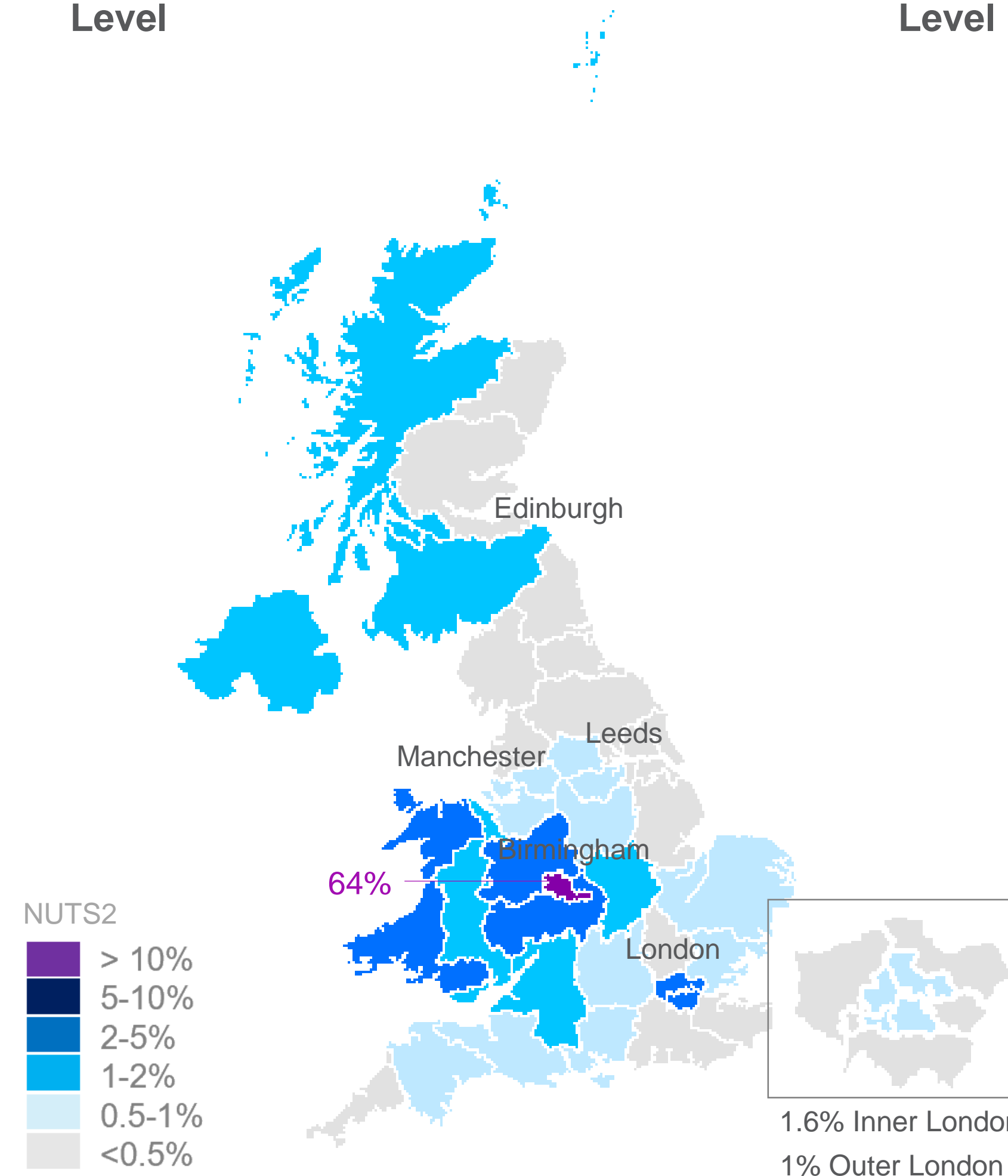
NUTS1 Regions receiving the highest share of West Midlands intermediate output:

- Around 68% of West Midlands' intermediate output in 2010 was consumed in West Midlands region
- 4% of the West Midlands' intermediate output was consumed by Scotland and Wales respectively.

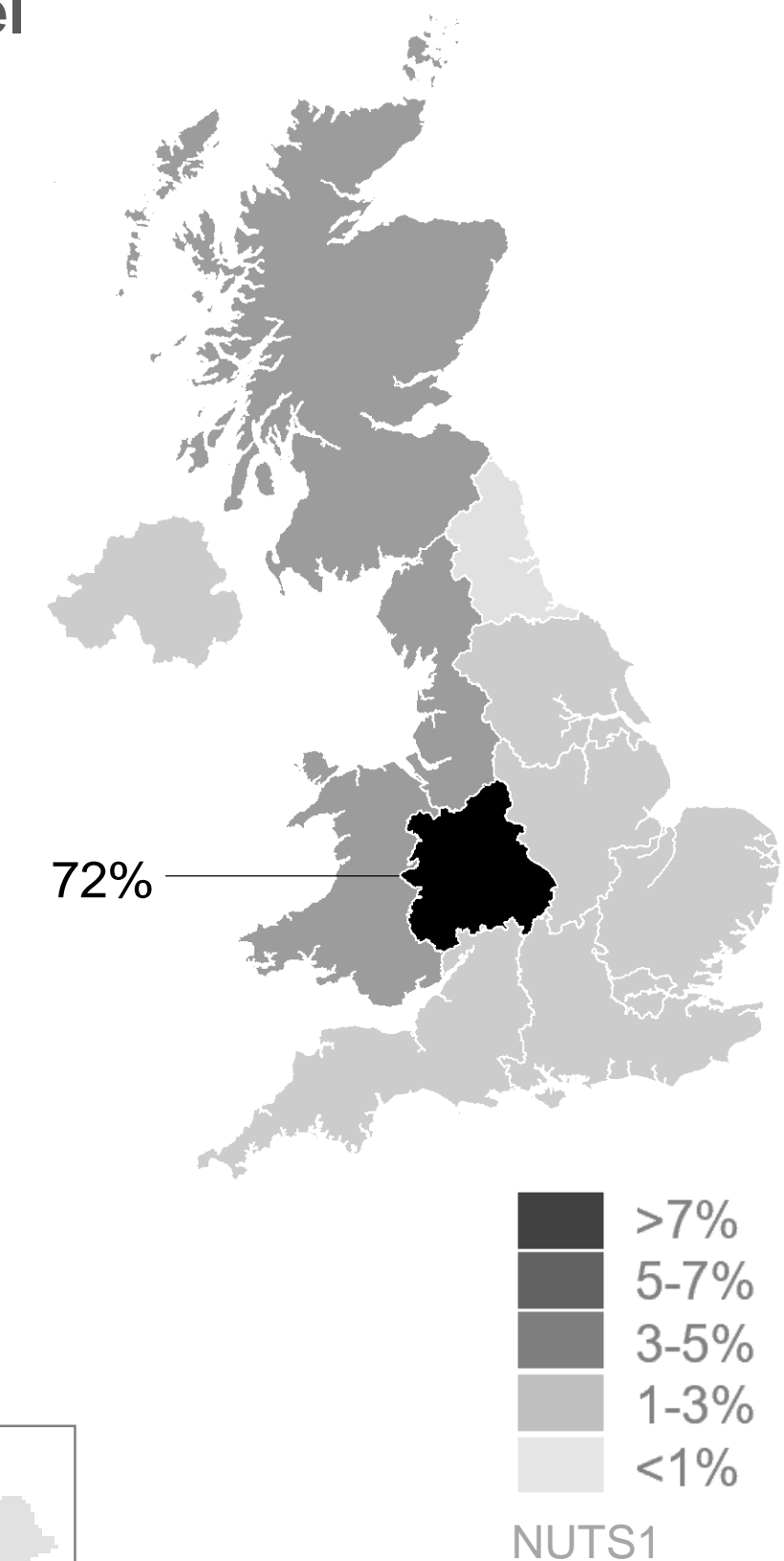
NUTS2 Regions receiving the highest share of West Midlands intermediate output:

- West Wales & The Valleys (3%)
- Shropshire and Staffordshire (3%)
- London (3%)
- South Western Scotland (2%)
- Herefordshire, Worcestershire and Warks (2%)

Recipients of West Midlands intermediate outputs, 2010, NUTS 2 Level



Recipients of West Midlands intermediate outputs, 2010, NUTS 1 Level



Source: Arup analysis, 2019

West Midlands intermediate output and sectoral relative comparative advantage (RCA)

The results suggest that the West Midlands has a very large relative comparative advantage in the hotels and restaurants sector, with an RCA of 68.1. This is due to the relatively high share of intermediate products produced by the sector (13%) in 2010.

CPA 2002 Sector	West Midlands		United Kingdom		RCA (B/D)
	Total output (A) <i>(In millions of euros, rounded to nearest hundred million)</i>	Share (B)	Total output (C) <i>(In millions of euros, rounded to nearest hundred million)</i>	Share (D)	
Hotels and restaurants	5,400	13%	4,600	0.2%	68.1
Non-market services	12,600	31%	131,600	5.6%	5.6
Electrical and optical equipment and transport equipment	700	2%	351,800	15.0%	2.9
Financial intermediation	4,700	12%	96,400	4.1%	2.8
Construction	4,500	11%	139,400	5.9%	2.8
Mining, quarrying and energy supply	2,800	7%	141,900	6.1%	2.1
Distribution	4,300	11%	94,600	4.0%	1.8
Food, beverages and tobacco	1,000	2%	77,700	3.3%	1.8
Textiles and leather	17	0%	32,500	1.4%	1.3
Real estate renting and business activities	4,000	10%	73,700	3.1%	0.7
Transport storage and communication	56	0%	810	0.0%	0.0
Coke, refined petroleum, nuclear fuel and chemicals	4	0%	14,000	0.6%	0.0
Agriculture	33	0%	19,200	0.8%	0.0
Other manufacturing	0	0%	1,166,300	49.7%	0
Total	40,100	100.0%	2,344,500	100.0%	

For further analysis we chose the five sectors in which the West Midlands has the highest RCA.

Source: Arup analysis, 2019

Intermediate output produced by the West Midlands and exported to other UK regions, by sector

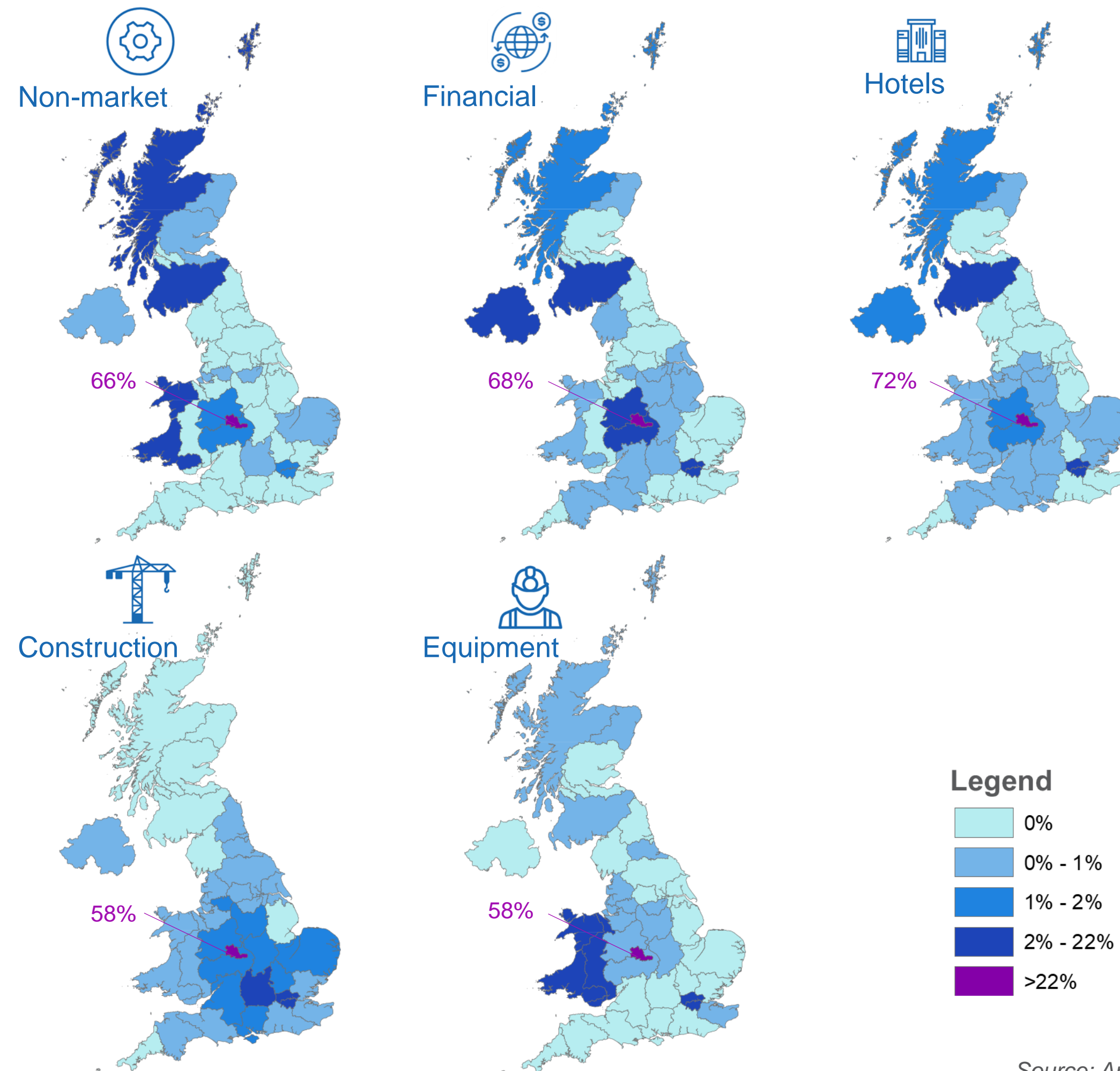
The five sectors in which the West Midlands have the largest relative comparative advantage are the following:

- Non-Market Services (31% of total intermediary outputs)
- Hotels and Restaurants (13%)
- Financial Intermediation (12%)
- Construction (11%)
- Equipment (2%)

These five sectors are depicted in the images that follow and illustrate trade linkages between the West Midlands and the rest of the UK. On average, approximately 64% of all intermediate outputs produced in the West Midlands are consumed internally in the West Midlands across these five sectors. This is lowest for the construction and equipment sectors, suggesting a large part of the intermediary goods in these sectors are exported to other regions in the UK.

Southern Scotland appears to be the largest consumer of the West Midlands' intermediate outputs across the non-market services, finance and hotels and restaurant sectors. London consumes approximately 4% on average of the West Midlands' intermediary outputs across the five sectors in our sample, slightly higher than when we include all sectors (3%).

Recipients of West Midlands intermediate outputs by sector, 2010, NUTS 2 Level



Source: Arup analysis, 2019

Intermediate output produced by West Yorkshire and exported to other UK regions

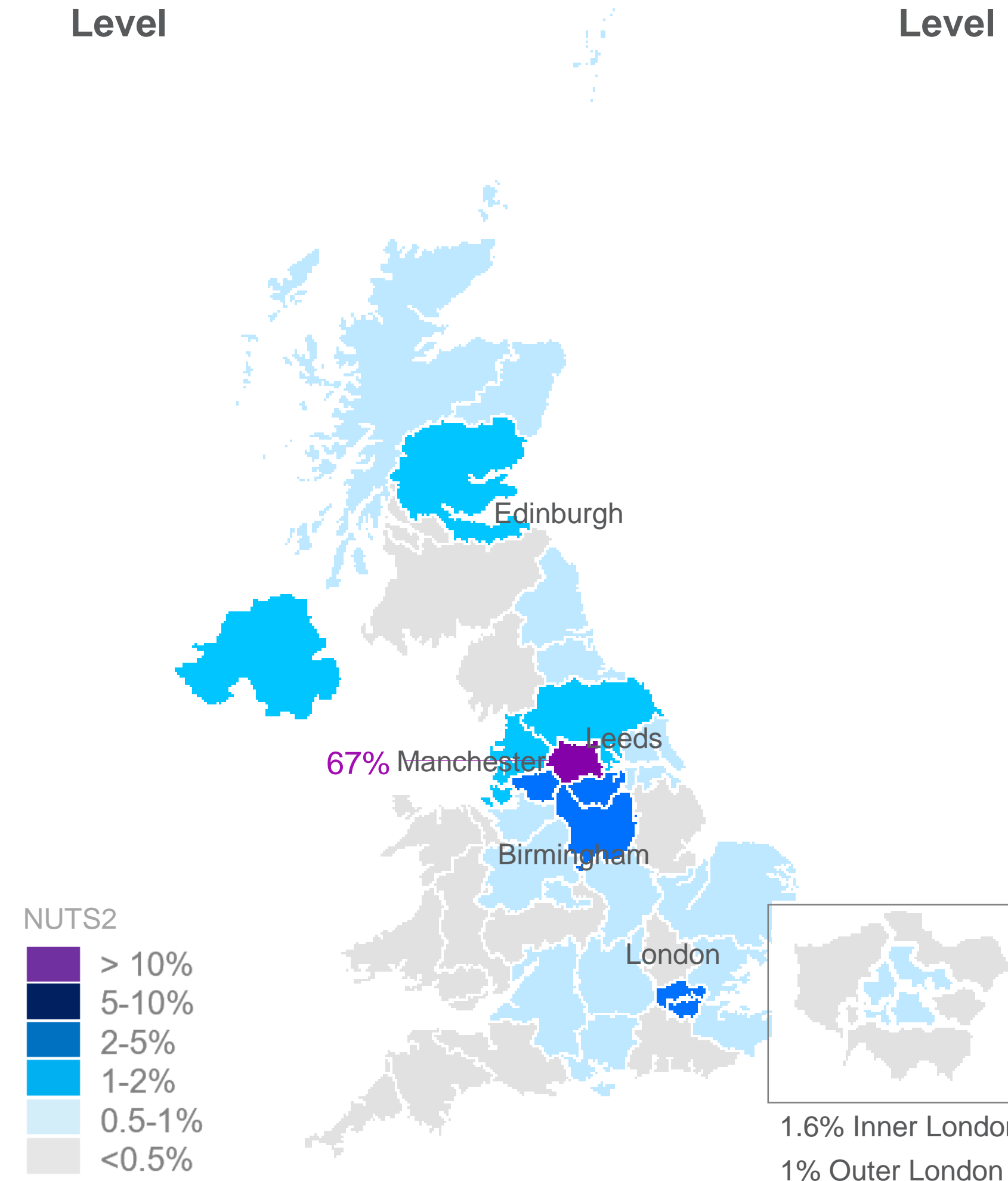
NUTS1 Regions receiving the highest share of West Yorkshire intermediate output:

- Almost 71% of West Yorkshire Intermediate production in 2010 was consumed in Yorkshire and the Humber and 67% in West Yorkshire.
- 7% of West Yorkshire's intermediate output was consumed in the North West and 4% in Scotland.

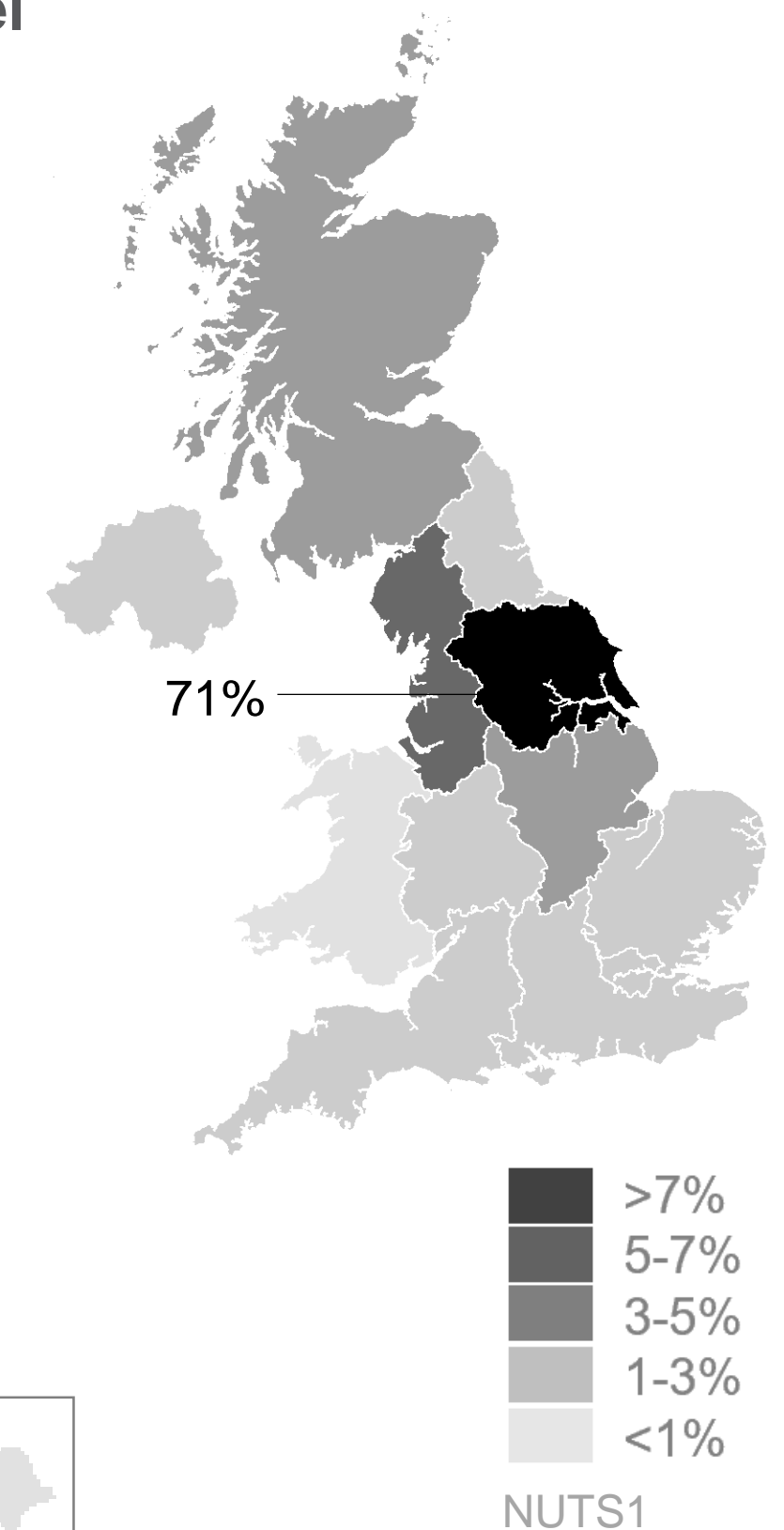
NUTS2 Regions receiving the highest share of West Yorkshire intermediate output:

- London (3%)
- Greater Manchester (2%)
- Derbyshire and Nottinghamshire (2%)
- Lancashire (2%)
- Eastern Scotland (2%)

Recipients of West Yorkshire intermediate outputs, 2010, NUTS 2 Level



Recipients of West Yorkshire intermediate outputs, 2010, NUTS 1 Level



Source: Arup analysis, 2019

West Yorkshire intermediate output and sectoral relative comparative advantage (RCA)

The results suggest that West Yorkshire has a relative comparative advantage in textiles and leathers as well as food, beverages and tobacco and manufacturing. The region therefore specializes more in lower value sectors. However, it is important to note that these sectors only represent 12% of total intermediate output of the region in 2010.

CPA 2002 Sector	West Yorkshire		United Kingdom		RCA (B/D)
	Total output (A) <i>(In millions of euros, rounded to nearest hundred million)</i>	Share (B)	Total output (C) <i>(In millions of euros, rounded to nearest hundred million)</i>	Share (D)	
Textiles and leather	72	0.2%	4,600	0.2%	5.45
Food, beverages and tobacco	1,500	3.9%	131,600	5.6%	2.78
Other manufacturing	3,000	8.0%	351,800	15.0%	2.55
Electrical and optical equipment and transport equipment	500	1.4%	96,400	4.1%	2.29
Financial intermediation	3,600	9.3%	139,400	5.9%	2.27
Mining, quarrying and energy supply	2,700	7.2%	141,900	6.1%	2.17
Construction	3,000	7.9%	94,600	4.0%	1.96
Distribution	4,500	11.8%	77,700	3.3%	1.95
Real estate renting and business activities	10,900	28.5%	32,500	1.4%	1.90
Transport storage and communication	4,200	11.1%	73,700	3.1%	1.87
Non-market services	3,800	10.0%	810	0.0%	1.79
Hotels and restaurants	28	0.1%	14,000	0.6%	0.38
Coke, refined petroleum, nuclear fuel and chemicals	6	0.0%	19,200	0.8%	0.02
Agriculture	300	0.7%	1,166,300	49.7%	0.01
Total	38,300	100.0%	2,344,500	100.0%	

For further analysis we chose the five sectors in which West Yorkshire has the highest RCA.

Source: Arup analysis, 2019

Intermediate output produced by West Yorkshire and exported to other UK regions, by sector

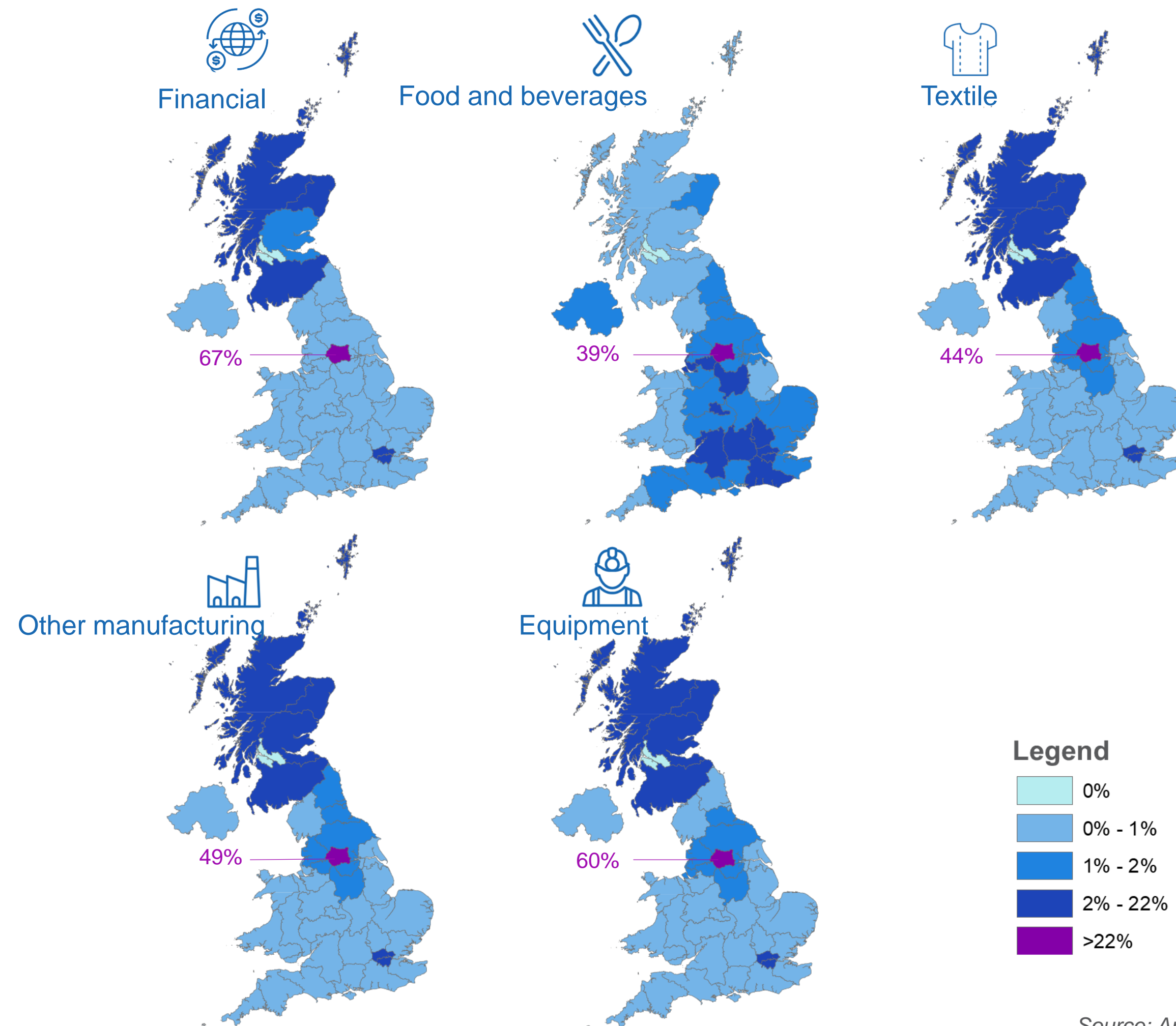
The five sectors in which West Yorkshire has the largest relative comparative advantage are the following:

- Financial Intermediation (9% of total intermediary outputs)
- Other Manufacturing (8%)
- Food and Beverage (4%)
- Equipment (1%)
- Textile (0.2%)

These five sectors are depicted in the images below and illustrate trade linkages between West Yorkshire and the rest of the UK. On average, approximately 55% of all intermediate outputs produced in West Yorkshire are consumed internally in West Yorkshire across these five sectors.

Southern Scotland appears to be the largest consumer of West Yorkshire's intermediate outputs across (approximately 9% across the textile, equipment and other manufacturing sectors). London consumes approximately 4% on average of West Yorkshire's intermediary outputs across the five sectors in our sample.

Recipients of West Yorkshire intermediate outputs by sector, 2010, NUTS 2 Level



Source: Arup analysis, 2019

Intermediate output by Greater Manchester and exported to other UK regions

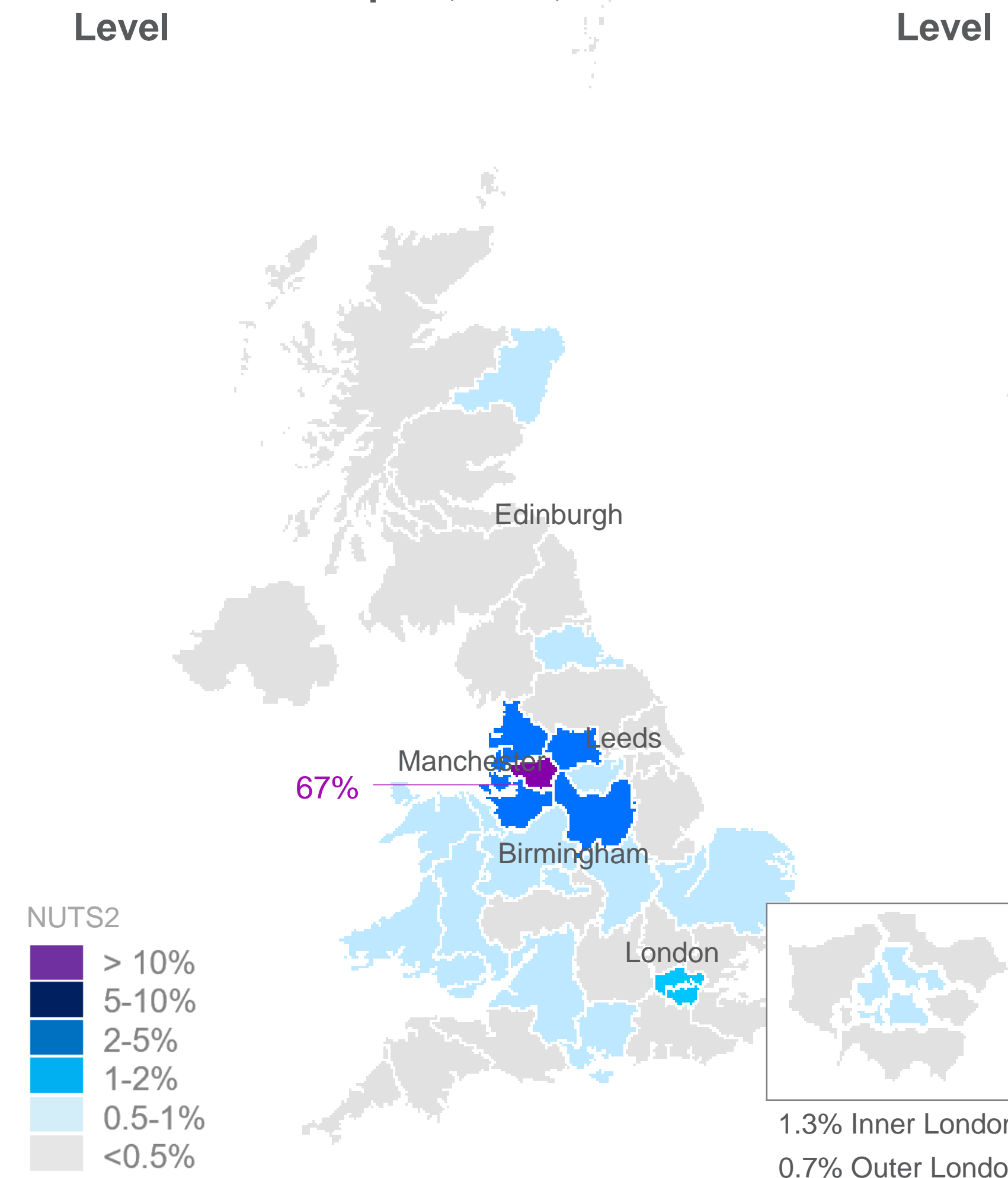
NUTS1 Regions receiving the highest share of Greater Manchester intermediate output:

- Almost 70% of Greater Manchester's Intermediate production in 2010 was consumed in Greater Manchester and 77% in the North West.
- 5% of Greater Manchester's intermediate output was consumed in Yorkshire and 4% in East Midlands.

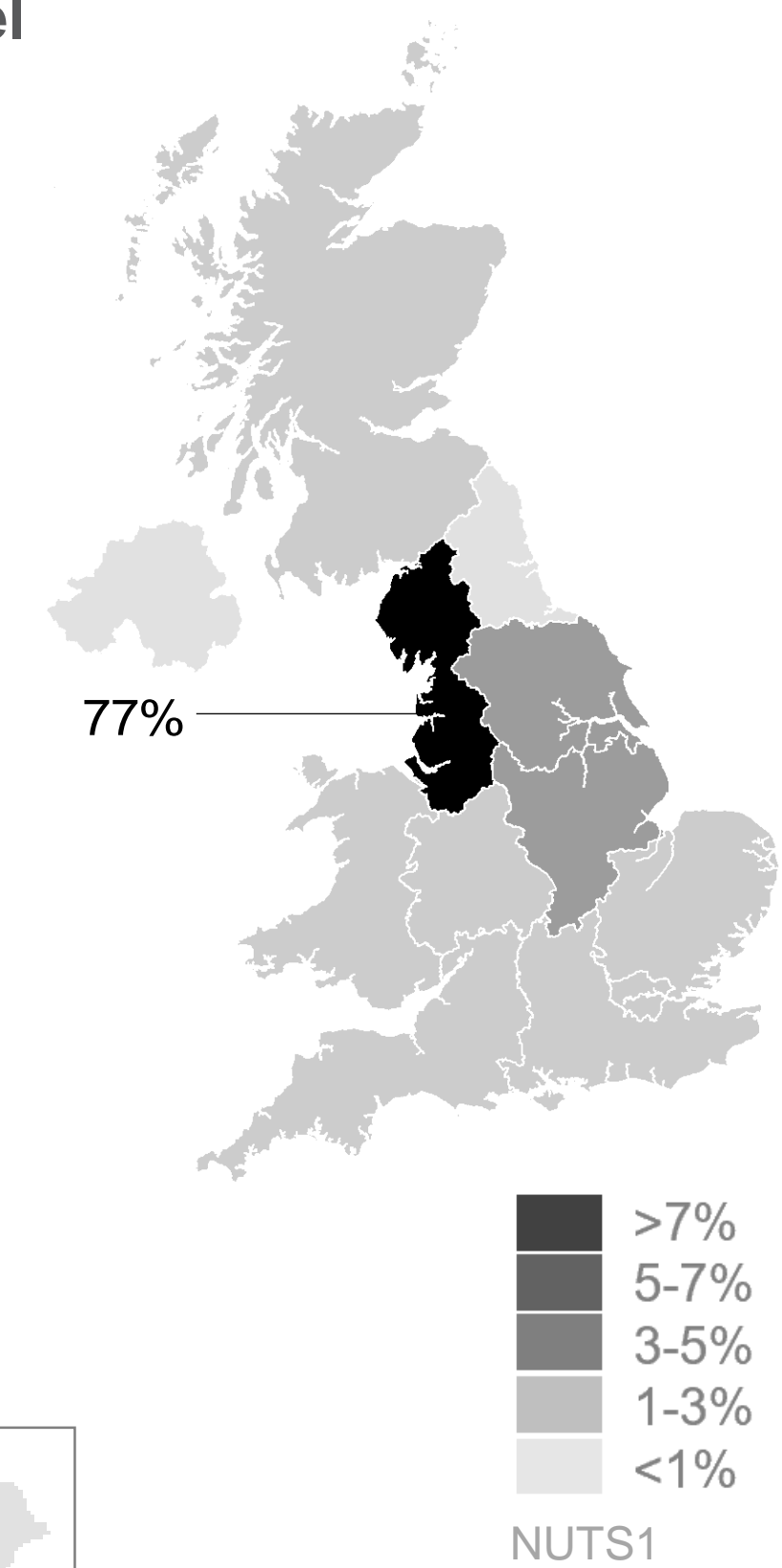
NUTS2 Regions receiving the highest share of Greater Manchester intermediate output:

- Merseyside (4%)
- West Yorkshire (3%)
- Derbyshire and Nottinghamshire (3%)
- Lancashire (2%)
- London (2%)

Recipients of Greater Manchester intermediate outputs, 2010, NUTS 2 Level



Recipients of Greater Manchester intermediate outputs, 2010, NUTS 1 Level



Source: Arup analysis, 2019

Greater Manchester intermediate output and relative comparative advantage (RCA)

The results suggest that Greater Manchester has a relative comparative advantage in textiles and leather as well as foods, beverages and tobacco and construction. Similarly to West Yorkshire, the region seems to specialize in comparatively lower value sectors. After real estate, construction is the second largest producer of intermediate output in the region.

CPA 2002 Sector	Greater Manchester		United Kingdom		RCA (B/D)
	Total output (A) <i>(In millions of euros, rounded to nearest hundred million)</i>	Share (B)	Total output (C) <i>(In millions of euros, rounded to nearest hundred million)</i>	Share (D)	
Textiles and leather	79	0.2%	4,600	0.2%	4.96
Food beverages and tobacco	2,000	4.3%	131,600	5.6%	3.11
Construction	5,600	12.1%	351,800	15.0%	3.01
Financial intermediation	4,100	8.9%	96,400	4.1%	2.17
Other manufacturing	3,000	6.5%	139,400	5.9%	2.08
Real estate renting and business activities	14,000	30.9%	141,900	6.1%	2.06
Transport storage and communication	5,600	12.1%	94,600	4.0%	2.03
Distribution	5,400	11.8%	77,700	3.3%	1.95
Non-market services	5,000	10.9%	32,500	1.4%	1.94
Electrical and optical equipment and transport equipment	507	1.1%	73,700	3.1%	1.83
Hotels and restaurant	37	0.1%	810	0.0%	0.40
Mining quarrying and energy supply	445	1.0%	14,000	0.6%	0.29
Coke refined petroleum nuclear fuel and chemicals	6	0.0%	19,200	0.8%	0.02
Agriculture	102	0.2%	1,166,300	49.7%	0.00
Total	45,900	100.0%	2,344,500	100.0%	

For further analysis we chose the five sectors in which Greater Manchester has the highest RCA.

Source: Arup analysis, 2019

Intermediate output by Greater Manchester and exported to other UK regions, by sector

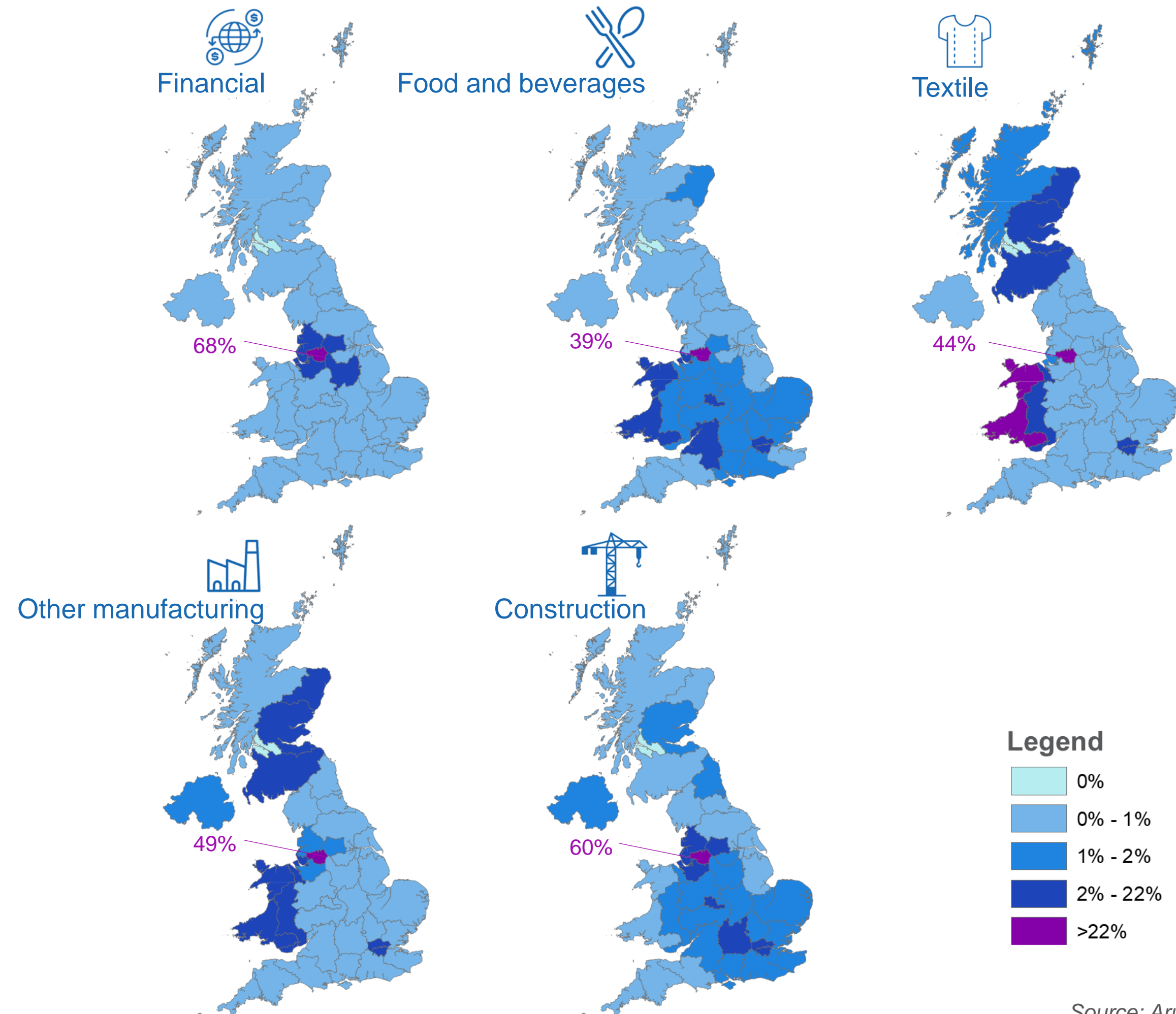
The five sectors in which Greater Manchester has the largest relative comparative advantage are the following:

- Construction (12% of total intermediary outputs)
- Finance (9%)
- Food and Beverage (4%)
- Other Manufacturing (4%)
- Textile (0.2%)

These five sectors are depicted in the images below and illustrate trade linkages between Greater Manchester and the rest of the UK. On average, approximately 55% of all intermediate outputs produced in Greater Manchester are consumed internally in Greater Manchester across these five sectors.

West Wales & The Valleys and the rest of the West Midlands seem to be the largest consumers of Greater Manchester's intermediate outputs across food and beverage, other manufacturing and textile sectors. London consumes approximately 5% on average of Greater Manchester's intermediary outputs across the five sectors in our sample.

Recipients of Greater Manchester intermediate outputs by sector, 2010, NUTS 2 Level



Source: Arup analysis, 2019

Intermediate output produced by West Wales & The Valleys and exported to other UK regions

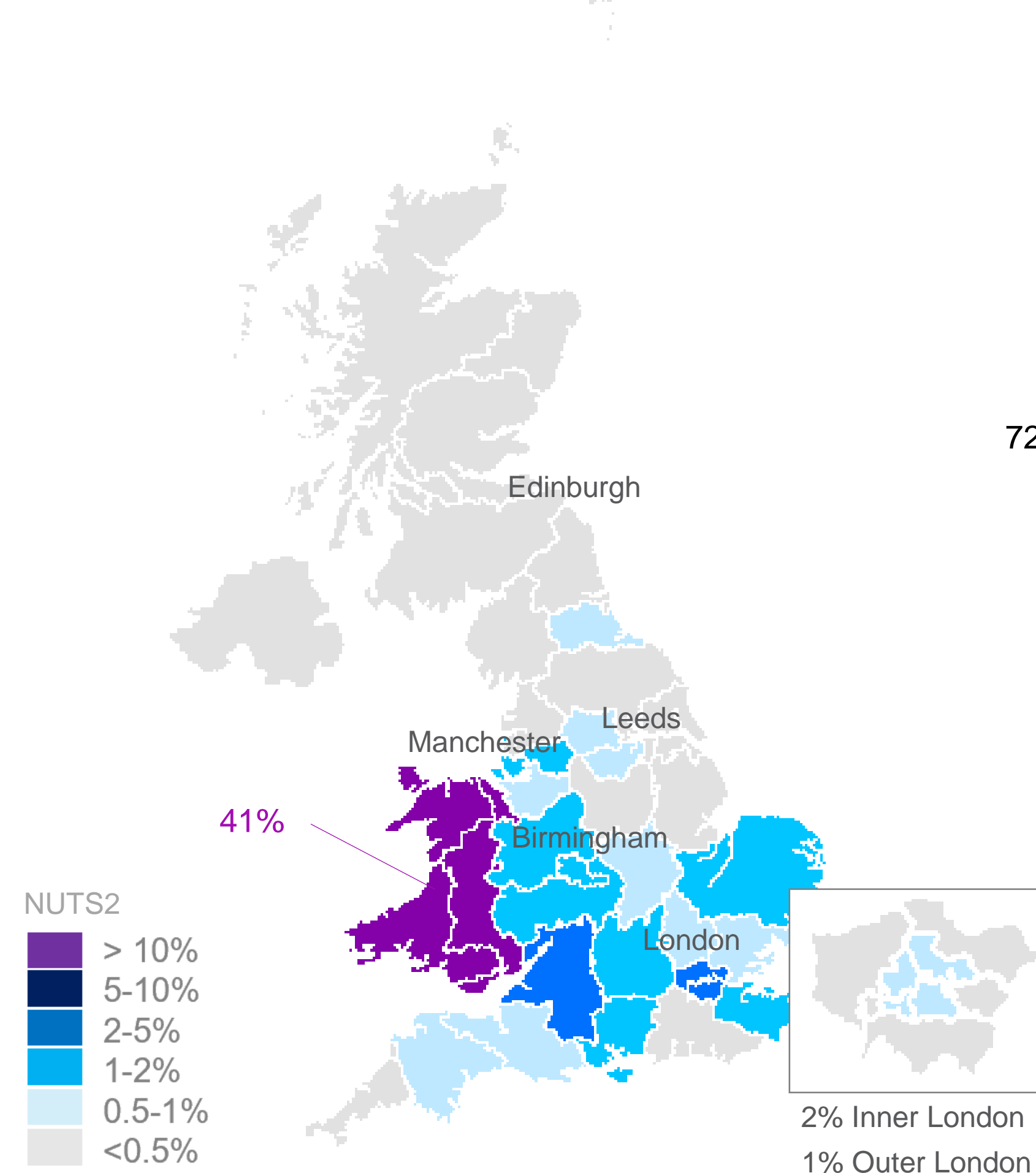
NUTS1 Regions receiving the highest share of West Wales & The Valleys intermediate output:

- Almost 72% of West Wales' Intermediate production in 2010 was consumed in Wales. Some 41% of total intermediate output was consumed in West Wales & The Valleys alone.
- Some 4% of West Wales & The Valleys' intermediate output was consumed in the North West, South West, West Midlands and South East respectively.

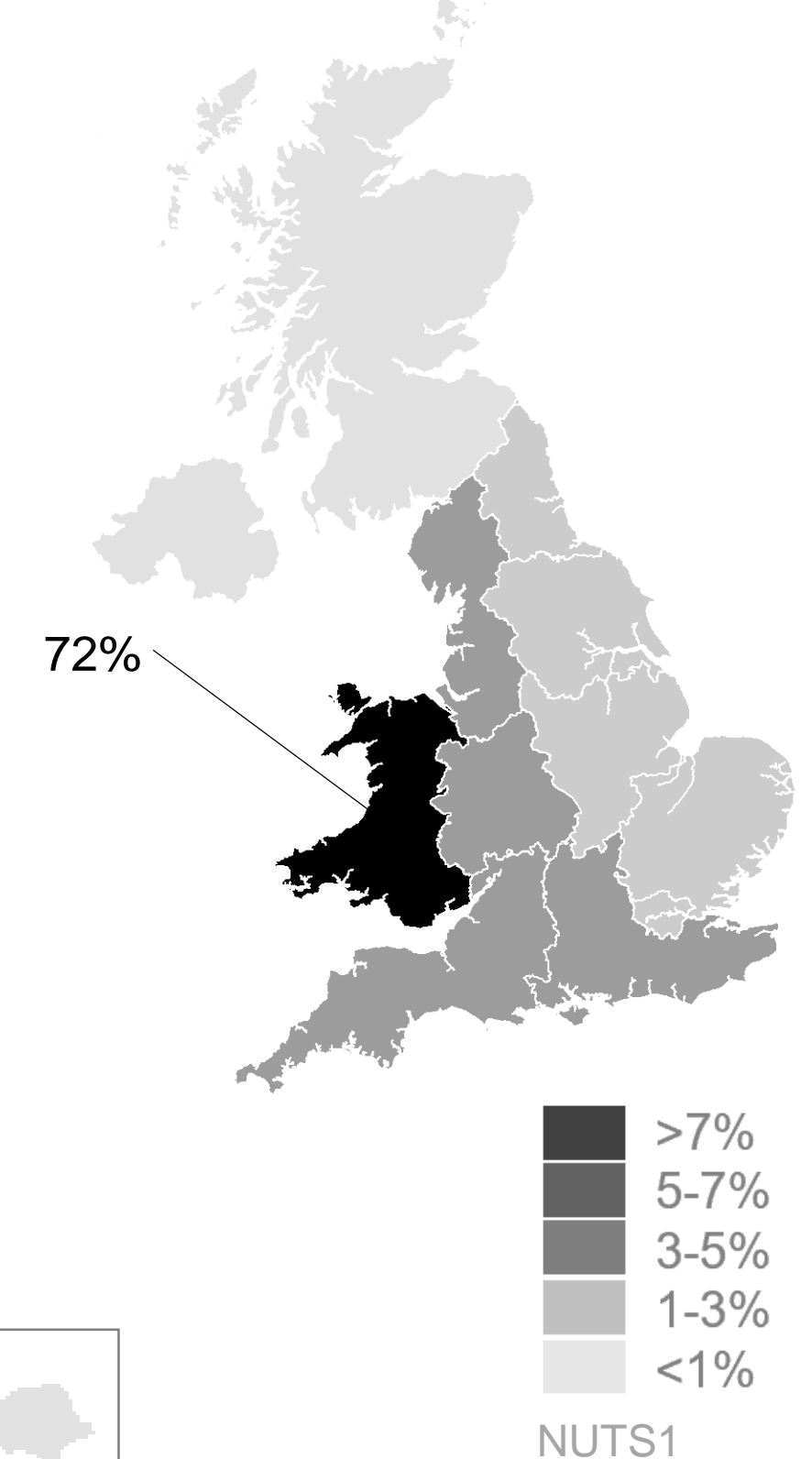
NUTS2 Regions receiving the highest share of West Wales & The Valleys intermediate output:

- Eastern Wales (31%)
- London (3%)
- Gloucestershire Wiltshire and North Somerset (2%)
- Berkshire Bucks and Oxfordshire (2%)
- West Midlands (2%)

Recipients of West Wales & The Valleys intermediate outputs, 2010, NUTS 2 Level



Recipients of West Wales & The Valleys intermediate outputs, 2010, NUTS 1 Level



Source: Arup analysis, 2019

West Wales & The Valleys intermediate output and relative comparative advantage (RCA)

The results suggest that West Wales & The Valleys has a relative comparative advantage in non-market services, hotels and restaurants as well as manufacturing. The region therefore specializes in a mix of higher and lower value sectors. Its specialization reflects the largest sectors in terms of intermediate outputs, namely non-market services and manufacturing.

CPA 2002 Sector	West Wales & The Valleys		United Kingdom		RCA (B/D)
	Total output (A) <i>(In millions of euros, rounded to nearest hundred million)</i>	Share (B)	Total output (C) <i>(In millions of euros, rounded to nearest hundred million)</i>	Share (D)	
Non-market services	5,000	26%	4,600	0.2%	4.6
Hotels and restaurant	133	1%	131,600	5.6%	3.5
Other manufacturing	2,000	11%	351,800	15.0%	3.5
Electrical and optical equipment and transport equipment	366	2%	96,400	4.1%	3.1
Construction	1,900	10%	139,400	5.9%	2.4
Food beverages and tobacco	579	3%	141,900	6.1%	2.1
Financial intermediation	1,400	7%	94,600	4.0%	1.7
Distribution	2,000	10%	77,700	3.3%	1.7
Textiles and leather	11	0%	32,500	1.4%	1.6
Mining quarrying and energy supply	1,000	5%	73,700	3.1%	1.6
Transport storage and communication	1,400	7%	810	0.0%	1.2
Real estate renting and business activities	3,400	18%	14,000	0.6%	1.2
Coke, refined petroleum nuclear fuel and chemicals	14	0%	19,200	0.8%	0.1
Agriculture	218	1%	1,166,300	49.7%	0.0
Total	19,400	100%	2,344,500	100.0%	

For further analysis we chose the five sectors in which West Wales & The Valleys has the highest RCA.

Source: Arup analysis, 2019

Intermediate output produced by West Wales & The Valleys and exported to other UK regions, by sector

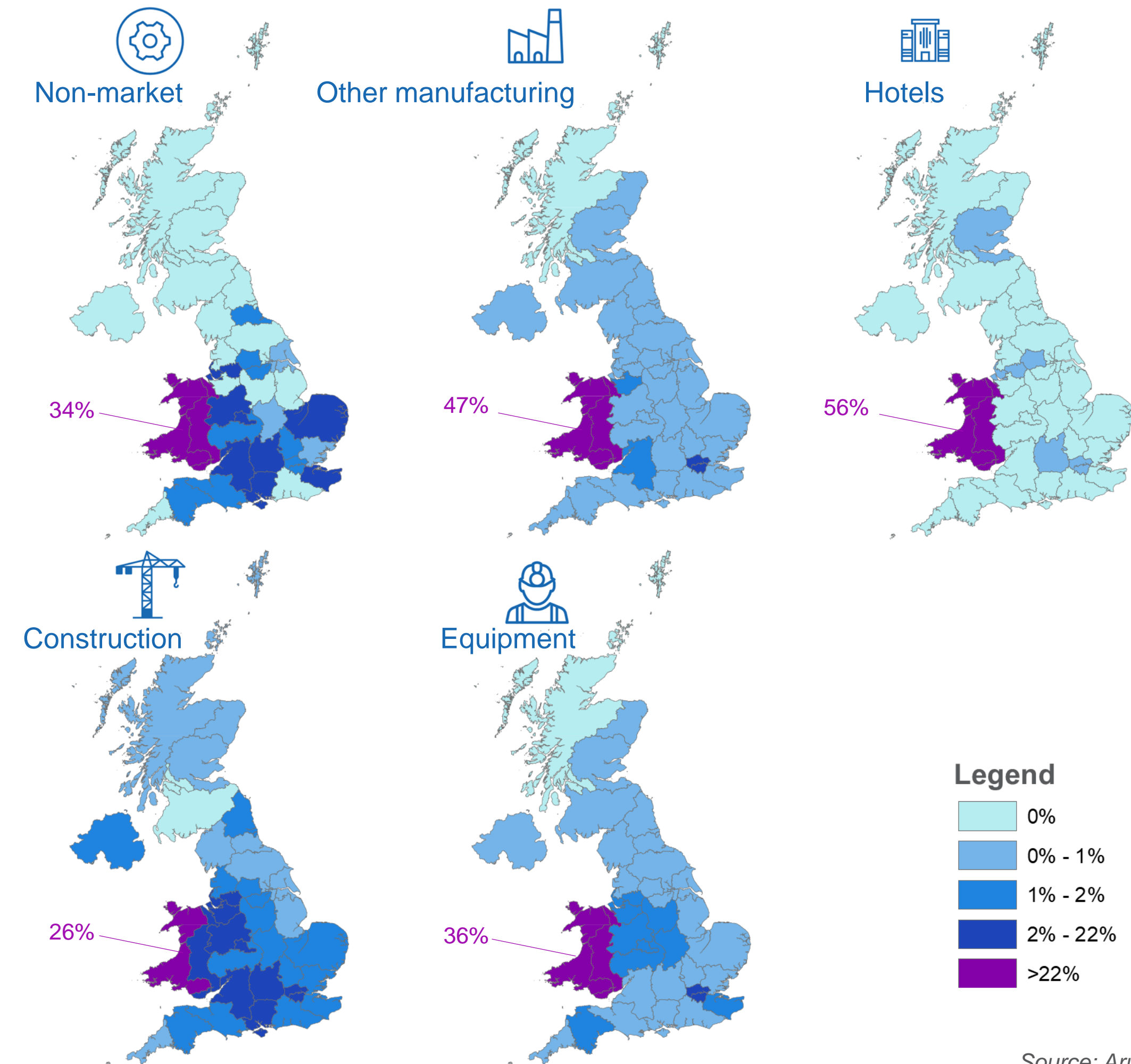
The five sectors in which West Wales has the largest relative comparative advantage are the following:

- Non-Market Services (26% of total intermediary outputs)
- Other Manufacturing (11%)
- Construction (10%)
- Equipment (2%)
- Hotels and Restaurants (1%)

These five sectors are depicted in the forthcoming images and illustrate trade linkages between West Wales & The Valleys and the rest of the UK. On average, approximately 36% of all intermediate outputs produced in West Wales & The Valleys are consumed internally in West Wales & The Valleys across these five sectors.

The rest of the Welsh region and parts of the West Midlands and South East appear to be the largest consumers of West Wales' intermediate outputs across the non-market services and construction sectors. London consumes approximately 4% on average of West Wales' intermediary outputs across the five sectors in our sample.

Recipients of West Wales & The Valleys intermediate outputs by sector, 2010, NUTS 2 Level



Source: Arup analysis, 2019

Intermediate output by Eastern Scotland and exported to other UK regions

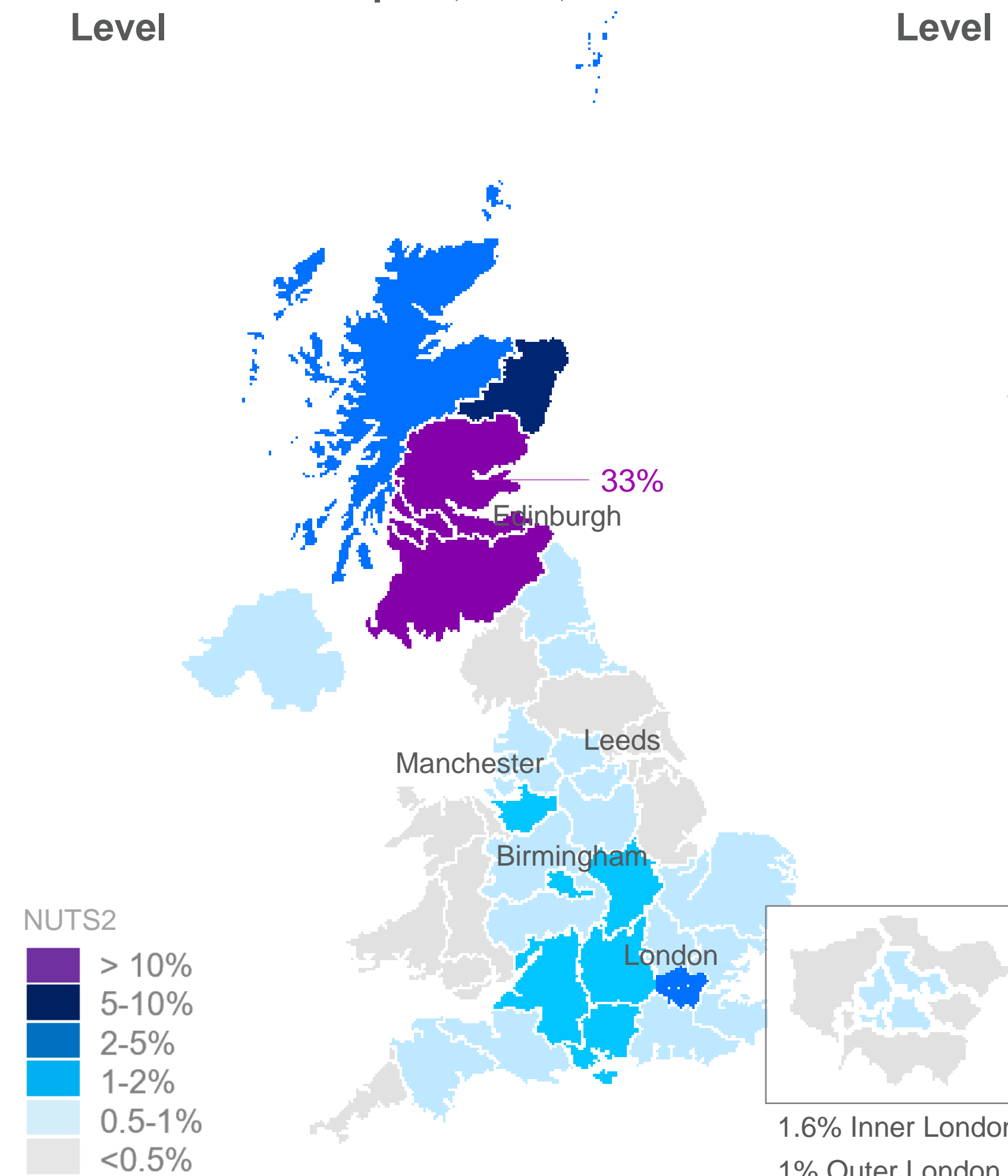
NUTS1 Regions receiving the highest share of Eastern Scotland intermediate output:

- Almost 73% of Eastern Scotland's Intermediate production in 2010 was consumed in Scotland. 33% of total intermediate output was consumed in Eastern Scotland alone.
- 4% of Eastern Scotland's intermediate output was consumed in the South East and North West respectively

NUTS2 Regions receiving the highest share of Eastern Scotland intermediate output:

- South Western Scotland (27%)
- North Eastern Scotland (10%)
- London (3%)
- Highlands and Islands (3%)

Recipients of Eastern Scotland intermediate Outputs, 2010, NUTS 2 Level



Recipients of Eastern Scotland intermediate outputs, 2010, NUTS 1 Level



Source: Arup analysis, 2019

Eastern Scotland intermediate output and sectoral relative comparative advantage (RCA)

The results suggest that West Wales & The Valleys has a relative comparative advantage in hotels and restaurants, mining and energy supply as well as food, beverages and tobacco. The region's specialization in mining energy supply reflects the region's offshore wind and large oil sector.

CPA 2002 Sector	Eastern Scotland		United Kingdom		RCA (B/D)
	Total output (A) <i>(In millions of euros, rounded to nearest hundred million)</i>	Share (B)	Total output (C) <i>(In millions of euros, rounded to nearest hundred million)</i>	Share (D)	
Hotels and restaurant	465	1.5%	4,600	0.2%	7.61
Mining, quarrying and energy supply	4,400	14.1%	131,600	5.6%	4.26
Food, beverages and tobacco	1,700	5.5%	351,800	15.0%	3.94
Construction	3,700	11.7%	96,400	4.1%	2.90
Electrical and optical equipment and transport equipment	449	1.4%	139,400	5.9%	2.39
Financial intermediation	3,000	9.8%	141,900	6.1%	2.37
Transport storage and communication	3,700	11.9%	94,600	4.0%	2.00
Other manufacturing	1,700	5.5%	77,700	3.3%	1.74
Real estate renting and business activities	6,900	22.2%	32,500	1.4%	1.48
Distribution	2,700	8.7%	73,700	3.1%	1.44
Non-market services	2,200	7.1%	810	0.0%	1.27
Textiles and leather	11	0.0%	14,000	0.6%	1.06
Coke, refined petroleum nuclear fuel and chemicals	3	0.0%	19,200	0.8%	0.01
Agriculture	194	0.6%	1,166,300	49.7%	0.01
Total	31,100	100%	2,344,500	100.0%	

For further analysis we chose the five sectors in which Eastern Scotland has the highest RCA.

Source: Arup analysis, 2019

Intermediate output by Eastern Scotland and exported to other UK regions, by sector

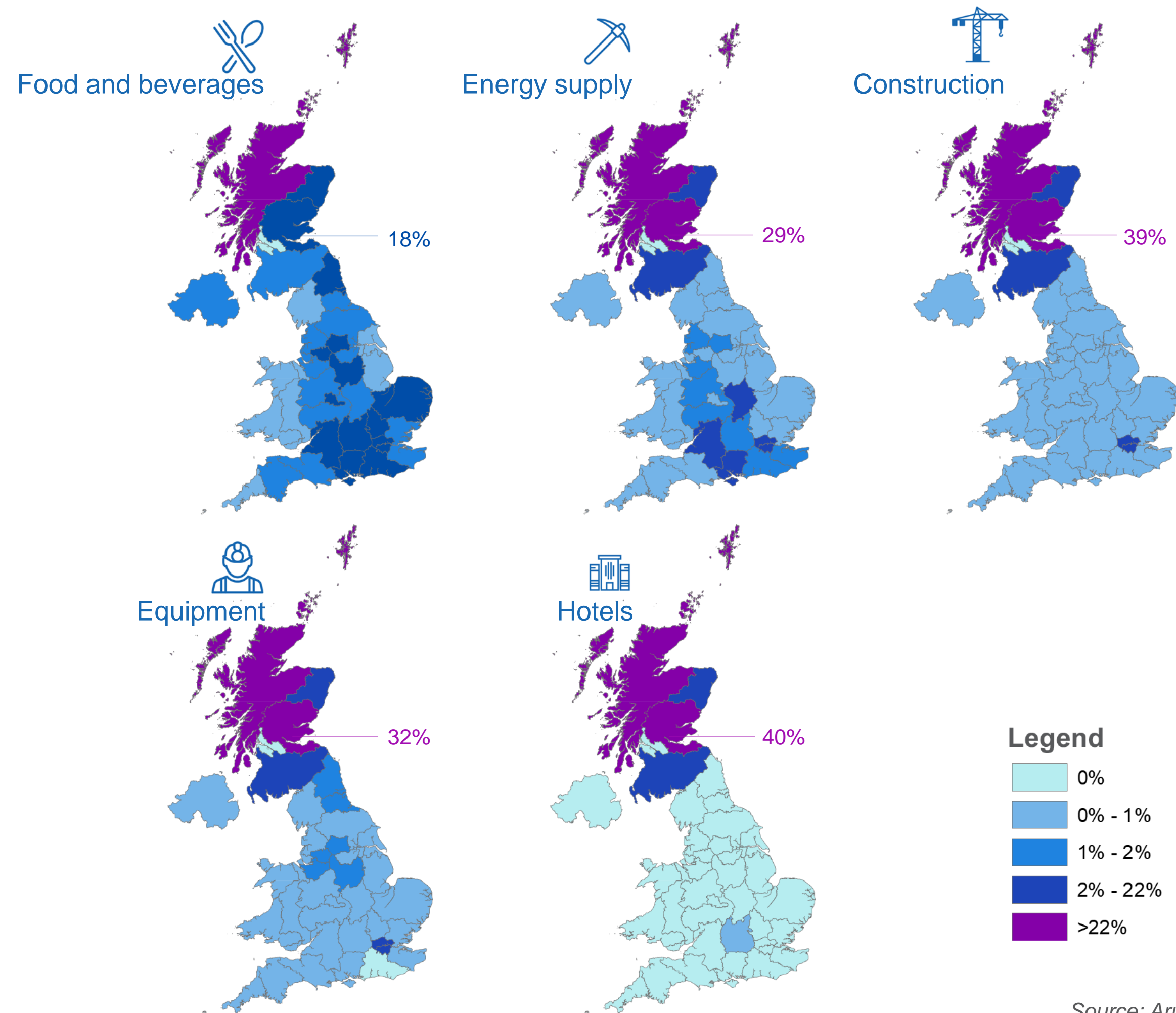
The five sectors in which Eastern Scotland has the largest relative comparative advantage are the following:

- Mining (14% of total intermediary outputs)
- Construction (12% of total intermediary outputs)
- Food and Beverage (6% of total intermediary outputs)
- Hotels and Restaurants (2% of total intermediary outputs)
- Equipment (1% of total intermediary outputs)

These five sectors are depicted in the figures that follow and illustrate trade linkages between Eastern Scotland and the rest of the UK. On average, approximately 31% of all intermediate outputs produced in Eastern Scotland are consumed internally in Eastern Scotland across these five sectors. South Western Scotland is not far behind, consuming approximately 27% of Eastern Scotland's intermediary outputs.

The South East is the largest consumer of Eastern Scotland's intermediate outputs in the food and beverage sector. London consumes approximately 4% on average of Eastern Scotland's intermediary outputs across the five sectors in our sample.

Recipients of Eastern Scotland intermediate outputs by sector, 2010, NUTS 2 Level



Source: Arup analysis, 2019

4.3 EUREGIO Analysis Summary

Sections 4.1 and 4.2 explored the intermediate output trade flows between regions within the UK. Starting with intermediate output produced in London, we identified the sectors in which the capital had a relative comparative advantage as well as the five key regions that were the largest recipients for this intermediary outputs.

Based on this analysis, we conducted the same exercise for the five identified regions; identifying the sectors in which they held a relative

comparative advantage as well as the regions with whom they traded most.

In this section, we present the key insights from our analysis and describe how our findings inform the next section, in which we dissect ONS' Structural Business Dataset to further our analysis of inter-regional and inter city relationships.

Regional sectoral relative comparative advantage (RCA) across UK NUTS2 Regions

Regions produce → **Regions consume**

The following table summarizes the relative comparative advantage (RCA) ratio for London and the top five recipient regions of London's intermediate output. As defined earlier, the Relative Comparative Advantage (RCA) is calculated by dividing the share of sectoral output at the region or city level by the share of sectoral output at the national level. It measures the concentration of a specific sector in a certain region or city in comparison to the UK average. For example, an RCA of 5 means that the specific sector's share as a percentage of total output is five times higher than in the UK economy as a whole.

This analysis shows that London specializes in higher value services such as Financial Intermediation, Non-market services, real estate and business activities. On the other hand, the regions it trades most with, such as East Scotland and West Wales & The Valleys specialize in low to mid-value sectors, mainly electrical equipment, manufacturing and construction.

Strikingly, the West Midlands has a very large relative comparative advantage in the Hotels and Restaurant sector, meaning the share of the sector's intermediate outputs is 68 times higher than in the UK economy as a whole. The importance of the sector is in the West Midlands is confirmed in Section 5.

Higher value goods and services

	London	West Midlands	West Yorkshire	Greater Manchester	West Wales & The Valleys	Eastern Scotland
Energy supply						4
Food and beverages			3	3		4
Textiles			5	5		
Equipment		3	2		3	2
Other manufacturing			2	2	3	
Construction		3		3	2	3
Hotels and restaurants	5	68			3	8
Transport	2					
Financial intermediation	3	2	2	2		
Real estate	3					
Non-Market Services	3	6			5	

Source: Arup analysis, 2019

Intermediate output produced in London and exported to other UK regions, by sector

London produces → **Regions Consume**

Each selected region consumes on average over 1.5% of London Intermediate output.

East Scotland and West Wales & The Valleys were the largest recipients of London intermediate output overall, consuming approximately 3% and 2% of London's total intermediary outputs across all sectors respectively.

When focusing on the sectors in which London held a relative comparative advantage (RCA) in 2010 (see page 26 for more detail), we can see that London was a strong exporter of financial, real estate and non-market services. Approximately one sixth of all intermediary outputs in these three sectors were consumed in the five regions depicted here.

We believe that these regional flows reflect the predominance of major cities in the economic makeup of the UK, especially the largest regional cities such as Edinburgh Manchester, Birmingham, and Leeds.

Share of total intermediate output produced in London and consumed in the five largest recipient regions by sector in which London holds a RCA, 2010, NUTS 2 Level

	West Midlands	West Yorkshire	Greater Manchester	West Wales & The Valleys	Eastern Scotland
<i>Average intermediate output produced in London that is consumed in regions</i>	1% (€3,800 million)	1% (€3,200 million)	1% (€4,000 million)	2% (€6,600 million)	3% (€9,700 million)
Energy supply					
Food and beverages					
Textiles					
Equipment					
Other manufacturing					
Construction					
Hotels and restaurants	1% (€86 million)	3% (€76 million)	3% (€83 million)	6% (€164 million)	1% (€28 million)
Transport	1% (€401 million)	1% (€232 million)	1% (€220 million)	2% (€678 million)	2% (€711 million)
Financial intermediation	<1% (€235 million)	<1% (€401 million)	1% (€401 million)	5% (€1,400 million)	6% (€1,800 million)
Real estate	1% (€1,500 million)	1% (€1,500 million)	2% (€2,100 million)	2% (€2,300 million)	3% (€3,500 million)
Non-Market Services	2% (€700 million)	1% (€500 million)	1% (€600 million)	4% (€1,600 million)	8% (€3,400 million)

Higher value goods and services ↓

Source: Arup analysis, 2019

Intermediate output produced in UK regions and exported to London, by sector

Regions produce → **London Consumes**

On average, London consumes around 3% of intermediate outputs produced in each of the five selected regions. This suggests that trade flows of intermediary goods and services are significant in both directions, flowing out of London to the regions and flowing in from the regions to London.

The highest shares of London consumption of intermediary goods and services from regions are in comparatively lower value sectors such as:

- Food and beverages,
- Equipment, and;
- Construction.

For example, 18% of West Midlands' intermediate outputs in the equipment sector and 11% of Manchester's intermediate outputs in the food and beverages sector is consumed in London.

Maps on pages 28, 32, 35, 38, 41 and 44 depict the relative importance of London as a key recipient of intermediary goods and services from other UK regions. London is the exception in an otherwise relatively inward facing regional trade pattern, where regions largely trade with 'themselves' and closely linked neighbouring regions as in the case of Scotland and Wales.

Higher value goods and services

Share of total intermediate output produced in the various regions and consumed in London by sector in which each region holds a RCA, 2010, NUTS 2 Level

	West Midlands	West Yorkshire	Greater Manchester	West Wales & The Valleys	Eastern Scotland
<i>Average intermediate output produced in regions that is consumed by London</i>	3% (€1,200 millions)	3% (€1,100 millions)	2% (€905 millions)	3% (€550 millions)	3% (€985 millions)
Energy supply					5% (€216 millions)
Food and beverages		9% (€126 millions)	11% (€230 millions)		7% (€127 millions)
Textiles		4% (€3 millions)	3% (€3 millions)		
Equipment	18% (€50 millions)	6% (€31 millions)		7% (€26 millions)	5% (€22 millions)
Other manufacturing		3% (€91 millions)	4% (€110 millions)	4% (€73 millions)	
Construction	11% (€260 millions)		6% (€330 millions)	7% (€1,200 millions)	2% (€90 millions)
Hotels and restaurants	5% (€1 millions)			<1% (€1,200 millions)	<1% (€0.2 millions)
Transport					
Financial intermediation	3% (€32 millions)	2% (€57 millions)	<1% (€2 millions)		
Real estate					
Non-Market Services	2% (€97 millions)			2% (€90 millions)	

Source: Arup analysis, 2019

Summary Findings

An analysis of the EUREGIO dataset provides an initial assessment of the trade linkages that exist between London and the rest of the UK. What we find is that while UK regions are quite self contained from a trade perspective (as more than two thirds of intermediate outputs are generally consumed in the region in which they originate), London remains a key recipient of goods and services produced in the rest of the UK. This relationship goes both ways as certain regions such as East Scotland, West Wales & The Valleys and the West Midlands are also important recipients of London produced goods and services.

24%

Of UK's intermediary outputs were produced in London in 2010

60%

Of London's Intermediary outputs were produced in just three sectors in 2010. We expect this share to have increased even further over the past decade.

**2000-
2010**

Very little change observable between 2000 and 2010 in terms of intermediary output value and shares (as a % of UK's total).

Sectoral specialization of UK regions

1. London holds a competitive edge in higher value sectors, as seen by the relative comparative advantage (RCA) it holds in sectors such as non-market services, real estate and financial intermediation. Similarly, 60% of intermediate output is produced in these three .
2. The regions with which London trades most, such as East Scotland and West Wales & The Valleys specialize in low to mid value sectors, mainly electrical equipment, manufacturing and construction.
3. The West Midlands has a high RCA in the hotels and restaurants sector, a finding that is consistent with the results from the Business Structure Database in the next section, where we find that a sizeable number of firms in the sector appear to be headquartered in Birmingham.

Summary Findings

Intermediate output trade flows

1. In 2010, London's Intermediary outputs represented approximately 24% of the UK total. This share grew only slightly over the 2000-2010 period. Its growth can be explained by the fact that the production of intermediary goods and services decreased less rapidly in London than in other UK regions in the aftermath of the 2008 Global Financial Crisis;
2. The Welsh and Scottish Regions are much more integrated than any other region, perhaps due to their special administrative status. Approximately 72% of all intermediate outputs in all sectors produced in these respective regions are consumed within the same region;
3. Intermediate output trade in other regions tends to support the literature review (see section 3) that concluded that regions tend to trade more with themselves or neighbouring regions due to reduced trade costs. While rich academic literature shows that this is the case in between countries, our data suggests that this is also the case regionally within the UK;
4. London, due to its economic weight, defies that theory as it has strong trade linkages with regions

5. that are furthest away from the capital such as Eastern Scotland;
5. Overall, it seems that London is consistently one of the largest consumers of intermediary goods produced in the different UK regions. On average, the capital consumes 3% or more of all intermediate outputs produced in each region of the UK. These seem to be mostly lower value goods and services. The data suggest that these goods and services may go through a 'value adding' mechanism in the capital as they are then exported as higher value goods and services to other UK regions;
6. Trade flows become even stronger when we look at specific sectors such as Financial Intermediation and Non-Market Services. For example, two regions, namely West Wales & The Valleys and Eastern Scotland, consume approximately 12% of all London's intermediary output in the financial intermediation sector, showing the strong links that exist between the capital and the regions.

Overall, these findings indicate that trade linkages in the UK seem to be driven by city relationships, rather than merely regional linkages. This is supported by the

academic findings presented in the literature review. Indeed, the specific regions that are London's intermediary output largest recipients seem to host some of the UK's largest cities (in terms of population and GVA), that are in turn the main centres of economic activity in their respective regions. In other words, our findings reflect the predominance of cities in the economic makeup of the UK, which reflects the agglomeration effects explored in the literature review.

Our findings reflect the predominance of cities in the economic makeup of the UK.

3% €27bn 7-9%

Of intermediary outputs produced in different UK regions were consumed in London (on average in 2010, respectively for each region).

Value of London's Intermediary outputs consumed in the five regions in our sample in 2010. This is equivalent to 10% of total intermediary output produced in London and over 30% of all non-London consumption in the same year.

Of intermediary output produced by non-London UK regions in sectors such as construction and equipment were consumed in London in 2010.

5 ONS Business Structural Database

As discussed in the previous section, the EUREGIO dataset provides an initial overview of trade linkages between UK regions (at the NUTS2 level) from 2000 to 2010. Through this analysis, we have found that 60% of intermediary output in London was produced in three high value sectors, namely real estate, financial intermediation and non-market services. Furthermore, approximately one third of intermediary output consumed in non-London regions was consumed by just five regions. It is the relationship between these regions (and more precisely, their largest cities) and London that we have been asked to explore further in this section.

In light of EUREGIO's limitations such as a high level of aggregation at the sectoral and geographical levels as well as its temporal limitations (as it solely covers the 2000-2010 period), we chose to

supplement the analysis of London's relationship with the rest of the UK with data from the Office of National Statistics' (ONS) Business Structural Database (BSD). Through the analysis of this dataset, we are able to explore inter-firm linkages that have located in different cities across the UK and provide a more granular picture of the complementary network of firms, sectors and functions that generate economic activity across the country.

This section aims to explore the hypotheses and questions raised in the literature review section, namely how firms are vertically integrated between headquarters and subsidiaries located across different UK cities and as a result how functional specialization has taken place across the country.

ONS Business Structural Database

Database Description

The Business Structure Database (BSD) contains key business variables for nearly all business organisations in the UK. The BSD is derived primarily from the Inter-Departmental Business Register (IDBR), which is a live register of data collected by HM Revenue and Customs via VAT and Pay As You Earn (PAYE) records.

IDBR data are complemented with data from ONS business surveys. If a business is liable for VAT (turnover exceeds the VAT threshold of £80,000 in revenue) and/or has at least one member of staff registered for the PAYE tax collection system, then the business will appear on the IDBR (and hence in the BSD). In 2004 it was estimated that businesses listed on the IDBR accounted for almost 99 per cent of economic activity in the UK. Only very small businesses, such as the self-employed were not found on the IDBR.

The data are divided into '**enterprises**' and '**local units**'. An enterprise is the overall business organisation, also referred to as 'headquarter'. A local unit is a 'plant' or 'subsidiary', such as a factory, shop, branch, etc. In some cases, an enterprise will

only have one local unit, and in other cases (such as a bank or supermarket), an enterprise will own many local units.

The following variables are available for enterprises and local units:

- Employment (and employees, which excludes business owners)
- Turnover
- Standard Industrial Classification (1992, 2003 and 2007 classifications)
- Legal status (e.g. sole proprietor, partnership, public corporation, non-profit organisation etc)
- Foreign ownership
- 'Birth' (company start date)
- 'Death' (termination date of trading)

Census output areas (2001 and 2011 geographies) are included in all data files, which allows us to identify enterprises and local units geographically at the Lower Layer Super Output Area (LSOA) level.

BSD highlights:

99%

Of economic activity in the UK is driven by businesses included in the BSD.

2

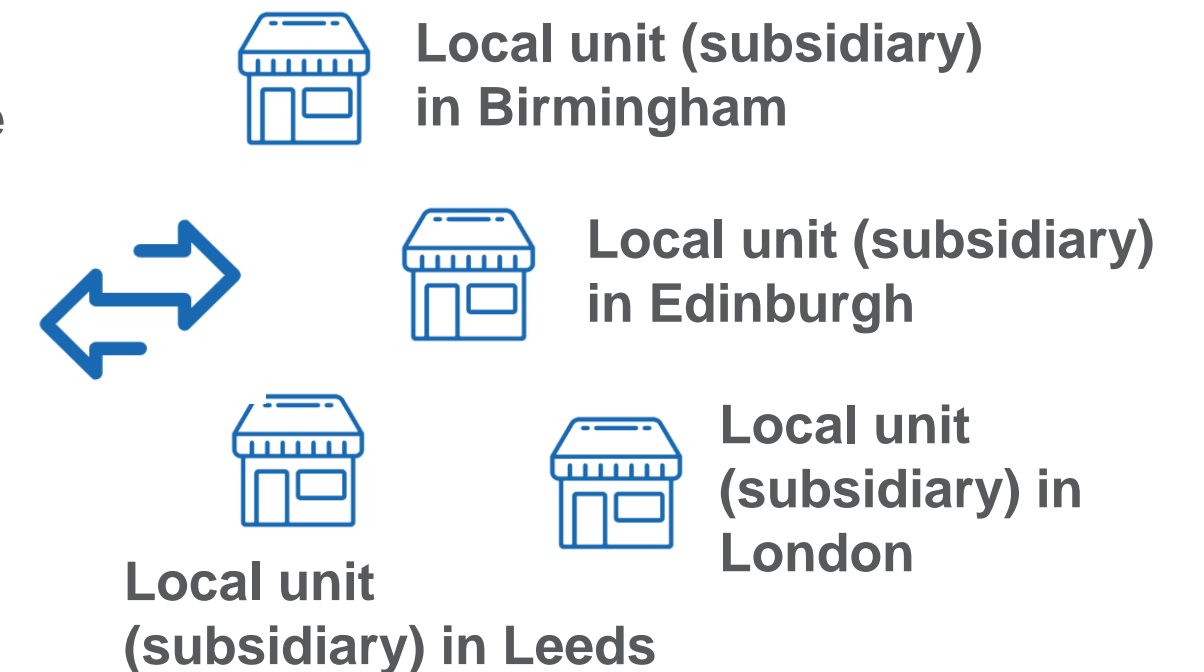
Types of businesses included in the BSD: enterprises (or headquarters) and local units (or subsidiaries)

2007-2018

Period studied in this report

Example:

Enterprise (or headquarter) based in Leeds in the real estate sector



Source: Arup analysis, 2019

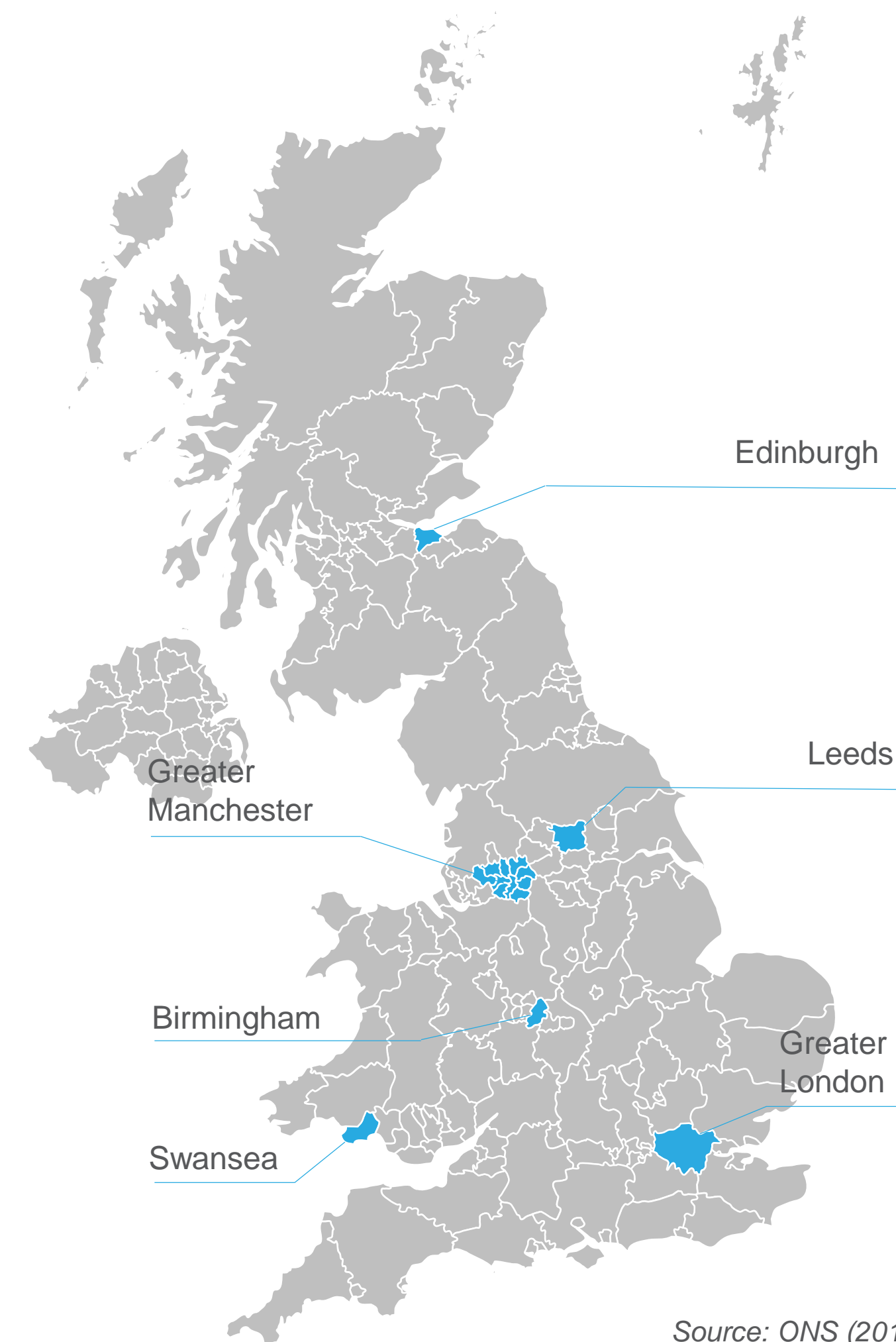
Microdata analysis: cities

Based on our preliminary findings from the EUREGIO dataset, we chose to focus the analysis on five following cities and combined authorities:

- Greater London (Greater London region)
- Greater Manchester (Greater Manchester region)
- Leeds (West Yorkshire region)
- Birmingham (West Midlands region)
- Edinburgh (Eastern Scotland region)
- Swansea (West Wales & The Valleys region)

These cities and combined authorities were selected as they are the largest cities (in population and Gross Value Added terms) in the regions selected in the EUREGIO analysis. Greater London and Greater Manchester were studied at a combined authority level as we believe this level of aggregation provides a more complete image of intra-firm linkages in these geographies.

Cities and combined authorities selected for the purpose of this analysis



Microdata analysis: sectors

To conduct our analysis, we translated the five sectors identified through EUREGIO analysis (in which London held a relative comparative advantage) into Standard Industrial Classification (SIC2007) equivalent sectors used in the BSD. The transport storage and communications sector was broken down further and only the communications sector was selected for further analysis. This is due to the sector's rapid growth and its growing economic importance in the last decade (it represented approximately 8% of total London employment in 2019 (ONS, 2019)). As for non-market services, we chose to focus solely on the professional, scientific and technical activities sector as it is the largest sector in terms of employment in the capital (estimated at 14% in 2019). The following tables illustrate the sectoral 'translation' we performed.

Sectors included in the EUREGIO Database (CPA 2002)

CPA 2002	Description
A+B	Agriculture
C+E	Mining quarrying and energy supply
DA	Food beverages and tobacco
DB+DC	Textiles and leather
DF + DG	Coke refined petroleum nuclear fuel and chemicals
DL+ DM	Electrical and optical equipment and Transport equipment
DD+DE+DH+DI+ +DJ+DK+DN	Other manufacturing
F	Construction
G	Distribution
H	Hotels and restaurant
I	Transport storage and communication
J	Financial intermediation
K	Real estate renting and business activities
L to P	Non-Market Services

Sectors included in the Business Structural Database (SIC 2007)

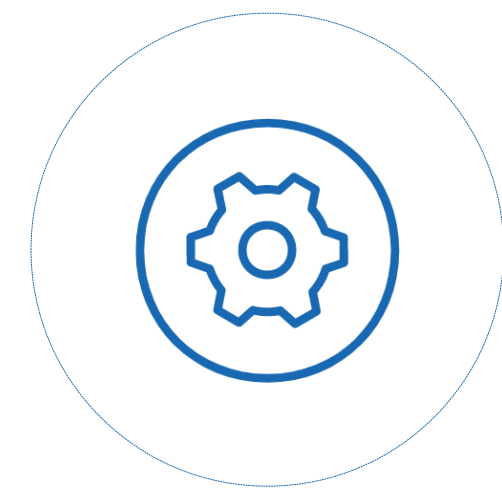
SIC2007	Description
A	Agriculture, Forestry and Fishing
B	Mining and quarrying
C	Manufacturing
D	Electricity, gas, steam and air conditioning supply
E	Water supply, sewerage, waste management and remediation activities
F	Construction
G	Wholesale and retail trade; repair of motor vehicles and motorcycles
I	Accommodation and food service activities
H	Transportation and storage
J	Information and communication
K	Financial and insurance activities
L	Real estate activities
M	Professional, scientific and technical activities
N	Administrative and support service activities
O	Public administration and defence; compulsory social security
P	Education
Q	Human health and social work activities
R	Arts, entertainment and recreation
S	Other service activities
T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use
U	Activities of extraterritorial organizations and bodies

Source: ONS (2019)

Microdata analysis: functions

Within the five selected sectors we chose between one and six detailed 5-digit classifications to form a meaningful and representative analysis of the whole range of activities in each sector. These five digit SIC codes act as functions in our analysis and were selected as they represented a large share of total employment in each sector. For example, the six functions chosen in the finance sector represented nearly half of the sector's total employment (ONS, 2015). The UK SIC hierarchy can be explored in full [here](#).

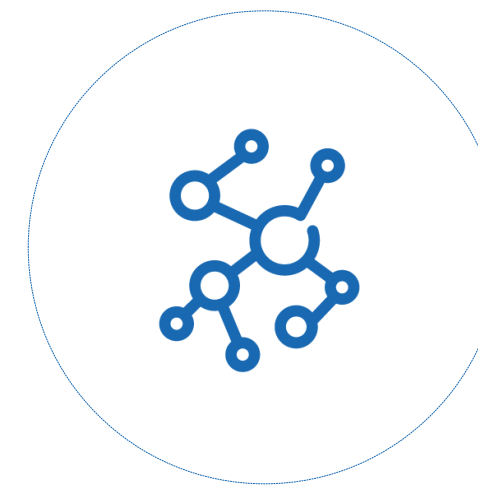
Share of total employment in the selected functions as a percentage of the sector's total in the UK (ONS, 2018)



SECTOR: PROFESSIONAL, SCIENTIFIC AND TECHNICAL (M)

Barristers and Solicitors at Law (69101)
Financial management (70221)
Management consultancy activities (70229)
Engineering design activities for industrial process and production (71121)
Other research and experimental development on natural sciences and engineering (71219)

21%



SECTOR: INFORMATION AND COMMUNICATION (J)

Business and domestic software development (62012)
Computer and consultancy activities (62020)
Data processing, hosting and related activities (63110)
Web portals (63120)

49%



SECTOR : REAL ESTATE (L)

Real estate agencies (68310)
Management of real estate on a fee or contract basis (68320)

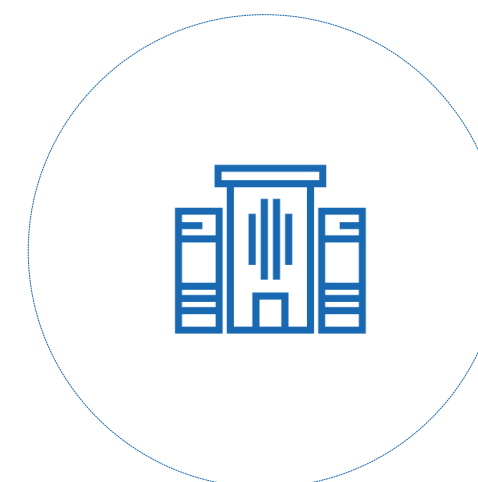
48%



SECTOR: FINANCE (K)

Banks (64191)
Activities of Investment Trusts (64301)
Activities of Venture Capital (64303)
Life Insurance (65110)
Non-life insurance (65120)
Fund management activities (66300)

48%



SECTOR: HOTELS AND RESTAURANTS (I)

Hotels and similar accommodation (55100)

16%

5.1 BSD analysis: summary

This section provides a high level overview of the enterprise-level data in the BSD database and the geographical spread of enterprise headquarters across the UK for the economy as a whole. The data presented here give a sense of UK-wide trends over the 2007 to 2018 period such as key information about the share, average size and average turnover of enterprise headquarters in each city in our sample over time. This preliminary data provides the groundwork supporting the analysis of intra- and inter-firm linkages (between enterprise headquarters and subsidiaries) across the UK in subsections 5.2 to 5.4.

TURNOVER SHARE

42% of all UK enterprise turnover in 2018 was generated by enterprises with a London headquarter. This has increased by 14% since 2007, demonstrating the concentration of value creation in London in comparison to other cities in the UK

48% of UK enterprise turnover was generated by enterprises headquartered in the five cities of interest: London, Manchester, Leeds, Birmingham, Edinburgh and Swansea. Some 10% of non-London enterprises were therefore headquartered in the cities in our sample (except for London). This supports the analysis conducted in Section 4, in which we argued that cities played a central role in the UK economy due to their agglomeration benefits.

EMPLOYMENT SHARE

20% of all UK employees worked for enterprises headquartered in London. This has increased by 3 percentage points since 2007

29% of all UK employees worked for enterprises headquartered in the five cities of interest: London, Manchester, Leeds, Birmingham, Edinburgh and Swansea

Microdata analysis: enterprise headquarters

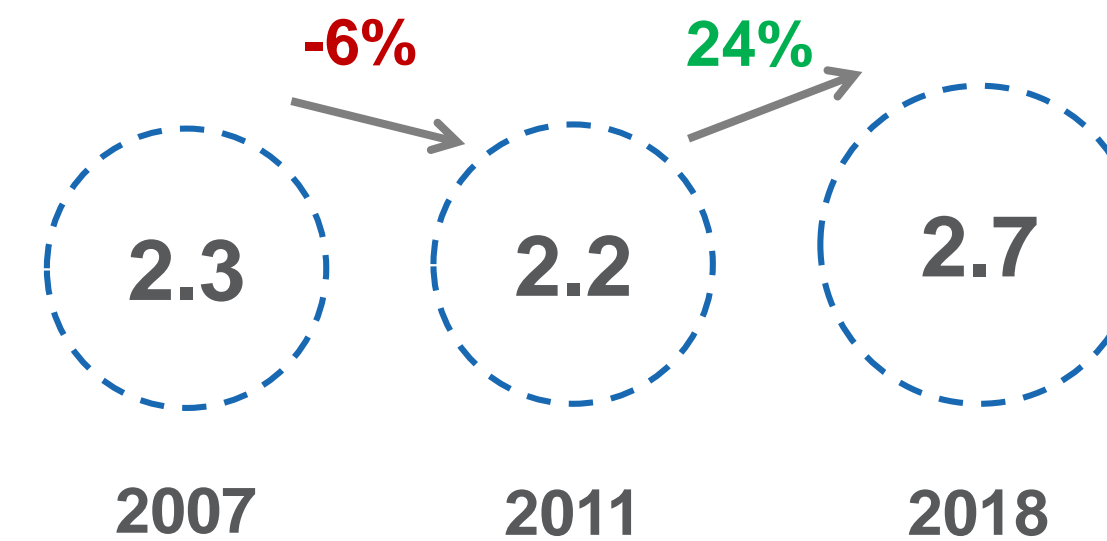
The number of enterprises in the UK declined in the four years following the 2008 Global Financial Crisis (GFC). Only in 2013 did the number of enterprises reach pre-GFC levels, after which there were linear increases until 2018.

Approximately 19% of all UK enterprises were headquartered in London in 2018. London therefore retains a dominant position both in the share and total number of enterprises headquartered in the capital. This dominance has increased over time. Leeds, Birmingham, Edinburgh and Swansea all had less than 1% of UK enterprises headquartered in their city boundaries (respectively). This remained constant between 2007 and 2018, even though the number of enterprises headquartered in cities such as Birmingham and Edinburgh grew by more than 30% over the previous 10 years. Overall, the six cities in our sample (including London) hosted 26% of enterprise headquarters in the UK. This was up four percentage points (from 22%) just ten years prior.

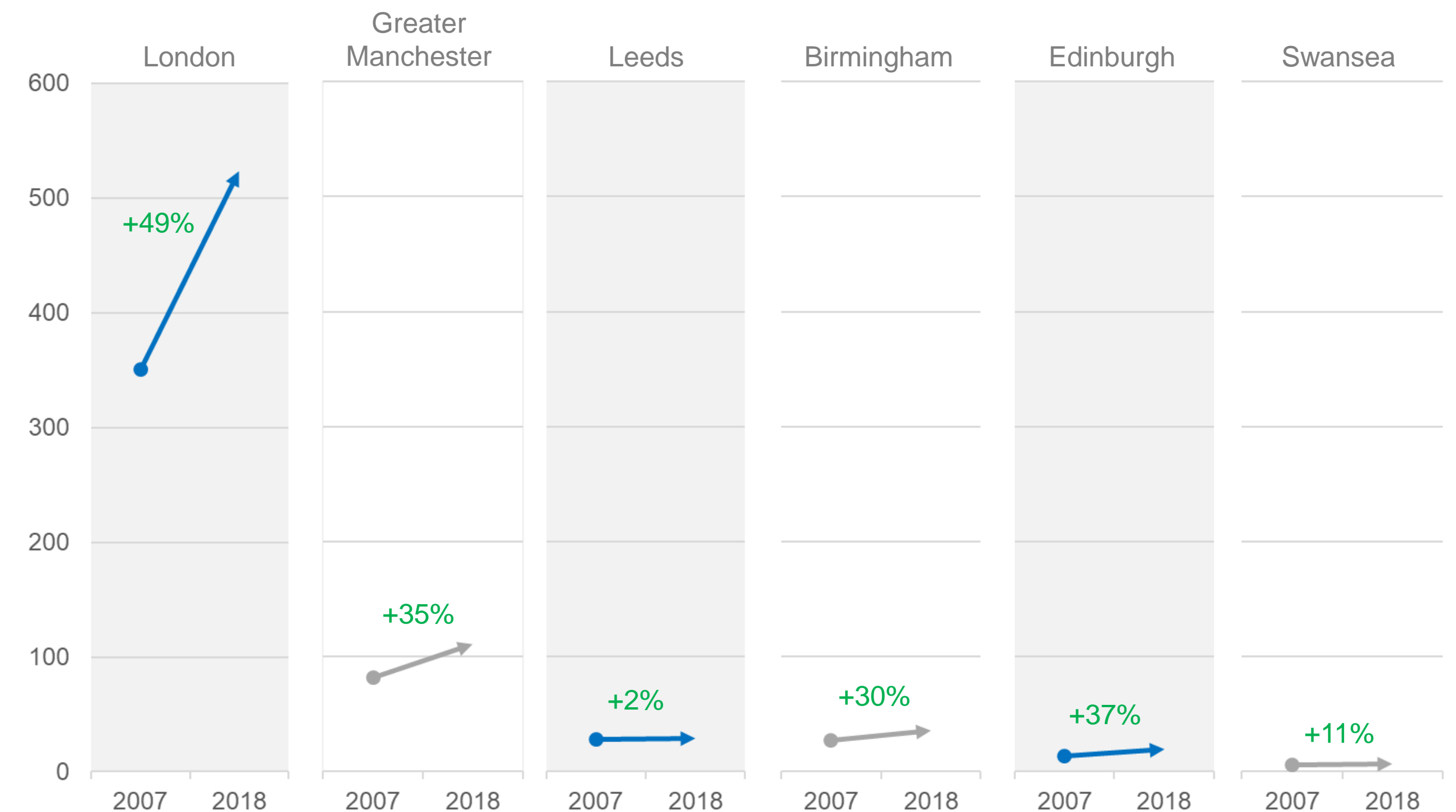
The number of enterprises headquartered in the capital grew by nearly 50% between 2007 and 2018; 12 percentage points more than Edinburgh (the city in our sample with the second highest growth rate), which grew by 37% over the same period.

This evidence appears to support the findings in the literature review, where we argued that headquarters from different sectors will cluster in few large cities to enjoy from the larger benefits of agglomeration for business services.

Number of enterprises in the UK (million)



Number and percentage change of UK enterprises in sample cities (2007-2018) ('000s)



% represents change in number of enterprises headquartered in city between 2007 and 2018

Source: Arup analysis, 2019

Microdata analysis: enterprise headquarters

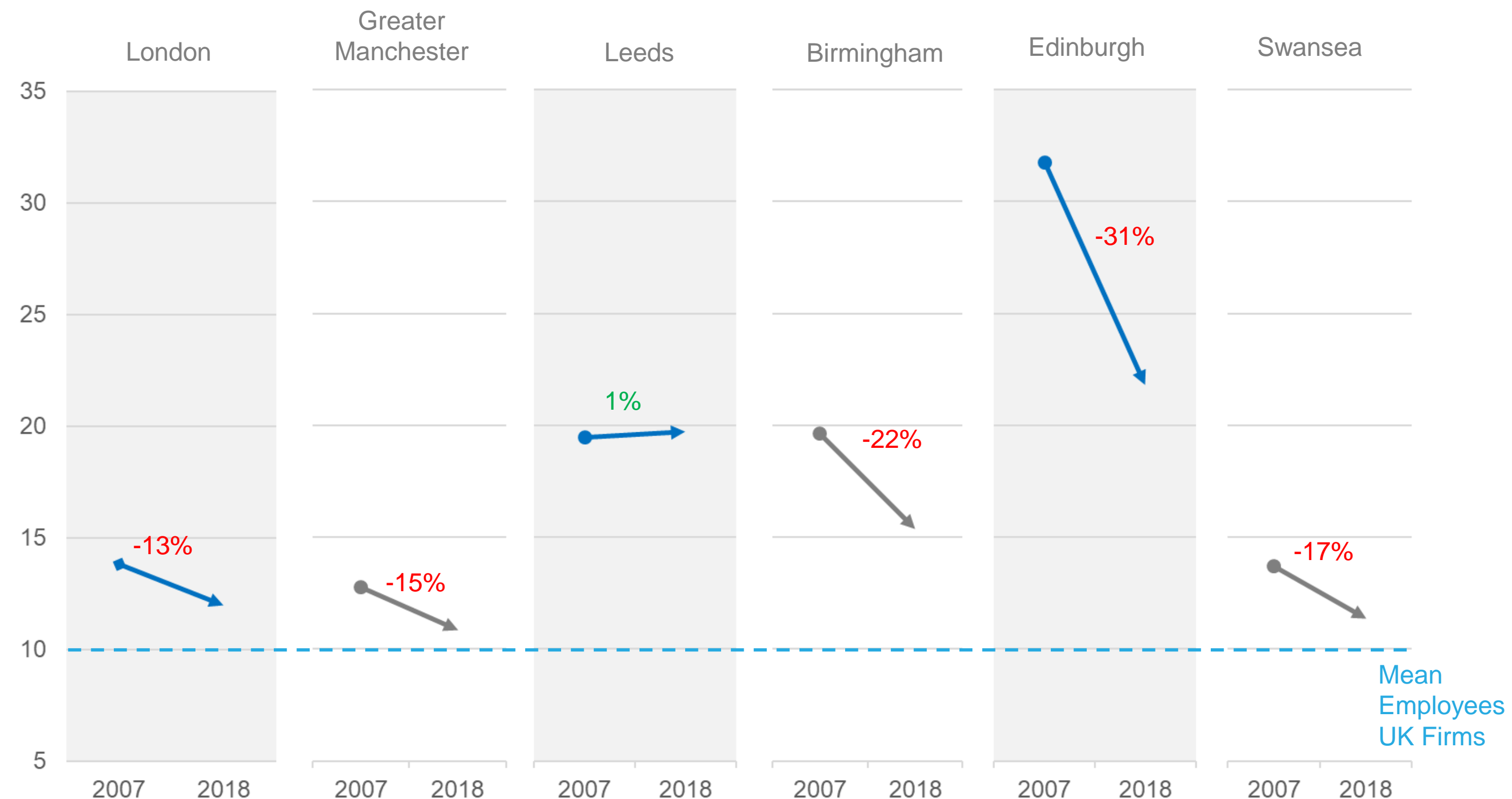
Enterprise average size was largest in Edinburgh and Leeds (at around 20 employees per firm in 2018), in comparison to the other cities in our sample.

Average enterprise size declined in all cities but Leeds between 2007 and 2019, suggesting that while the number of enterprises has grown over the period, they have typically have employed fewer people (therefore bringing the average down). This could be a reflection of the boom in enterprises with no or a small number of employees, which increased by 89% between 2000 and 2019 versus the number of large employers which remained relatively stable over the same period (ONS, 2020). However, enterprise size in the cities in our sample remain larger than the UK average, which stood at around 10 FTE in 2018. Larger cities in our sample appear to have smaller companies on average, which is due to the high level of disparity of enterprise size and activities in cities such as London and Manchester.

Average turnover increased in all cities but Edinburgh between 2007 and 2018. Leeds saw the largest increase in percentage terms, although enterprise mean turnover in real terms remained approximately 50% lower than that of London enterprises. This suggests that productivity levels increased in most cities, certainly London, Greater Manchester and Birmingham as turnover per worker has increased in real terms over the previous 10 years. ONS statistics (2020a) confirm this hypothesis, showing that labour productivity in the UK (real gross value added per hour worked) increased by approximately 8 percentage points between 2004 to 2017, and even higher in London and Birmingham at around 11 percentage points respectively over the same period.

As a caveat, while we used mean FTE in our analysis to ensure comparability across cities, it is worth noting that large firms (500+employees) employ a very high number of employees across the UK. In 2018, just 0.2% of firms (500+ employees) employed 40% of the country's employees. London's 500+ firms, of which there were 850 in 2018, employed one in five of the 40%, or 8% of the UK total (Business Population Estimates, 2019). We therefore expect London's role as a source of employment across the country to be even higher than presented here.

Mean FTE (Full Time Employees) and percentage change in FTE of enterprises with headquarter in city (2007-2018)



% represents change in number of FTE in enterprises headquartered in city between 2007 and 2018

Source: Arup analysis, 2019

Microdata analysis: enterprise headquarters and their subsidiaries

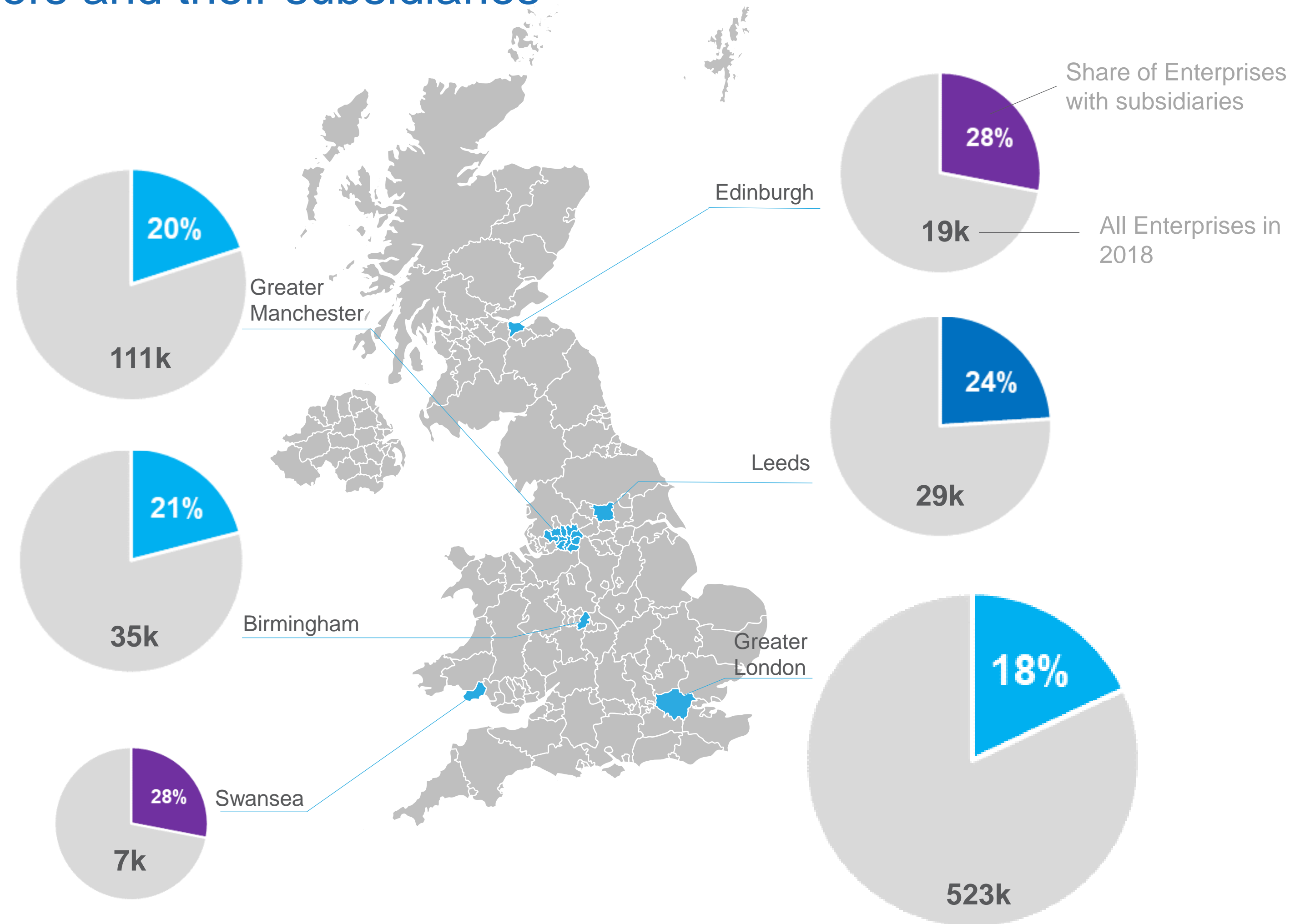
About one fifth of enterprises in Greater Manchester, Birmingham and London had subsidiaries spread around the country in 2018. This represents approximately 96,000 enterprises with subsidiaries in London, 22,000 in Manchester and 7,000 in Birmingham.

In Edinburgh and Swansea, almost 30% of enterprises had subsidiaries, the highest of the cities in our sample. It therefore appears that smaller cities have a larger proportion of enterprises with subsidiaries, but this relationship could simply be spurious in our sample.

These findings reflect the importance of intra-firm linkages in driving economic activity in the UK and indicate that a substantial number of UK firms extend further than their headquarter location.

Further analysis in the following sections indicate that these linkages are particularly strong in the financial sector reflecting the importance of London as a host of a large share of enterprise headquarters with subsidiaries in various cities across the UK.

Over the 2007-2018 period, the share of enterprises with subsidiaries has increased by 124% in the finance sector, while decreasing slightly by 20% and 15% in the real estate and hotel sectors (from 29% to 23% and 24% to 21% respectively). Overall, across all sectors and all enterprises in the UK, this share has increased by 10%. Enterprises have therefore become more spread out geographically speaking – hiring more employees in other cities of the UK and setting up more subsidiaries across the country. This is certainly true for the financial sector.



5.2 Where do headquarters have their subsidiaries (number of firms)?

This section provides an analysis of the relationship between subsidiaries and their headquarters (in terms of the number of firms) and how these are spread geographically around the UK. Our analysis provides us with the following key findings:

- On average, 84% of subsidiaries are linked to enterprises in the same city. That ratio is comparatively lowest for the hotel and restaurants sector, where this share is around 78%. Subsidiaries are thus very concentrated geographically in the same city as their headquarters;
- London enterprises have 90% of their subsidiaries in London, whilst Birmingham and Edinburgh, enterprises have 74% and 73% of their subsidiaries in their respective cities;

- Birmingham and Edinburgh have respectively 4% and 3% of their subsidiaries in London – a relatively high value among the regional cities we studied;
- subsidiaries in professional and communication services are relatively concentrated in the six big cities we chose to analyse, compared to other sectors we analysed;
- Edinburgh is a large ‘exporter’ of financial services, as nearly 80% of subsidiaries linked to enterprises headquartered in Edinburgh are based in cities other than Edinburgh (15% of these were headquartered in London);
- Hotels and restaurants headquartered in Birmingham, Leeds and Manchester have a relatively high number of their

subsidiaries in London, with Birmingham especially high at 15.

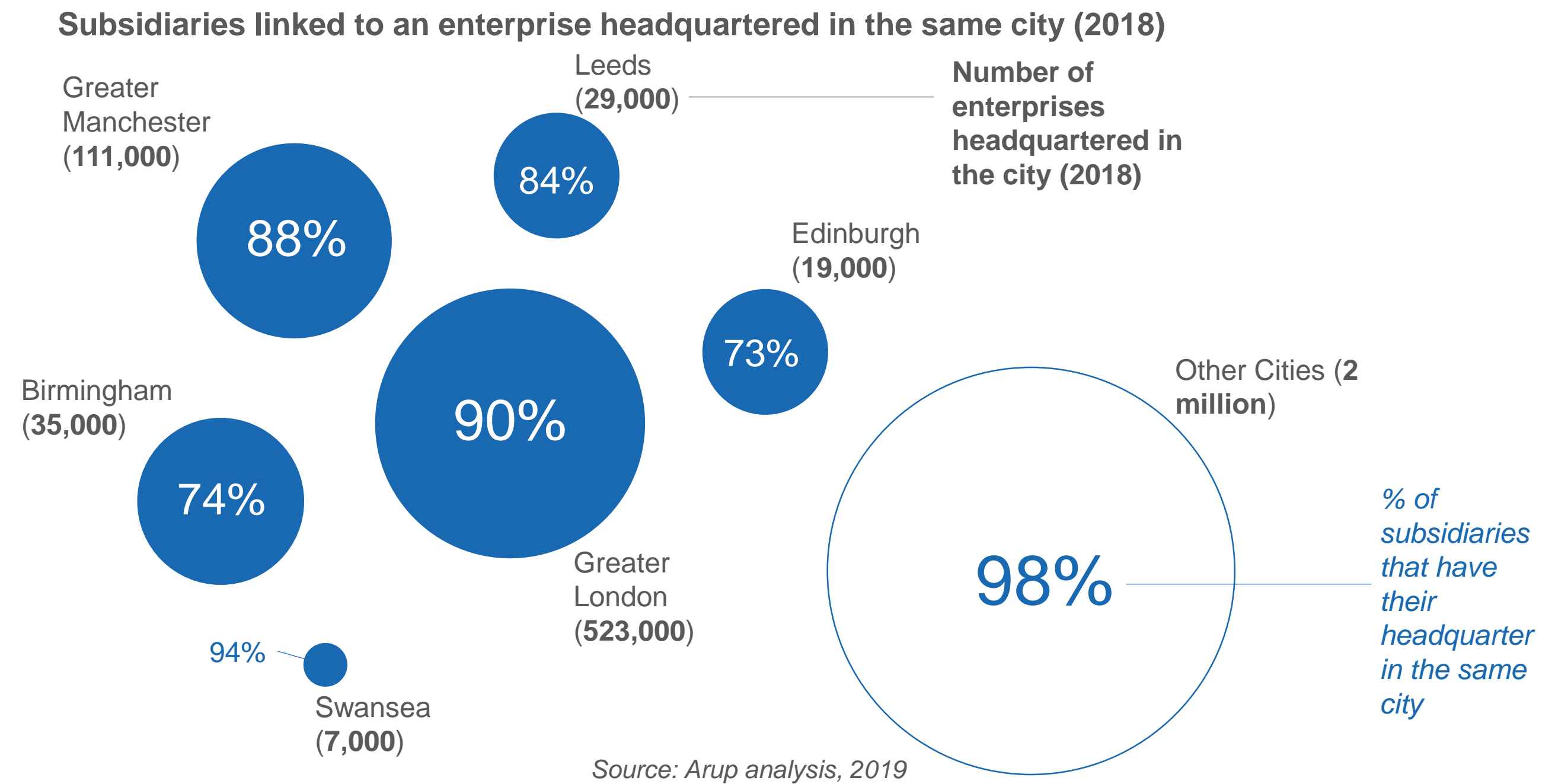
These findings indicate that while headquarters mostly have their subsidiaries in the city in which they are located (a reflection of earlier findings in section 4), approximately one fifth or more of subsidiaries are located in another city other than the one their headquarters are based in. This share varies depending on the sector and city and is highest in the financial sector, supporting previous evidence published by Centre for Cities (2018). It also provides strong evidence at the firm level that there is a strong economic relationship between London and the rest of the country.

Enterprise headquarters and location of their subsidiaries

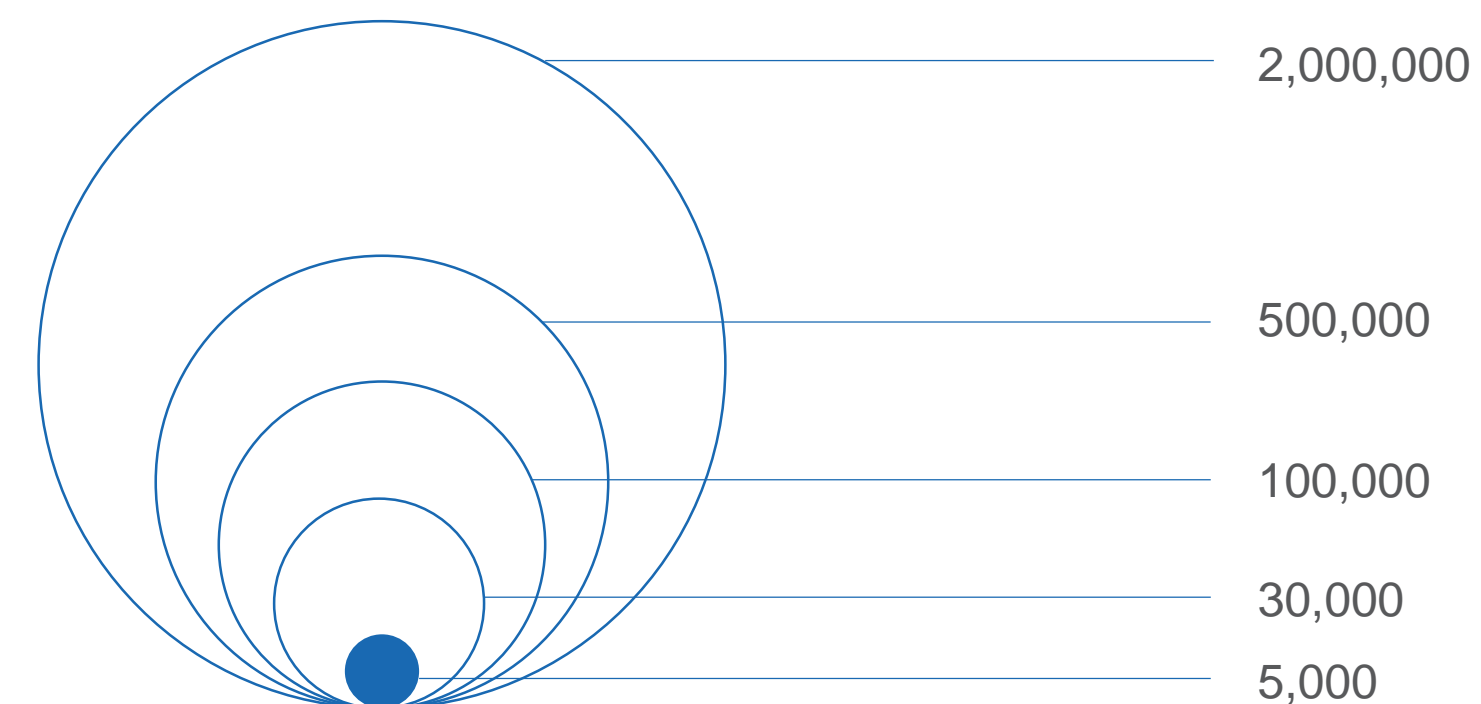
On average, 84% of subsidiaries are linked to enterprises in the same city. This goes as high as 94% in Swansea and the lowest of 73% in Edinburgh. This indicates that businesses in the UK are somewhat spatially concentrated as only about 16% of subsidiaries - on average across the cities in our sample - have headquarters in a city other than the one in which they are based. For example, 12% of subsidiaries in Greater Manchester have their headquarter in another city on the UK. This represents more than 13,000 businesses. As noted, Edinburgh is the city in our sample where subsidiaries depend most on enterprises headquartered in other cities, which might reflect the city's attractiveness to outside investment and companies seeking to establish a regional subsidiary. To illustrate this, foreign direct investment (FDI) in the city increased by more than 13% over the two decades leading up to 2018, the fifth largest recipient of the UK over the same period.

It is worth noting that firms in other UK cities are much more concentrated geographically than the cities in our sample. On average, some 98% of subsidiaries have their headquarters in the same city when looking at cities not included in our analysis. This suggests that the cities which trade most with London are also more integrated in the network of firms that spans across the country.

Appendix 1 presents these data in more detail for all cities in our sample and for the five sectors we selected for our analysis.



Legend:
Number of Enterprises



Enterprise headquarters and location of their subsidiaries (London with the rest of the UK)

London is home to the largest number of headquartered enterprises in the UK (estimated at more than half a million in 2018, or 19% of UK's enterprises) and 4% of regional subsidiaries nationwide depend on London headquartered enterprises. This share is highest in the financial sector, where 8% on average of regional subsidiaries based in our sample cities depend on London headquarters.

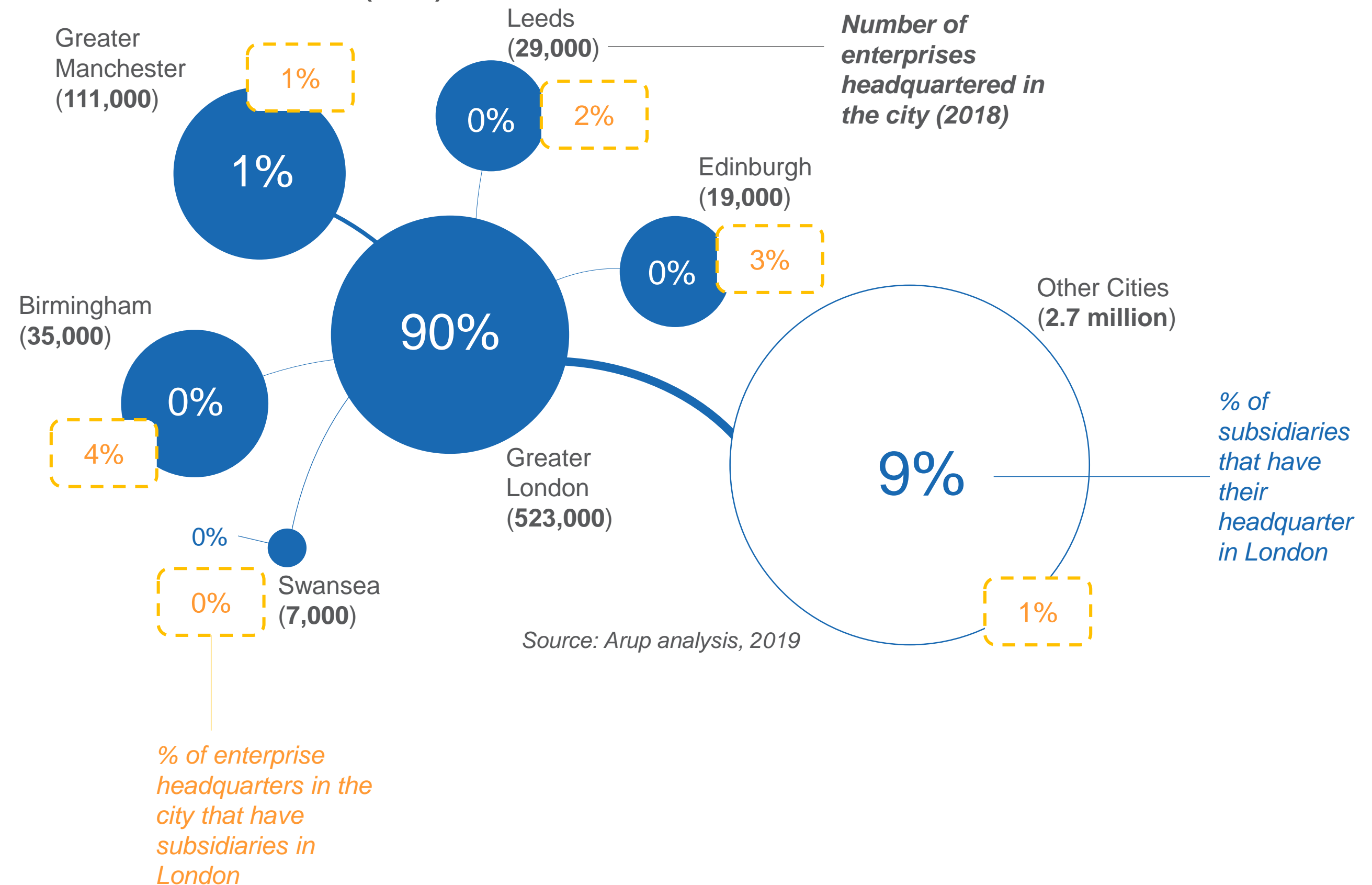
London enterprises have 90% of their subsidiaries in London. The rest of the subsidiaries are spread mainly in between Greater Manchester (1%) and the rest of the UK (cities that are not in our sample at around 9%).

When looking at the reverse relationship (that is to say enterprises headquartered in cities across the UK which have their subsidiaries in London – in orange on the following figure), we notice that London is an important host city for subsidiaries of UK businesses. For example, Birmingham and Edinburgh have 4% and 3% of their subsidiaries (across all sectors) in London respectively .

Breaking down this analysis at the sectoral level, we find the following key findings:

- Some 20% of firms in the financial sector headquartered around the country had subsidiaries based in London.
- Some 81% of subsidiaries belonging to London-headquartered finance enterprises were based in the capital, compared to 90% overall. This indicates that firms in the financial sector are much more spread out geographically than firms in other sectors. Intra-firm linkages are therefore wider and more integrated in the finance sector. This echoes the findings presented in a 2018 report authored by Centre for Cities, in which they demonstrate the strong linkages between UK finance firms.
- Approximately 20% of subsidiaries around the UK have their headquarters in London in the hotels and restaurants sector, suggesting that the sector is relatively spread out geographically versus other sectors that are highly concentrated at the local level.

Subsidiaries linked to an enterprise headquartered in London and UK enterprises with subsidiaries in London (2018)



Enterprise headquarters and location of their subsidiaries (non-London findings)

Data on the relationship between subsidiaries and enterprises across the UK reveal some interesting trends, namely indicating the importance of the finance industry in Edinburgh and the hotel and restaurant sector in Birmingham as well as the geographic concentration of firms in the real estate, information and communications and professional, technical and scientific sectors.

Our analysis suggests the following:

- Some 11% of all subsidiaries attached to enterprises headquartered in Edinburgh were based in London in the finance sector in 2018. We find that Edinburgh is a large ‘exporter’ of financial services, as nearly 80% of subsidiaries linked to enterprises headquartered in Edinburgh are based in cities other than Edinburgh.
- More than three quarters of subsidiaries attached to Birmingham-headquartered enterprises were based in cities across the UK, illustrating Birmingham’s rather unique position as a host of many firms in the hotels and restaurants sector. This evidence supports earlier findings in the EUREGIO dataset analysis section.
- For the professional, technical and scientific sector, 96% of subsidiaries on average are based in the same city as their headquarters. The same degree of geographic concentration applies to the real estate and information and communications sectors, where 94% and 97% of subsidiaries on average are based in the same city as their headquarters. In other words, firms headquartered in a specific UK city, if they attain a certain size and therefore own one or multiple subsidiaries will be much more likely to have these subsidiaries based in the same city rather than somewhere else in the UK. This makes sense for the real estate sector for example, where subsidiaries are real estate offices and are generally more local than national. For information and communications firms, this could suggest that firms are heavily reliant on firms that are nearby geographically speaking.

80% of subsidiaries attached to Edinburgh headquartered enterprises in the finance sector were based in cities other than Edinburgh in 2018. This is much higher than any other city in our sample and indicates that Edinburgh is a large exporter of financial services across the UK.

77% of subsidiaries attached to Birmingham headquartered enterprises in the hotels and restaurants sector were based in cities other than Birmingham in 2018. This evidence echoes the findings in section 4 that indicated the importance of the sector in the West Midlands economy.

97% of all subsidiaries across the UK in the information and communications sector are based in the same city as their headquarters. This share is estimated at 94% and 96% for the real estate and professional, technical and scientific sectors respectively, indicating that these three sectors are highly concentrated geographically speaking across the UK.

5.3 How much does employment in regional subsidiaries depend on firms headquartered in London and in other cities?

Having looked at inter-firm relationships through the number of firms linked across the country, we now turn to employment linkages to give a more nuanced view of intra-firm linkages across the UK.

Similar to the findings in section 5.2, subsidiary employment in each city relies primarily on headquarters in the same city. On average, this ratio is estimated at 62%, being highest in London at around 83% and lowest in Leeds at around 31% (i.e. 83% of subsidiary employment in London have a HQ in London).

Sectorally speaking, the real estate sector is most localized as a large majority of

subsidiary employment is linked to enterprises in the same city. On the other hand, the finance sector is most “spread out”: for each city, out of the five sectors, the ratio of subsidiary employment in the finance sector that is attached to a headquarter in the same city is usually the lowest.

Some 9% of all total employment in regional subsidiaries depend on headquarters in London. This number is around 1% for other cities in our sample.

The importance of intra-firm linkages found in this section (when looking at employment rather than just the number of firms as explored in section 5.2) is mainly driven by

firm size. Indeed, even though firms headquartered in London only have a relatively small number of subsidiaries based in other UK cities, these firms are larger and employ more people than local firms. The same holds for firms with an HQ in the other cities in our sample: the subsidiaries of these firms that are based in other cities are larger than their local counterparts.

Enterprise headquarters and location of their local unit employment

Looking at employment numbers rather than merely the number of firms presents a more nuanced picture of intra-firm linkages across the UK.

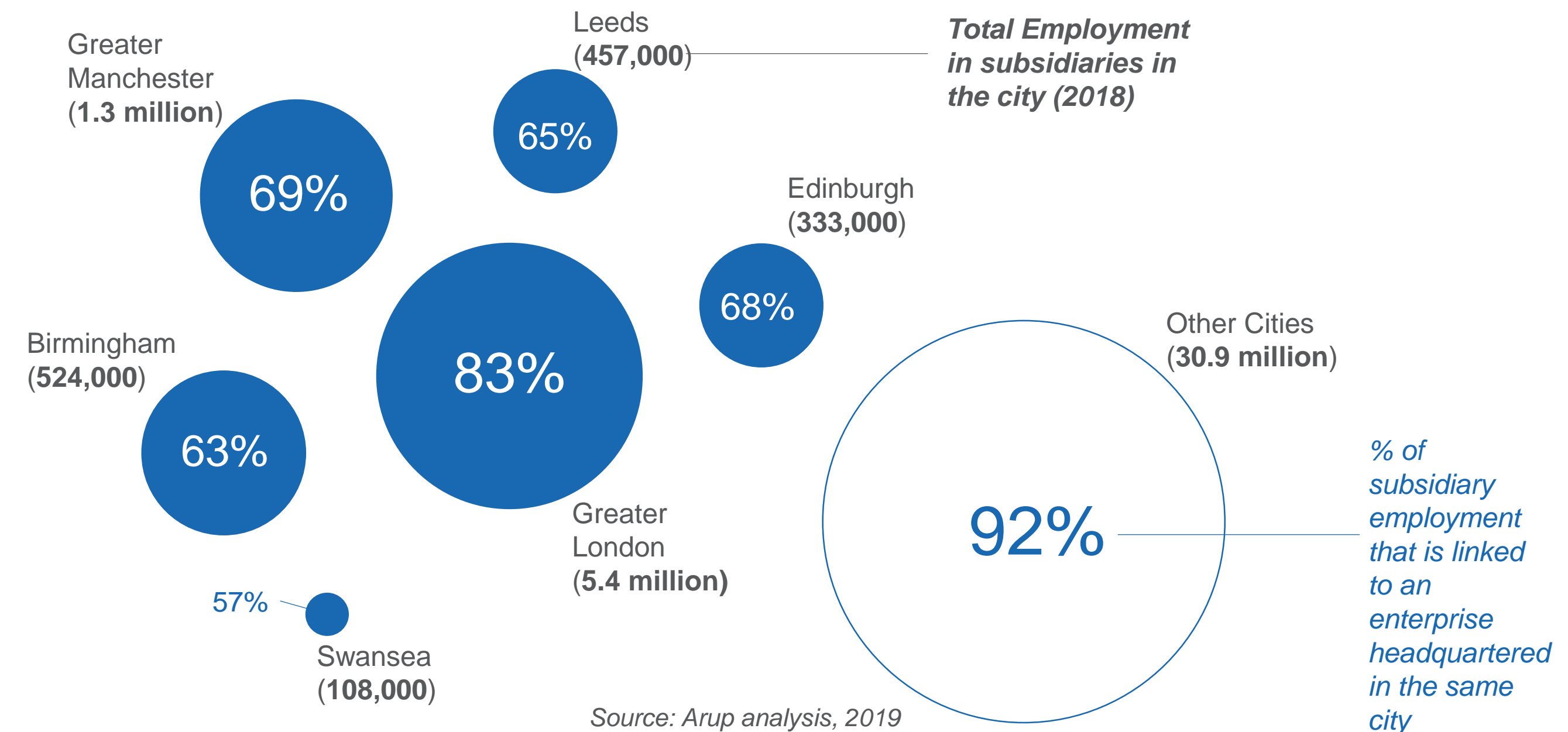
Some 14% of all subsidiary employment in the UK was employed by subsidiaries based in London, slightly lower than the share of enterprises based in London as a share of total UK enterprises.

Through our analysis, we find that, when looking at employment estimates, a much lower share of subsidiaries depend on enterprises headquartered in the same city than when simply looking at the number of firms (in section 5.2). Indeed, approximately 68% of subsidiary employment depended on enterprises headquartered in the same city (on average, across all cities in our sample), much lower than when looking at firms not included in our sample. This share is highest in London at 83% and lowest in Swansea at 57%.

This suggests that:

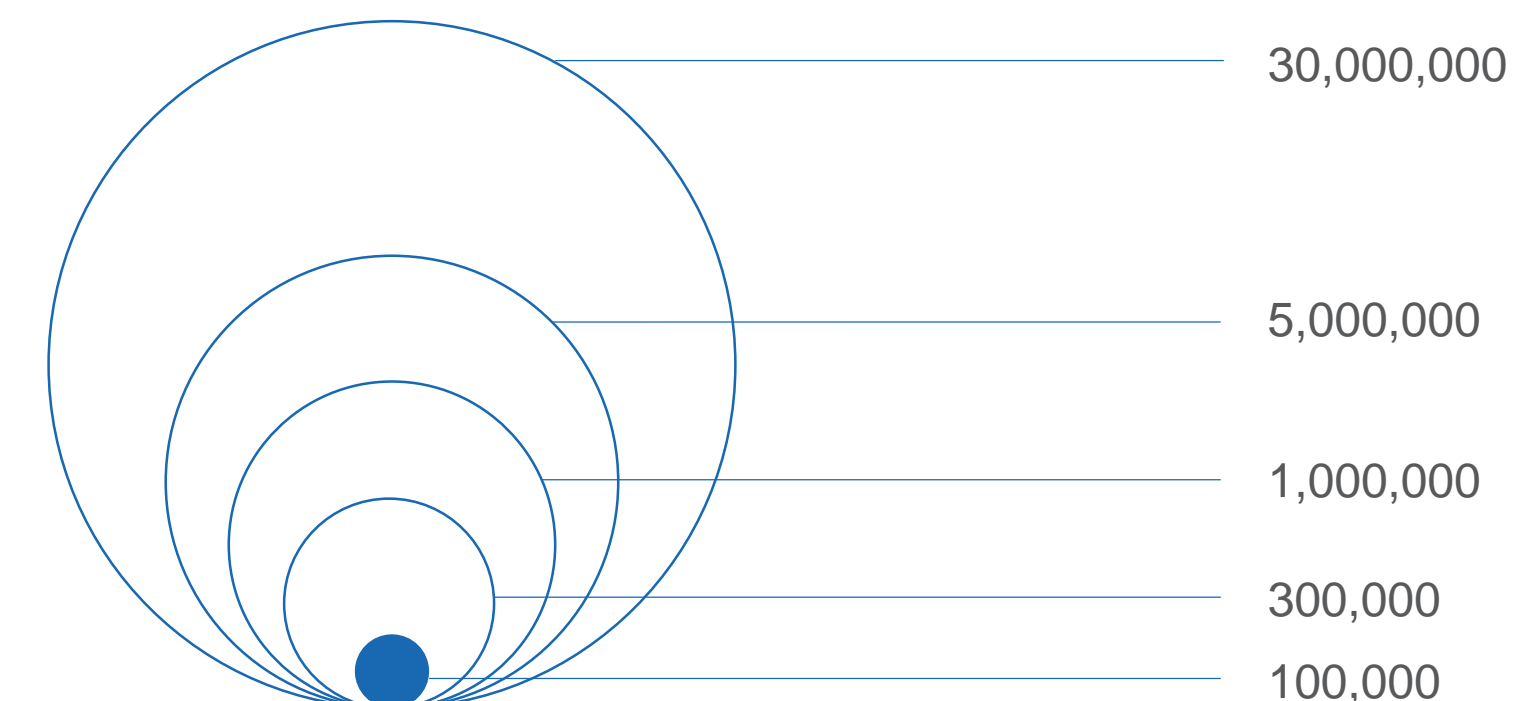
- The cities in our sample are much more integrated and linked than other cities across the UK, where approximately 92% of subsidiaries depend on enterprises headquartered in the same city. This echoes the findings from the EUREGIO data analysis;
- A large share – approximately 43% in Swansea and 30% to 37% of non-London cities in our sample – of subsidiary employment in the cities we studied relied on enterprises headquartered elsewhere in the UK. This was driven mostly by firm size as the subsidiaries of firms that are based in other cities are larger than those of firms in the same city.

Subsidiary employment linked to an enterprise headquartered in the same city (2018)



Legend:

Number of Total Employees



Employment in subsidiaries linked to enterprises headquartered in London

On average, and across all sectors, 9% of total employment in regional subsidiaries depend on London (i.e. the subsidiaries have a headquarters in London). That ratio is significantly higher for the financial sector and information and communication services – around 20% of total employment in regional subsidiaries depend on headquarters in London. Between one fifth and one fourth of employment in subsidiaries in Leeds, Manchester and Birmingham was in subsidiaries that were linked to an enterprise headquartered in London. This indicates the large importance London headquartered firms play as source of major employment across cities in the UK – specifically in the finance sector.

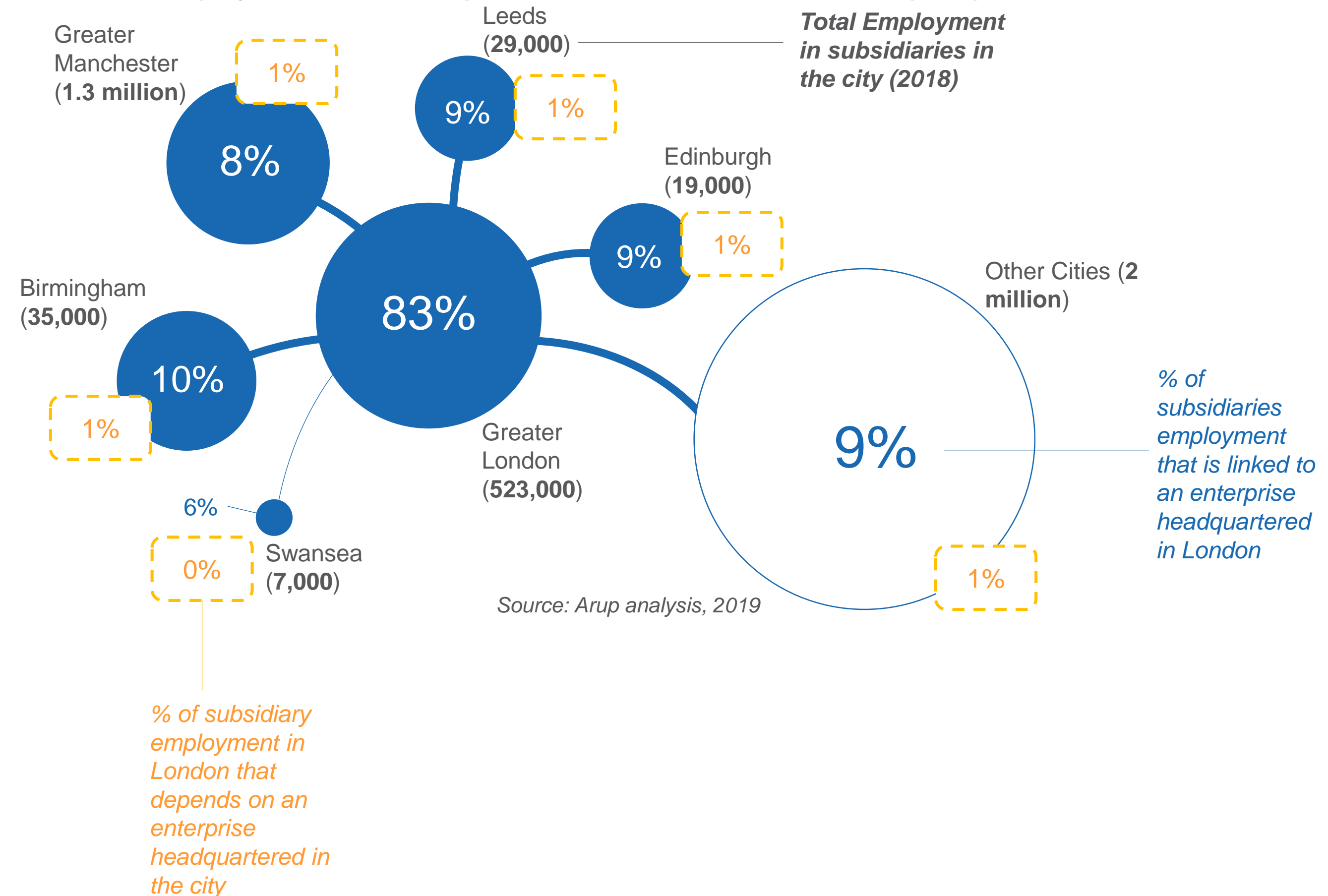
Through our analysis, we find that these results are mainly driven by firm size. Indeed, subsidiaries headquartered in London employ, on average, two to three times more employees than subsidiaries headquartered somewhere else and situated in the same city.

Swansea differs significantly from other selected cities – it has the lowest share of all jobs depending on headquarters in London, practically no ‘dependable’ jobs in professional services and real estate, while the highest share of dependable jobs for information and communication services.

Focusing on London specifically, we notice that on average, 83% of its subsidiary employment is linked to a headquarter in the capital. This means that employment in London is relatively concentrated, relying mostly on firms that are based within the city boundaries. From all the sectors considered, that ratio is highest for real estate and professional services - similar to the results found in section 5.2.

Approximately 1% of subsidiary employment in London depends on an enterprise headquartered in the respective cities in our sample.

Share of employees in subsidiaries linked to an enterprise headquartered in London and share of employment in UK enterprises with subsidiaries in London (2018)



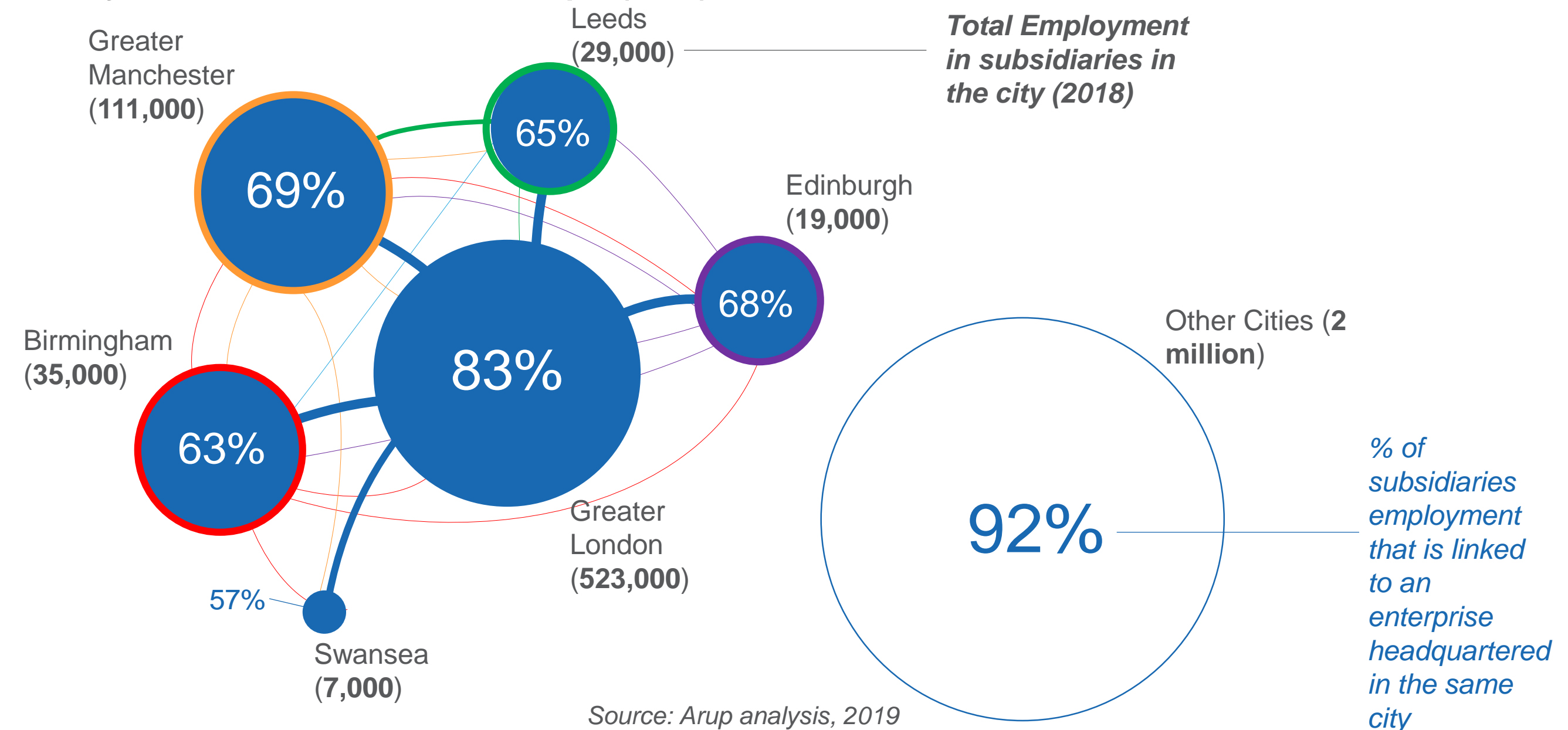
Employment in subsidiaries linked to enterprises headquartered in cities across the UK (non-London findings)

As noted previously, we find that firms are much more dependent on other cities when looking at total employment numbers rather than the number of firms that are linked across UK cities and sectors. This is driven by firm size as the mean size of subsidiaries with an headquarter somewhere else is usually larger than subsidiaries with an HQ in the same city.

We find that:

- In general, employment in subsidiaries in the five cities in our sample rely largely on enterprises based in the same city. The real estate, professional, technical and scientific and information and communications sectors appear to be more geographically concentrated than finance or the hotels and restaurants sectors.
- An important share of employment in subsidiaries in the finance sector in cities across the country depend on Edinburgh-based firms. This ratio stood at around 13% on average in cities included in our sample, with approximately one fifth of local unit employment in the finance sector in Leeds and Birmingham depending on Edinburgh-based firms. This echoes the findings presented in section 5.2.
- Smaller cities such as Swansea, Edinburgh and Leeds depend more on firms headquartered in other cities as a source of local unit employment than the larger cities in our sample that appear to be more concentrated geographically.
- No (or close to none of the) subsidiaries in the cities in our sample depended on enterprises headquartered in Swansea for employment
- Approximately one quarter of Swansea local unit employment depended on enterprises headquartered in UK cities that were not included in our sample in 2018.

Share of employees in subsidiaries linked to an enterprise headquartered in another city, only for cities included in our sample (2018)



5.4 Functional specialisations in London and linkages to other cities

Out of the five selected sectors, enterprises in professional services and the information and communications sector in London have the lowest share of enterprises with subsidiaries in other cities – 11-12% in comparison to 66% for Finance.

For all selected functions, the vast majority of London subsidiaries are linked to HQs in London. This ratio is never lower than 94% with two exceptions: Life Insurance (85%) and Banks (50%).

Another key finding is that London is an important host of enterprise headquarters with local units across the UK. When looking at sectoral and functional level data, we find that:

- A large share of subsidiaries in cities around the UK that perform banking and fund management activities depend on enterprises headquartered in London (30% on average);
- In terms of functions in professional services, comparatively more subsidiaries in Birmingham have HQs in London – 6% for the barristers and solicitors function and 6% for engineering activities. Also 12% Edinburgh research subsidiaries have a HQ in London;
- Many regional subsidiaries in data processing have an HQ in London – 24% in Edinburgh, 21% in Leeds and 8% in Manchester, indicating that London outsources a large part of these activities to these three cities.

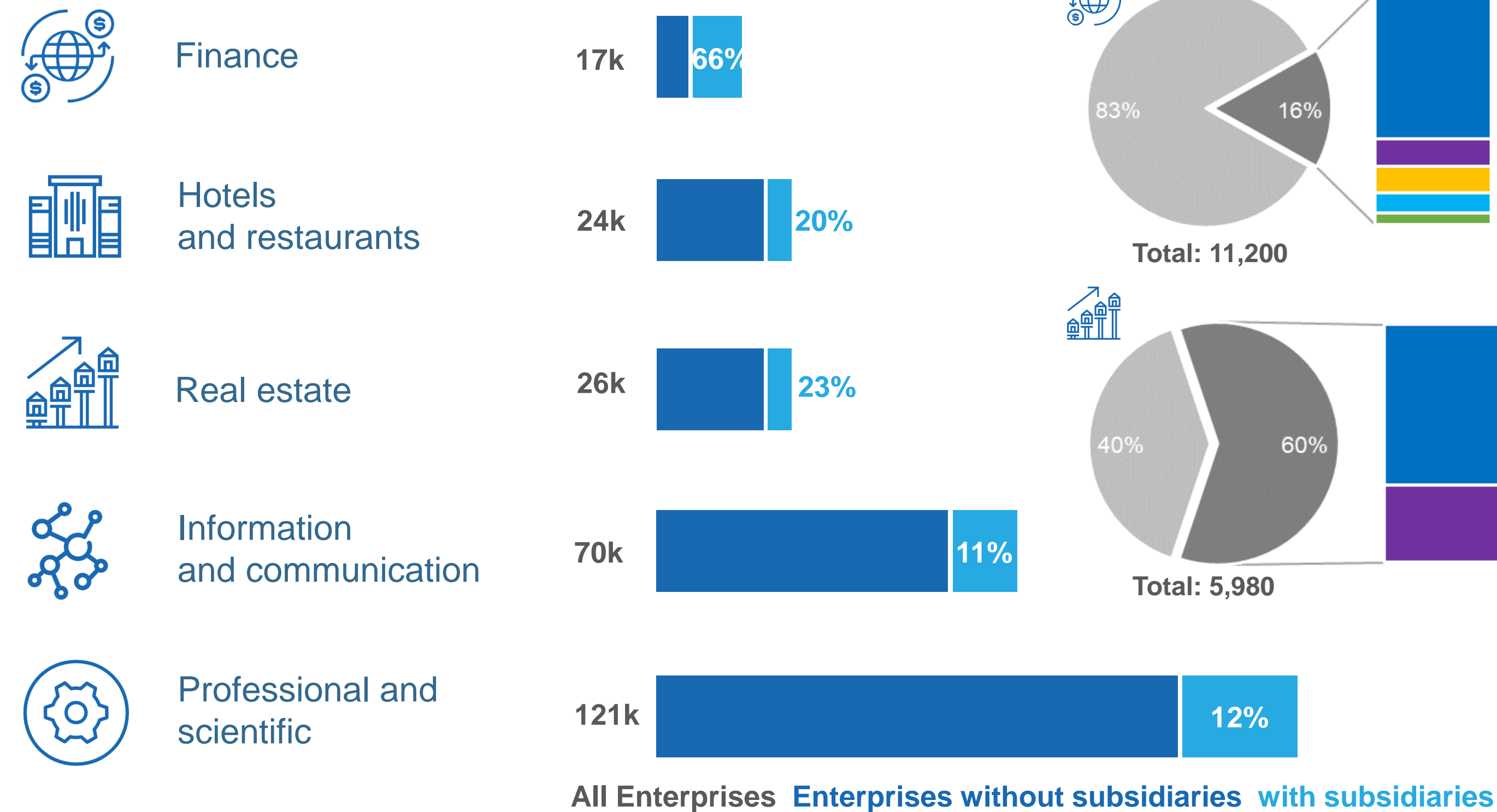
- On average 5% of local real estate agencies have HQs in London;
- On average 10% of local hotels have a HQ in London.

These findings highlight London's important role as a major host of enterprise headquarters with local units across the UK. This is particularly true in the finance sectors and the functional activities we defined within it. The relationship between London and the cities in our sample is mutually reinforcing as London also hosts an important part of activities outsourced from other cities in the UK. This is particularly true for Edinburgh, due to the strength of the city's finance relationship with London.

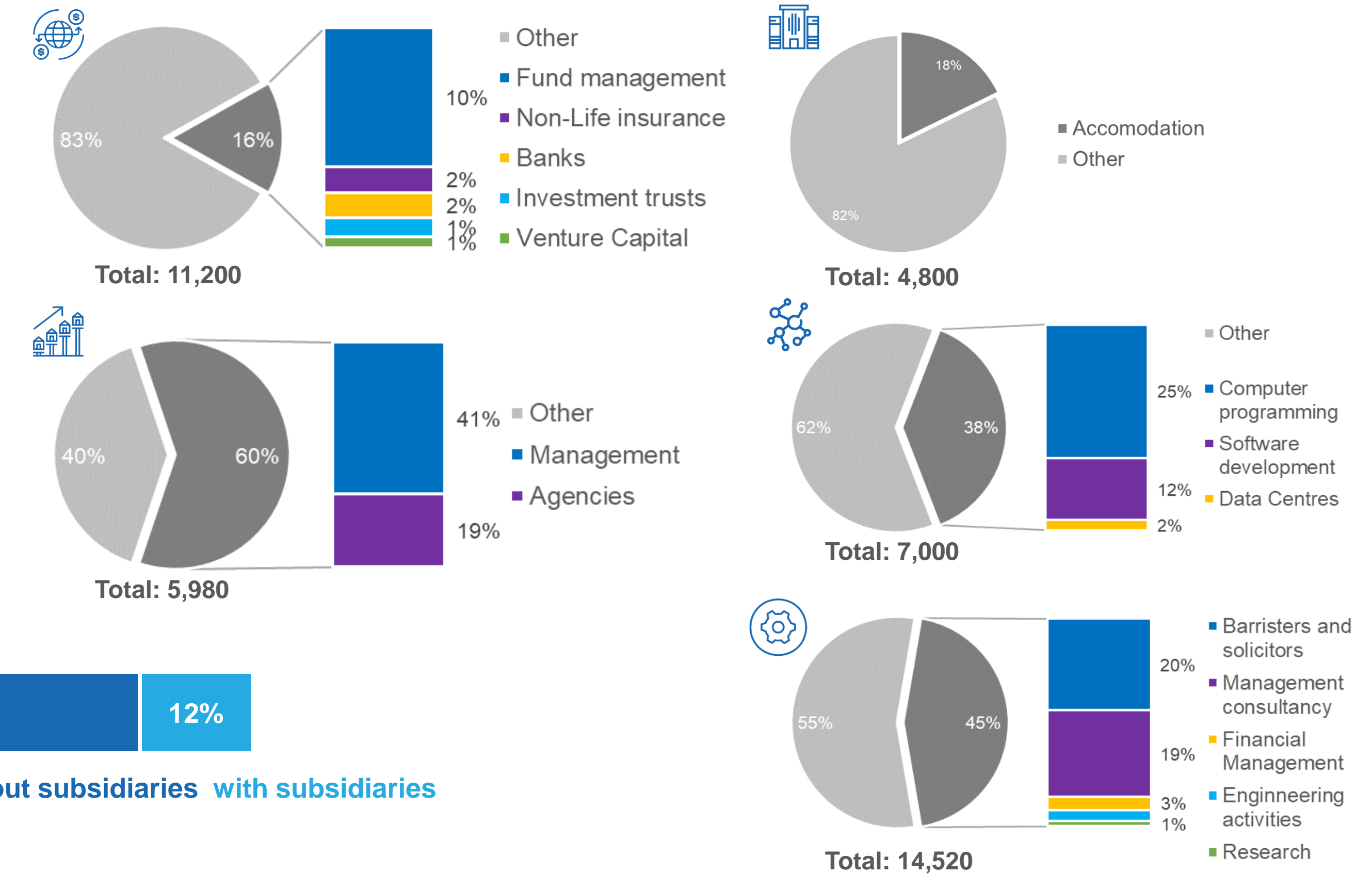
Functional specialisations – London Enterprises

Bars show numbers of London Enterprises in a given sector and shares of enterprises with and without subsidiaries. Enterprises in those five sectors account for 50% of all London enterprises.

Share of London enterprises with and without subsidiaries



Composition of London enterprises that have subsidiaries in given sectors and functions



Source: Arup analysis, 2019

Functional specialisations – Subsidiaries with a London HQ in the finance sector



SECTOR: FINANCE (K)

Banks (64191)

Activities of Investment Trusts (64301)

Activities of Venture Capital (64303)

Life Insurance (65110)

Non-life insurance (65120)

Fund management activities (66300)

Half of all subsidiaries in the banking function in London have their headquarters in London. Looking at other cities in our sample, approximately 30% of UK local bank subsidiaries depend on London-headquartered banks, reinforcing the importance of the capital as a banking centre and source of jobs in the banking industry elsewhere in the UK. The same observation holds for firms active in fund management activities. Indeed, half of fund management activities in Birmingham depended heavily on enterprises headquartered in London. To a lesser extent, that was the case for Manchester, Leeds and Edinburgh.

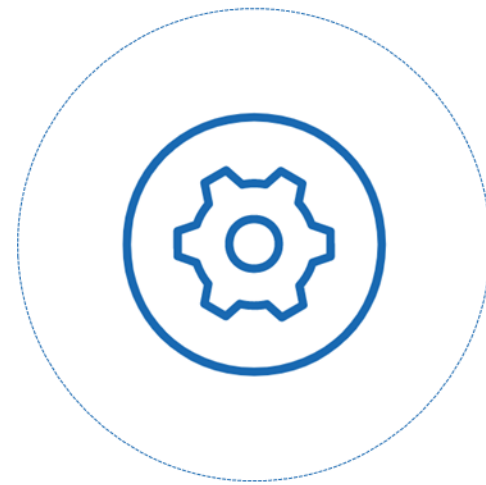
Other functions in the finance sector seem to be more concentrated geographically in the capital. More than 90% of investment trust, venture capital, fund management and non-life insurance activities in London were linked to an enterprise based in London.

Share of all subsidiaries in those functions in given location, which depend on a HQ in London

LU Location	Banks	Activities of Investment Trusts	Activities of Venture Capital	Fund Management Activities	Life Insurance	Non-Life Insurance	Other Finance
London	50%	98%	100%	97%	85%	93%	94%
Manchester	31%	-	-	26%	-	17%	2%
Leeds	37%	-	-	-	-	28%	4%
Birmingham	35%	-	-	48%	-	-	4%
Edinburgh	17%	-	-	16%	-	-	4%
Swansea	-	-	-	-	-	-	3%
Other	31%	4%	-	8%	8%	7%	2%

Source: Arup analysis, 2019

Functional specialisations – Subsidiaries with a London HQ in the professional, scientific and technical sector



SECTOR: PROFESSIONAL, SCIENTIFIC AND TECHNICAL (M)

Barristers and Solicitors at Law (69101)

Financial management (70221)

Management consultancy activities (70229)

Engineering design activities for industrial process and production (71121)

Other research and experimental development on natural sciences and engineering (71219)

Practically all subsidiaries in professional and scientific sector in London have a HQ in London.

Less than one tenth of the subsidiaries in the various functions selected in the professional, scientific and technical sector were linked to enterprises headquartered in London.

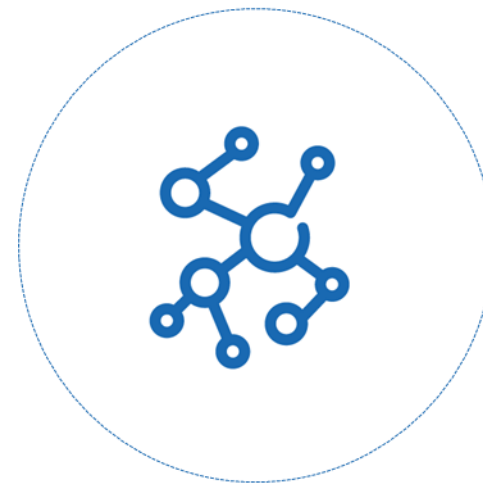
Research in Edinburgh is an exception, with approximately 12% of all subsidiaries active in this function dependant on an enterprise with a headquarter in London. This might indicate the strong links between Universities and research centres between London and Edinburgh.

Share of all subsidiaries in those functions in given location, which depend on a HQ in London

LU Location	Barristers and Solicitors at Law	Financial management	Management Consultancy Activities	Engineering Activities for Industrial Process Production	Research	Other
London	97%	99%	99%	97%	97%	94%
Manchester	-	-	-	-	-	3%
Leeds	-	-	1%	-	-	4%
Birmingham	6%	-	2%	6%	-	4%
Edinburgh	-	-	1%	-	12%	5%
Swansea	-	-	-	-	-	3%
Other	1%	-	-	1%	2%	2%

Source: Arup analysis, 2019

Functional specialisations – Subsidiaries with a London HQ in the information and communications sector



SECTOR: INFORMATION AND COMMUNICATION (J)

- Business and domestic software development (62012)
- Computer and consultancy activities (62020)
- Data processing, hosting and related activities (63110)
- Web portals (63120)

Again, practically all London subsidiaries in selected Information and communication functions have an HQ in London.

Around one fourth of Leeds and Edinburgh subsidiaries active in data processing and hosting and around one tenth of Manchester ones are dependent on an enterprises headquartered in London. This might suggest that such tasks are outsourced to the highlighted cities from London headquartered enterprises in the information and communications sector.

Share of all subsidiaries in those functions in given location, which depend on a HQ in London

LU Location	Software Development	Computer Consultancy and Activities	Data Processing and Hosting	Other
London	98%	99%	96%	94%
Manchester	1%	1%	8%	3%
Leeds	2%	1%	21%	4%
Birmingham	1%	1%	-	4%
Edinburgh	2%	1%	24%	5%
Swansea	-	-	-	3%
Other	1%	1%	7%	2%

Source: Arup analysis, 2019

Functional specialisations – Subsidiaries with a London HQ in the real estate sector



SECTOR : REAL ESTATE (L)

Real estate agencies (68310)

Management of real estate on a fee or contract basis (68320)

Approximately 10% of real estate agencies in London depended on real estate firms headquartered outside of the capital.

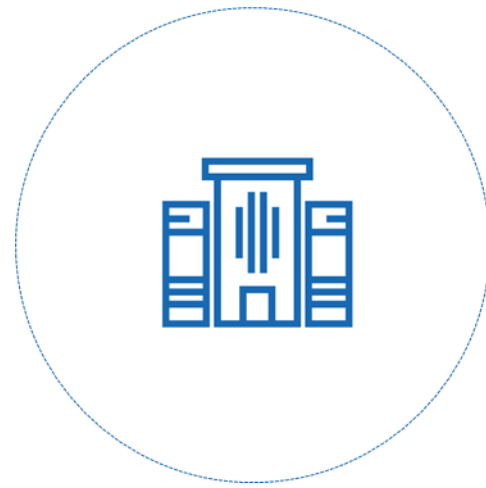
On average 5% of real estate agencies in the regional cities (except for Swansea) have a HQ in London. This suggests that real estate functions are very concentrated geographically, echoing the findings in the previous sections where we argued that real estate firms spread out much less than firms in other sectors.

Share of all subsidiaries in those functions in given location, which depend on a HQ in London

LU Location	Real Estate Agencies	Management of Real Estate	Other
London	91%	98%	94%
Manchester	3%	1%	3%
Leeds	5%	1%	4%
Birmingham	4%	2%	4%
Edinburgh	7%	-	5%
Swansea	-	-	3%
Other	2%	-	2%

Source: Arup analysis, 2019

Functional specialisations – Subsidiaries with a London HQ in the hotels and restaurants sector



SECTOR: HOTELS AND RESTAURANTS (I)

Hotels and similar accommodation (55100)

More than 10% of hotels and similar accommodation in London depended on a hotel chain headquartered outside of London in 2018.

Around 10% of local accommodation in Leeds, Birmingham and Edinburgh and 5% in Manchester is linked to an enterprise in London. This suggests that London headquartered hotels and restaurants have a wide network of subsidiaries in cities across the UK, as about on tenth of local subsidiaries in most cities in our sample depended on London-based firms in the sector.

Share of all subsidiaries in those functions in given location, which depend on a HQ in London

LU Location	Hotels and Similar Accommodation	Other
London	89%	94%
Manchester	5%	3%
Leeds	12%	4%
Birmingham	9%	4%
Edinburgh	9%	5%
Swansea	-	3%
Other	3%	2%

Source: Arup analysis, 2019

5.5 Functional specialisations in our sample cities: findings






Having studied the functional linkages between enterprises headquartered in London and subsidiaries spread across the cities in our sample, we now turn to an analysis of functional linkages between firms headquartered in non-London cities and their subsidiaries in other UK cities. We find that there is only a limited number of enterprises headquartered in the various non-London cities that outsource specific activities elsewhere in the UK.

As highlighted previously, we find that firms are strongly concentrated geographically, mostly in the real estate and professional, technical and scientific sectors. Finance and hotels and restaurants appear to be more 'spread out' and more likely to outsource specific activities to firms based in other cities than the one in which their headquarter is based.

Functional specialisations – subsidiaries with Greater Manchester HQ

Key findings

Few subsidiaries in cities across the UK had their HQ in Greater Manchester. This holds across the five sectors of interest selected in our study.

	<p>Finance</p>	<p>Only 3% of subsidiaries in the banking function in Greater Manchester have their headquarter in Greater Manchester, versus 31% in London. Other functions in the finance sector appear to be more concentrated geographically in Greater Manchester itself.</p>		<p>Hotels and restaurants</p>	<p>More than 30% of hotels and similar accommodation in Greater Manchester depended on a hotel chain headquartered outside of Greater Manchester in 2018. Under 1% of subsidiaries in other cities in the hotel and restaurant sector were linked to enterprises headquartered in Greater Manchester.</p>
	<p>Information and communication</p>	<p>Practically all Greater Manchester subsidiaries in selected Information and communication functions have a HQ in Greater Manchester. Approximately 4% of subsidiaries in cities across the UK (apart from the other five cities in our sample) working in computer consultancy and activities had an HQ in Greater Manchester.</p>		<p>Real estate</p>	<p>Similarly to other cities in our sample, approximately 90% of real estate agencies in Greater Manchester depended on real estate firms headquartered in Greater Manchester. Under 1% of subsidiaries in other cities in the real estate sector were linked to enterprises headquartered in Greater Manchester.</p>
	<p>Professional and scientific</p>	<p>Practically all (above 90%) subsidiaries in professional and scientific sector in London have a HQ in Greater Manchester. This is similar to the trend observed in London. Under 1% of subsidiaries in other cities in the professional, scientific and technical sector were linked to enterprises headquartered in Greater Manchester.</p>			

Functional specialisations – subsidiaries with Leeds HQ

Key findings

Few subsidiaries in cities across the UK had their HQ in Leeds. This holds across the five sectors of interest selected in our study.



Finance

All local investment trusts, fund management and life insurance subsidiaries in Leeds had their HQ in Leeds. 15% of Leeds subsidiaries in other financial activities were linked to enterprises based in other cities in the UK.



Hotels and restaurants

57% of subsidiaries in the hotel sector had their HQ in Leeds. This is lower than other cities in our sample, where this number averages 67%. Hotels in Leeds therefore depend more widely on hotel enterprise headquarters in other cities in the UK.



Information and communication

More than 80% of all Leeds subsidiaries in selected Information and communication functions have a HQ in Leeds. This is very similar to other cities in our sample, yet lower to London where firms seem to be even more concentrated geographically.



Real estate

Similarly to other cities in our sample, real estate agencies and management relies in the majority of cases on enterprises headquartered in the same city.








Professional and scientific

Above 90% of Leeds subsidiaries in selected professional, technical and scientific functions have a HQ in Leeds.

Functional specialisations – subsidiaries with Birmingham HQ

Key findings

Few subsidiaries in cities across the UK had their HQ in Birmingham. This holds across the five sectors of interest selected in our study.

	<p>Finance</p>	<p>All local investment trust, venture capital and life insurance subsidiaries in Birmingham had their HQ in the same city. However, the majority of banks (94%) had their HQ in another UK city, 34% in London and 46% in Edinburgh.</p>		<p>Hotels and restaurants</p>	<p>Like Leeds, 57% of subsidiaries in the hotel sector in Birmingham had their HQ in Birmingham. This is lower than other cities in our sample, where this number averages 67%.</p>
	<p>Information and communication</p>	<p>More than 80% of all Birmingham subsidiaries in selected Information and communication functions have a HQ in Birmingham. This is very similar to other cities in our sample.</p>		<p>Real estate</p>	<p>Similarly to other cities in our sample, real estate agencies and management relies in the majority of cases on enterprises headquartered in the same city.</p>
	<p>Professional and scientific</p>	<p>Very few subsidiaries in cities across the UK had their HQ in Birmingham and this was particularly the case for the professional, technical and scientific sector.</p>			

Functional specialisations – subsidiaries with Edinburgh HQ

Key findings

Few subsidiaries in cities across the UK had their HQ in Edinburgh. This holds across the five sectors of interest selected in our study.

	<p>Finance</p>	<p>Edinburgh has a strong banking presence, with more than a third of local banks across the UK depending on an Edinburgh-based headquarter. This is as high as 53% in Manchester and 46% in Birmingham. Other financial functions are relatively concentrated geographically, with more than 75% of subsidiaries in Edinburgh having their HQ in the same city.</p>		<p>Hotels and restaurants</p>	<p>68% of subsidiaries in the hotel sector had their HQ in Edinburgh, similar to other cities' average.</p>
	<p>Information and communication</p>	<p>More than 76% of all Edinburgh subsidiaries in selected Information and communication functions have a HQ in Edinburgh. This is very similar to other cities in our sample.</p>		<p>Real estate</p>	<p>Similarly to other cities in our sample, real estate agencies and management relies in the majority of cases on enterprises headquartered in the same city.</p>
	<p>Professional and scientific</p>	<p>Very few subsidiaries in professional, technical and scientific functions in cities across the UK had their HQ in Edinburgh.</p>			

Functional specialisations – subsidiaries with Swansea HQ

Key findings

Approximately no subsidiaries in cities across the UK had their HQ in Swansea. This holds across the five sectors of interest selected in our study, and is particularly true for Finance functions, where even subsidiaries in Swansea are, to a large extent, linked to finance enterprises outside of Swansea itself.

	<p>Finance</p>	<p>There were few, if any, finance headquarters in Swansea in 2018. Even for subsidiaries based in Swansea, nearly none were linked to an headquarter in the same city.</p>		<p>Hotels and restaurants</p>	<p>63% of subsidiaries in the hotel sector had their HQ in Swansea. This is slightly lower than other cities in our sample, where this number averages 67%.</p>
	<p>Information and communication</p>	<p>Nearly all of Swansea subsidiaries in selected Information and communication functions have a HQ in Swansea.</p>		<p>Real estate</p>	<p>Similarly to other cities in our sample, real estate agencies and management relies on enterprises headquartered in the majority of cases in the same city.</p>
	<p>Professional and scientific</p>	<p>Very few subsidiaries in professional, technical and scientific functions in cities across the UK had their HQ in Swansea.</p>			

5.6 BSD Analysis Summary

Sections 5.1 to 5.4 explored the intra-firm linkages that exist between firms located in the different cities in our sample. Starting with high level data, we identified that approximately one fifth of enterprises are headquartered in London, employing 20% of total UK enterprise employment. We then drilled further in more detail, analysing the linkages between enterprise headquarters and subsidiaries (in terms of the numbers of firms linked to one another as well as the employment dependent on one another), providing this analysis per sector of interest.

Through this analysis, we found that firm linkages were particularly strong in the finance sector,

where approximately 21% of total employment in regional subsidiaries in the finance sector depended on London headquarters in 2018.

We then looked at intra-firm linkages at the function level (for which we used 5 digit SIC codes), finding that London-headquartered enterprises are a very important source of work and employment for a wide range of more specific activities in other cities, mainly in the finance sector.

In this section, we present the key insights from our analysis.

JOBS LINKED TO LONDON

9% of jobs in regional subsidiaries depends on London headquartered enterprises, across all sectors in 2018.

21% of total employment in regional subsidiaries in the finance sector depends on London headquarters.

LINKS TO THE SAME CITY

62% of local unit employment in the 6 cities of interest depend on enterprises headquartered in the same city (on average).

83% of all local unit employment in London depend on enterprises headquartered in the capital.

Summary Findings

1. In 2018, 20% of UK enterprises were headquartered in London, representing one fifth of total UK employment. This highlights the economic dominance of the capital, which was discussed in the literature review. While reinforcing the narrative on the UK economic imbalance, we find that firms are highly integrated geographically in sectors such as finance and hotels and restaurants, leaving us with a more nuanced picture of wide firm networks across cities in the country;
2. Our evidence supports the findings in the literature review, where we argued that headquarters from different sectors will cluster in few large cities to enjoy from the larger benefits of agglomeration for business services.
3. It is worth noting that firms in other UK cities are much more concentrated spatially than the cities in our sample. On average, some 98% of local units have their headquarters in the same city when looking at cities not included in our analysis. This suggests that the cities which trade most with London are also more integrated at a firm level.
4. Overall, across all sectors and all enterprises in the UK over the 2007-2018 period, the share of enterprises with subsidiaries has increased by 10%. Over the same period, this share has increased by 124% in the finance sector, while decreasing slightly by 20% and 15% in the real estate and hotel sectors (from 29% to 23% and 24% to 21% respectively). Enterprises have therefore become more spread out geographically speaking – hiring more employees in other cities of the UK and setting up more subsidiaries across the country. This is certainly true for the financial sector.
5. Subsidiary employment in each city relies primarily on headquarters in the same city. On average, this ratio is estimated at 62%, being highest in London at around 83% and lowest in Leeds at around 31% (i.e. 83% of subsidiary employment in London have a HQ in London). This also means that approximately 40% of subsidiary employment relies on enterprises headquartered elsewhere in the UK. Again, while this is true for the cities in our sample, it does not appear to be the case for the rest of the country.
6. Subsidiaries headquartered in London employ, on average, two to three times more employees than subsidiaries headquartered somewhere else and situated in the same city.
7. When focusing on functions more specifically, we find evidence supporting the outsourcing of some activities from London to other cities in our sample. A few examples include the outsourcing of research activities to Edinburgh, data processing activities to Edinburgh, Leeds and Manchester, and finance and insurance activities to all cities in our sample. This indicates the importance of

London-headquartered enterprises as key employers in the regions as well as the dependence on the cities in our sample on activity in London.

Our findings highlight the importance of intra-firm linkages in driving economic activity in the UK and indicate that a substantial number of UK firms extend further than their headquarter location. These findings suggest that what is good for London is good for the rest of the UK and vice versa. This appears to be the case specifically in the finance and hotels and restaurants sectors, where important inter-firm linkages were found.

20% 124% 2-3x

of UK enterprises were headquartered in London in 2018

The share of enterprises with subsidiaries has increased by 124% in the finance sector over the 2007-2018 period, indicating the importance of the sector as a source of intra-firm linkages across the UK.

Subsidiaries headquartered in London employ, on average, two to three times more employees than subsidiaries headquartered somewhere else and situated in the same city

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Appendix 1: Regional subsidiaries linked to HQs in other cities (number of firms)

Headquarters and locations of their subsidiaries

	<i>Location of subsidiaries</i>							
<i>Enterprise HQ</i>	London	Manchester	Leeds	Birmingham	Edinburgh	Swansea	Others	Total Subsidiaries* <i>(rounded to nearest thousand)</i>
London	90%	1%	0%	0%	0%	0%	9%	612,000
Manchester	1%	88%	0%	0%	0%	0%	10%	133,000
Leeds	2%	1%	84%	0%	0%	0%	13%	36,000
Birmingham	4%	1%	0%	74%	0%	0%	20%	50,000
Edinburgh	3%	1%	0%	0%	73%	0%	23%	28,000
Swansea	0%	0%	0%	0%	0%	94%	6%	7,000
Other	1%	0%	0%	0%	0%	0%	98%	2,350,000

Source: Arup analysis, 2019

Headquarters and locations of their subsidiaries in the finance sector

	<i>Location of subsidiaries</i>							
<i>Enterprise HQ</i>	London	Manchester	Leeds	Birmingham	Edinburgh	Swansea	Others	Total Subsidiaries* <i>(rounded to nearest thousand)</i>
London	81%	1%	1%	1%	0%	0%	16%	23,000
Manchester	1%	91%	0%	0%	0%	0%	8%	4,000
Leeds	2%	1%	86%	0%	0%	0%	11%	1,000
Birmingham	3%	1%	0%	88%	0%	0%	9%	846
Edinburgh	11%	4%	1%	2%	19%	0%	64%	5,400
Swansea	0%	0%	0%	0%	0%	92%	8%	155
Other	2%	1%	0%	0%	0%	0%	96%	49,000

Source: Arup analysis, 2019

Headquarters and locations of their subsidiaries in the professional, scientific and technical sector

	<i>Location of subsidiaries</i>							
<i>Enterprise HQ</i>	London	Manchester	Leeds	Birmingham	Edinburgh	Swansea	Others	Total Subsidiaries* <i>(rounded to nearest thousand)</i>
London	98%	0%	0%	0%	0%	0%	2%	22776
Manchester	1%	95%	0%	0%	0%	0%	4%	4221
Leeds	1%	0%	95%	0%	0%	0%	4%	1006
Birmingham	1%	0%	0%	97%	0%	0%	2%	846
Edinburgh	1%	0%	0%	0%	93%	0%	6%	5409
Swansea	0%	0%	0%	0%	0%	96%	4%	155
Other	1%	0%	0%	0%	0%	0%	99%	49215

Source: Arup analysis, 2019

Headquarters and locations of their subsidiaries in the information and communication sector

	<i>Location of subsidiaries</i>							
<i>Enterprise HQ</i>	London	Manchester	Leeds	Birmingham	Edinburgh	Swansea	Others	Total Subsidiaries* <i>(rounded to nearest thousand)</i>
London	95%	0%	0%	0%	0%	0%	5%	610,000
Manchester	1%	95%	0%	0%	0%	0%	4%	133,000
Leeds	1%	0%	98%	0%	0%	0%	2%	36,000
Birmingham	1%	0%	0%	97%	0%	0%	2%	50,000
Edinburgh	1%	0%	0%	0%	98%	0%	1%	28,000
Swansea	0%	0%	0%	0%	0%	100%	0%	7,000
Other	1%	0%	0%	0%	0%	0%	99%	234,000

Source: Arup analysis, 2019

Headquarters and locations of their subsidiaries in the real estate sector

	<i>Location of subsidiaries</i>							
<i>Enterprise HQ</i>	London	Manchester	Leeds	Birmingham	Edinburgh	Swansea	Others	Total Subsidiaries* <i>(rounded to nearest thousand)</i>
London	95%	0%	0%	0%	0%	0%	4%	29,000
Manchester	0%	98%	0%	0%	0%	0%	2%	5,000
Leeds	2%	0%	92%	0%	0%	0%	6%	2,000
Birmingham	1%	1%	0%	92%	0%	0%	7%	2,000
Edinburgh	1%	0%	0%	0%	86%	0%	13%	1,000
Swansea	0%	0%	0%	0%	0%	97%	3%	155
Other	1%	0%	0%	0%	0%	0%	98%	118,000

Source: Arup analysis, 2019

Headquarters and locations of their subsidiaries in the hotels and restaurants sector

	<i>Location of subsidiaries</i>							
<i>Enterprise HQ</i>	London	Manchester	Leeds	Birmingham	Edinburgh	Swansea	Others	Total Subsidiaries* <i>(rounded to nearest thousand)</i>
London	83%	1%	0%	0%	0%	0%	15%	33,000
Manchester	3%	83%	0%	0%	0%	0%	13%	8,000
Leeds	5%	1%	72%	0%	0%	0%	22%	3,000
Birmingham	15%	2%	1%	23%	1%	0%	58%	10,000
Edinburgh	1%	0%	0%	0%	94%	0%	6%	2,000
Swansea	0%	0%	0%	0%	0%	96%	4%	655
Other	2%	1%	0%	0%	0%	0%	97%	145,000

Source: Arup analysis, 2019

Appendix 2: Employment in subsidiaries linked to enterprises headquartered in other cities

Employment in subsidiaries linked to HQs in other cities for firms across all sectors

Location of subsidiaries	Employment in subsidiaries	Employment in subsidiaries linked to a HQ in the following cities (% of total employment in subsidiaries those cities)						
		London	Manchester	Leeds	Birmingham	Edinburgh	Swansea	Others
London	5,438,565	83%	1%	1%	1%	1%	0%	13%
Manchester	1,314,157	8%	69%	2%	1%	1%	0%	19%
Leeds	457,328	9%	1%	65%	1%	1%	0%	23%
Birmingham	523,717	10%	1%	1%	63%	1%	0%	24%
Edinburgh	333,422	9%	1%	1%	1%	68%	0%	20%
Swansea	108,912	6%	1%	1%	1%	0%	57%	34%
UK total	30,910,859							

Source: Arup analysis, 2019

Employment in subsidiaries linked to HQs in other cities in the finance sector

Location of subsidiaries	Employment in subsidiaries	Employment in subsidiaries in the sector	Employment in subsidiaries linked to a HQ in the following cities (% of total employment in subsidiaries those cities)						
			London	Manchester	Leeds	Birmingham	Edinburgh	Swansea	Others
London	5,438,565	282,552	77%	0%	1%	0%	7%	0%	15%
Manchester	1,314,157	11,579	26%	40%	2%	0%	13%	0%	19%
Leeds	457,328	5,327	21%	1%	31%	0%	18%	0%	29%
Birmingham	523,717	5,417	25%	1%	0%	21%	21%	0%	32%
Edinburgh	333,422	3,331	10%	0%	0%	0%	77%	0%	13%
Swansea	108,912	634	14%	0%	0%	14%	10%	10%	62%
UK total	30,910,859								

Source: Arup analysis, 2019

Employment in subsidiaries linked to HQs in other cities in the professional, scientific and technical sector

Location of subsidiaries	Employment in subsidiaries	Employment in subsidiaries in the sector	Employment in subsidiaries linked to a HQ in the following cities (% of total employment in subsidiaries those cities)						
			London	Manchester	Leeds	Birmingham	Edinburgh	Swansea	Others
London	5,438,565	724,856	88%	0%	1%	0%	0%	0%	11%
Manchester	1,314,157	120,978	10%	76%	1%	0%	0%	0%	13%
Leeds	457,328	45,104	11%	0%	66%	0%	0%	0%	23%
Birmingham	523,717	46,211	14%	0%	1%	61%	0%	0%	24%
Edinburgh	333,422	28,860	13%	0%	0%	0%	66%	0%	21%
Swansea	108,912	4,578	0%	0%	0%	0%	0%	73%	27%
UK total	30,910,859								

Source: Arup analysis, 2019

Employment in subsidiaries linked to HQs in other cities in the information and communications sector

Location of subsidiaries	Employment in subsidiaries	Employment in subsidiaries in the sector	Employment in subsidiaries linked to a HQ in the following cities (% of total employment in subsidiaries those cities)						
			London	Manchester	Leeds	Birmingham	Edinburgh	Swansea	Others
London	5,438,565	429,577	84%	1%	0%	0%	0%	0%	15%
Manchester	1,314,157	47,156	21%	59%	0%	0%	0%	0%	20%
Leeds	457,328	21,942	17%	0%	55%	0%	0%	0%	28%
Birmingham	523,717	13,979	18%	0%	0%	51%	0%	0%	31%
Edinburgh	333,422	19,208	13%	0%	0%	0%	65%	0%	22%
Swansea	108,912	2,895	32%	0%	0%	0%	0%	38%	30%
UK total	30,910,859								

Source: Arup analysis, 2019

Employment in subsidiaries linked to HQs in other cities in the real estate sector

Location of subsidiaries	Employment in subsidiaries	Employment in subsidiaries in the sector	Employment in subsidiaries linked to a HQ in the following cities (% of total employment in subsidiaries those cities)						
			London	Manchester	Leeds	Birmingham	Edinburgh	Swansea	Others
London	5,438,565	151,545	92%	0%	0%	0%	0%	0%	8%
Manchester	1,314,157	27,117	8%	84%	0%	0%	0%	0%	8%
Leeds	457,328	6,353	10%	0%	73%	0%	0%	0%	17%
Birmingham	523,717	8,596	11%	0%	0%	78%	0%	0%	11%
Edinburgh	333,422	5,822	4%	0%	0%	0%	85%	0%	11%
Swansea	108,912	1,344	0%	0%	0%	0%	0%	92%	8%
UK total	30,910,859								

Source: Arup analysis, 2019

Employment in subsidiaries linked to HQs in other cities in the hotel and restaurant sector

Location of subsidiaries	Employment in subsidiaries	Employment in subsidiaries in the sector	Employment in subsidiaries linked to a HQ in the following cities (% of total employment in subsidiaries those cities)						
			London	Manchester	Leeds	Birmingham	Edinburgh	Swansea	Others
London	5,438,565	461,946	80%	1%	0%	5%	0%	0%	14%
Manchester	1,314,157	84,707	11%	63%	1%	3%	0%	0%	12%
Leeds	457,328	27,837	9%	5%	57%	6%	0%	0%	23%
Birmingham	523,717	35,037	11%	1%	0%	67%	0%	0%	21%
Edinburgh	333,422	33,115	14%	2%	0%	4%	58%	0%	22%
Swansea	108,912	9,005	5%	1%	0%	6%	0%	62%	21%
UK total	30,910,859								

Source: Arup analysis, 2019