The location and concentration of businesses in Britain: business clusters, business services, market coverage and local economic development

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An important debate has recently developed around the significance of business clusters for the development of the economy. This paper assesses the extent to which concentrated clusters of businesses exist in Britain, using the fine spatial mesh of postcode districts. It identifies the major clusters using a development of the methodology to define local labour market areas. The paper demonstrates the high degree of localization and uneven development of businesses in Britain. It also shows that business service firms are even more highly localized and clustered than other businesses. Moreover, the larger the business centre, the more localized and clustered the firms. The pattern suggests that there is a strong influence of increasing returns of scale, and that, as well as local clusters, much of the British economy is covered by one metacluster. Implications from these results are drawn for the likely future development of the economy, the location of business service suppliers in order to develop their market coverage, and local economic development policy.

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Introduction

The location and relative concentration of businesses underpins the geographical distribution of incomes, savings and employment in the economy as a whole. It has long been recognized that, in Britain, this distribution is highly uneven, with major concentrations and growth of businesses and employment in the South, but smaller scales of development and slower growth, or even decline, in the North. Although this pattern has been evolving and changing, and there may be increasing urban-rural divisions to it, uneven business development is a phenomenon widely recognized in many studies in Britain (eg Howells and Green 1988; Keeble *et al* 1991; Keeble and Bryson 1996; Marshall 1994; Westhead and Moyes 1991; Wood 1991), and has received considerable recent attention, owing to its importance to the competitiveness of economies. Despite growing globalization, reductions in transport costs and the growing technical possibilities of sourcing supplies

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from anywhere in the world, most interbusiness relationships remain highly localized. There has been vigorous debate about the factors that explain such continuing localization and agglomeration, with some authors emphasizing the role of local transaction costs, others the importance of the drawing-down by each business of common factors of production that stimulate their quality and supply, the importance of social networks and the role of local institutions. In a wider argument, Porter (1990; 1998) has suggested that localization forces are part of a more general phenomenon of business clusters. In particular, he has argued that clustered concentration offers significant advantages for competing in global markets. Porter's arguments have had a considerable impact on government policy thinking worldwide, and are strongly reflected in the British government's Competitiveness White Paper (DTI 1998), which is seeking to encourage stronger business clustering and interfirm collaboration.

The significance of business concentrations for the competitiveness of locations is argued by Porter (1990) to derive from the relative strengths of local networks of related and supporting industries, local demand conditions, supportive factor inputs and local interfirm relations, including the degree of local competition. In his 1998 text, Porter develops the concept further to emphasize the specific importance of 'clusters':

> geographic concentrations of interconnected companies, specialist suppliers, service providers, firms in related industries and associated institutions. (Porter 1998, 197)

Although he emphasizes aspects of clusters that may derive from cooperation, it is also clear that clusters may merely be firms that find mutual advantage from the same location; so-called 'commonalities and complementarities' (199). For Porter, the role of clusters resolves a locational paradox: whilst economies are becoming more globalized and the traditional roles of localization have reduced, nevertheless location remains fundamental to competitiveness, with more distant sourcing of a firm's inputs 'normally a second-best solution' (236–7).

Despite the potential importance of clusters and differing degrees of concentration, there has been relatively little attention devoted to assessing and analysing the pattern of business location in Britain. Most previous analyses have chiefly focused on either the labour market (Champion *et al* 1987) or the location of business services (Howells and Green 1988; Keeble and Bryson 1996). The form of local labour markets and the location of business services are important aspects of the more general phenomenon of business concentration assessed here. However, the purpose of this paper is to give the first analysis of the general pattern of business location and concentration in Britain at a detailed postcode district level. It situates the phenomenon of business concentration within debates about clustering and uneven development in the economy, focusing on the arguments which suggest that geographical clusters, agglomeration economies and urban hierarchical dominance may be pervasive influences of business location as a whole, and business service location in particular. The paper argues that local clusters, networks, embeddedness and transport and communication costs (based on distance between business clients and suppliers) are likely to increase the localization and concentration of businesses within the economy, despite increasing globalization.

The paper first reviews the debates about the reasons for business clustering and concentration, and summarizes the growing evidence of localization of supply-demand interactions between businesses. The paper then presents the first countrywide analysis of business clusters in Britain and shows how these concentrations focus on a relatively small number of centres. The structure of businesses within clusters and their immediate hinterland is then analysed. It is demonstrated that business service firms are even more concentrated than is the general pattern. Implications are drawn from these results for the concept of geographical clusters, for the location of suppliers who are seeking to maximize their market coverage and for policy initiatives that seek to stimulate local economic development.

Business concentration

Clusters

The concept of clusters of related and supporting industries owes much to traditional concepts of agglomeration and urbanization economies. These explain the location of business concentrations as a result of the advantages gained from reduced transaction and transport costs, and the increased

potential for face-to-face contact. These benefits derive from reduced search, bargaining, monitoring and transaction-specific costs between firms, either as a direct result of geographical proximity, or because each business can draw on a common framework of understanding and factor inputs. This is chiefly a demand-side perspective.

Two distinct categories of agglomeration economies have usually been identified (see, for example, Richardson 1972). First, there are urbanization economies, which derive from the location and are external to the firm but internal to a local context (be it a city, region or nation, but usually a city). Second, there are localization economies that are external to the firm, but internal to the industry or group of industries that trade directly with each other. The concept of clusters (developed by Porter 1998) combines these two aspects, often confusingly, since the first leads to questions about common frameworks of factor conditions, whilst the second leads to questions about interfirm trade. Whilst clustering can clearly benefit from both forms of agglomeration economy, they are two distinct issues, with very different policy implications.

There is also a distinction to be drawn in how the dynamics of evolution occur. Porter tends to argue from the basis of static competitive advantage: that clusters help an area to compete and hence to maintain or increase its rate of economic growth. Other authors, however, have gone further, arguing that agglomeration economies explain a pattern of increasing geographical concentration. For example, Krugman (1993a) and Krugman and Venables (1996; see also Martin and Sunley 1996; 1998) have argued that there are increasing returns of scale deriving from localization and urbanization effects, and that larger cities and clusters experience greater competitive advantage than smaller ones. The non-linearity of this process is further developed in the analytical treatments of Romer (1986; 1990) and Krugman (1993b), who suggest that the very largest cities dominate to a disproportionate extent, and that this dominance is likely to continue to increase. Romer, in particular, argues that there are rapidly increasing returns of scale as a result of endogenous technological progress between both competing and cooperating firms. There are, as a result, continuing and growing advantages to locating in the large international cities, such as London (which can be expected to dominate in the context of Britain).

Another way of looking at the agglomeration phenomenon has been suggested by Casson (1998), who has argued that positive externalities for information flows and interbusiness exchanges are gained in larger markets, where each individual buyer or seller

> not only stands to make a useful match for themselves, but also increases the probability that their opposite numbers in the market can make the match they most desire. (45)

This allows considerable advantages for market coordination as a whole, but in particular offers opportunities for entrepreneurs and intermediaries to capture the greatest potential by locating within the most agglomerated markets. In addition, the denser this network of exchange possibilities, the greater the potential for each buyer and seller to reduce the effects of risk from shocks (Casson 1998, 46). Casson's arguments echo other accounts (such as Harrison *et al* 1996; Phelps 1992) and extend traditional observations of the importance of face-to-face contact in high-order business exchanges.

Whilst these demand-side interpretations are important, it has been increasingly recognized that, from a policy perspective, there is also an important supply-side to the concentration process. Firstly, localization and agglomeration can either induce or benefit from significant provision of both traded and non-traded inputs, which can increase the variety, reduce the cost or increase the rate of innovation and technical change in subsidiary and related industries. Secondly, the factor supply process is significantly influenced by a number of public policy domains of activity. These supply-side effects in part draw from the direct influence of factor markets: the role of education and labour skills, land and site availability and the supply of innovation, new knowledge and finance. Many of these factors are strongly influenced by public policy decisions. Supply-side effects also result from institutional structures, which are also strongly influenced by government: competition law, regulatory structures and compliance frameworks.

Porter (1990; 1998), in his concept of clusters, combines both demand- and supply-side effects. Although this is somewhat confusing, it probably best captures the reality of the role of concentration argued by Romer, Krugman and others: that interacting concentrations of businesses spin off each other's demands, draw on common benefits from

their generic influence on factor supply and gain greater benefit from these synergies the larger the concentration.

Business services

An important aspect of concentration is the question of whether business services become specialized by the process of agglomeration. A particularly strong role of service industries in acting as a stimulant to agglomeration has been argued by Coffey and Bailly (1992) and Wood (1991). They interpret the strengthening of business needs for knowledge-based information and services, and strong interaction between businesses and their service suppliers, as forces that localize business interactions and thus increase the forces of agglomeration. Lindahl and Beyers (1999) go further in arguing that business services are a 'stuck' category, fixed to their location, but also giving a competitive advantage to that location. They suggest the particular importance of locations 'rich' in business services as attractors of creativity and stimulators of information exchange. Hence, for Lindahl and Beyers, business services are a key force stimulating non-linear agglomeration effects.

The importance of different geographical contexts for business concentration and agglomeration has been recognized in many studies. For example, Coffey and Bailly (1992) and O'Farrell (1995) have argued that whilst location has become more flexible between regions, within regions there has been a strong tendency for greater spatial concentration of business-to-business services to occur in the larger urban centres. Economically central locations and face-to-face contact between senior managers of large companies and their services suppliers have long been argued to be key influences centralizing large companies in urban centres (Evans 1973; Pred 1977; Goddard 1978). In addition, not only has the historical settlement pattern influenced this focus, but so too have new business locations and internal growth within existing centres (Pred 1980; Scott 1993; Marshall 1994).

In Britain, the concentration of business services is strongly evidenced by Howells and Green (1988), who show that there had been a major shift of employment towards business services, responsible for 744 000 additional jobs in 1971–84, with the highest concentrations in London and the major conurbations, and some major provincial centres. The classification of conurbation dominants, provincial dominants and London accounted for 53 per cent of all producer service employment. Howells and Green saw this group as covering two categories of area: an 'economic elite' of locations, chiefly in the South, and a few medium-sized towns and 'established business centres', chiefly in the major conurbations and regional centres such as Glasgow, Tyneside, Liverpool, Manchester, West Yorkshire, Sheffield, Birmingham, Bristol, Southampton, Portsmouth, Exeter and London. More recent analyses have confirmed the pattern of business services location in London, the South-East and major regional centres. For example, Keeble *et al* (1991) found 62 per cent of 'other business services' (SIC 8395) in the SE region in 1989, with highly localized concentration (calculated through location quotients) in London, the SE and the regional centres of Manchester, Birmingham, Glasgow, Edinburgh, Aberdeen and Cardiff. By employment level, Keeble and Bryson (1996) have shown that 43 per cent of UK services are located in London, and 62 per cent in London and the SE. For some specialist business services the concentration is even higher, with market research and management consultancy, for example, located 80 per cent in London and 93 per cent in London and the SE (Keeble *et al* 1991).

The continuing importance of urban centres as primary business locations has been challenged by the emergence of company downsizing and decentralization, outsourcing and a greater role for SMEs in the economy. These developments have, in principle, allowed a more flexible and footloose pattern of location for many types of business. Thus, for example, Scott (1988; 1993), Storper and Scott (1992) and Sabel (1989) have argued that horizontal integration between businesses is replacing vertical integration, thus allowing a more diffuse pattern of economic development since a wider network of places can participate in economic growth. Local networks between firms may also stimulate economic growth in traditionally more peripheral locations (see Pyke *et al* 1990; OECD 1996).

However, Scott (1988, 177) argues that this wider scope may be relatively transitory, as sets of producers converge on each other's locations. As a result, new agglomeration economies appear to be being produced, suggesting that there is a continual concentration on existing major centres. For

example, corporate headquarters continue to be located chiefly in the major urban centres (Marshall 1994; Marshall and Green 1990; O'Farrell and Hitchens 1990). Also, whilst corporate decentralization, outsourcing and SME development may be giving greater scope for development outside the main centres, the extent of spread of many of these developments tends to be restricted to within 50–80 kilometres from headquarters or major centres (Coffey and Polèse 1987; Marshall *et al* 1987; Marshall and Green 1990; O'Farrell *et al* 1993; Hitchens *et al* 1994; Marshall 1994). Hence proximity to major urban centres continues to be significant even if location within them may be less important.

For example, in the USA, Harrison *et al* (1996) find that it is 'suburban' areas adjacent to the largest urbanized and metropolitan centres that show the highest rates of innovation and business growth (even though the urban centres themselves may be the least innovative, showing slow rates of business growth). Similarly, Illeris (1989; 1994), who reviews a range of studies in different countries, concludes that within-region interactions account for 60–80 per cent of supply. van Dinteren (1987), in a survey of firms in Dutch cities of 50 000–200 000 population, found that the same city accounts for 10–70 per cent of the sources of external advice, depending on the service field. Tordoir (1994) found that 40–96 per cent of services were supplied within the same region in the USA and the Netherlands, with the local sourcing increasing with city size and frequency of use. Illeris and Rasmussen (1992) found that, in Denmark, 50 per cent of consultancy advisors were located within 40 kilometres, and 80 per cent within 90 kilometres, of the client.

Similarly, in Britain, the evidence tends to suggest that it is not only location within urban centres, but also close proximity to those centres that may be important. There is certainly substantial interregional trade in major high-order business services (such as finance, accountancy, legal services, consultancy and market research), which are often supplied within a national market in Britain (O'Farrell and Hitchens 1990; Coffey and Bailly 1992; O'Farrell 1995). This has allowed some scope for peripheral and rural locations, as identified by Keeble *et al* (1993). But urban size factors still appear to influence location towards the more major local centres. Thus Wood *et al* (1993, 625) find that research and management consultancy firms 'are predominantly urban-based', and, where located in more rural or small-town environments, have 'modern communications still allowing accessibility to major economic centres'. Hence, business service firms appear both to be key contributors to clustering and also to gain considerable benefits from it.

Local networks

A key aspect of non-traded exchanges between firms within clusters has also been argued to result from local networks and social interactions that stimulate local agglomeration. In 'third Italy' (Brusco 1982; Piore and Sabel 1984), Baden-Württemberg (Sabel 1989), Massachusetts (Sabel *et al* 1987) and other localities, a growing body of analysis has suggested that business concentrations may benefit from the social structures that affect interfirm relations, interdependence with external sources of advice, interfirm technological development and R&D, and the structure of local institutions. These networks, Granovetter (1985) argues, encourage increasing and self-sustaining agglomeration because the firms that are *embedded* in supportive local networks gain economic advantage.

Local environments differ in the extent of these networks because of the extent of social relations, or differences in local institutional structure. For example, O'Farrell and Wood (1998) argue that different environments of trust can contribute to the success of business service firms located in London and south-east England, compared to Scotland. For specialist business services, they argue for close networks of interaction with clients and the concentration of 'home region externalities' 'based on close interaction with clients' (124).

Business concentration clearly facilitates more intensive social interaction, and interaction intensity is argued to be a key element differentiating between types of client-supplier relations (Illeris 1989; 1994; Tordoir 1994). Hence closeness between firms may facilitate more frequent and effective social as well as economic communication, and mutual benefits. The extent to which localization and concentration are important to facilitating networks and socially embedded trust-producing exchanges is, however, disputed. For example, Bryson and Daniels (1998) find that business consultants predominantly have 'weak' ties to their clients, and Bryson (1997) finds that only 2 per cent of respondents in a survey of clients of business

consultants choose their consultants on the basis of location or local availability. Curran *et al* (1993) and Curran and Blackburn (1994) also find that SME owner-managers have limited local networks and low levels of use of social or family relationships for business purposes. They also find that the link of SMEs to their locality has been growing weaker. Curran and Blackburn conclude that the role of locality and local embeddedness has been greatly exaggerated, that 'the death of the local economy' may be occurring with a reduced role for local linkages.

An important distinction is also drawn by Coe and Townsend (1998, 387) between the scales at which localization is occurring. They criticize the literature on local networks for confusing a phenomenon that is by 'no means homogenous' between locations, sectors or operational scales. In particular, they contest the argument for localization in a context where many supply networks are increasingly regionalized. In the case of their own empirical material of financial and business services in south-east England, Coe and Townsend demonstrate the importance of regional supply chains rather than localized areas within the same county (within-county supply ranges from 8 per cent to 20 per cent, whilst London is a source of supply for 22–25 per cent, and the rest of the SE for 21–27 per cent).

The contradictions between these findings may be resolved by noting their different spatial contexts and the different types of activity analysed. This draws us towards consideration of the spatial context of the local supply and demand interactions. There could well be expected to be very different interactions within a locality that is relatively isolated (Plymouth or Aberdeen), than one that is close to a major regional service focus (such as localities around London – as in Coe and Townsend's study – or around Manchester and Birmingham), or one in a context of many closely located medium-sized centres (such as the Thames Valley, Midlands or south coast). This suggests that not only should local clusters be considered, but also their competitive situation vis-à-vis other clusters at varying distances. This line of argument leads to a consideration of the possible role of spatial interaction frameworks.

Spatial interactions

The demand and supply sides of business location interactions are, in the accounts by Porter, Krugman or Romer, a key contribution to increasing returns of scale. But the interaction between supply and demand for businesses has been little studied. Martin and Sunley (1996) have argued that Krugman's approach draws from specialization due to history, technical conditions and other factors that generate local externalities and knowledge spillovers. Later they argue that this acts as a force for further capital accumulation leading to regional growth divergence and hierarchical effects (Martin and Sunley 1998). The interface between existing locations as attractions and new demand requirements has led Esparza and Krmenec (1996), Lentnek *et al* (1995) and Phillips *et al* (1998) to suggest the use of spatial interaction models to explain interbusiness purchases and transactions. Spatial interaction models have the advantage of simultaneously focusing on the demand structure of businesses, supplier-competition between locations and spatial prices related to transport and interaction costs. Such approaches are consistent with both agglomeration and embeddedness concepts in emphasizing the role of concentrated clusters of business locations where intensive face-to-face exchanges are more easily possible. Thus, for example, Lentnek *et al* (1992; 1995) and Phillips *et al* (1998) suggest that the choice and intensity of use of advisory and other business services is constrained by both the location of suppliers and the costs arising from transport and communication costs. Although primarily associated with consumer shopping behaviour, spatial interaction models have been applied successfully to a wide range of phenomena, and Birkin *et al* (1996) suggest their application to a number of business services.

Clustering of activities with a high frequency of travel or delivery costs, low profit margins and a considerable volume of goods or equipment to transport may be particularly relevant in a spatial interaction framework. Whilst much of the literature has tended to focus on high-order business services (such as consultancy, computer services or market research), which may be relatively footloose geographically, it is clear that a large number of interbusiness linkages and externally sourced business services, in volume and often in value, are relatively localized (eg Coffey and Polèse 1987; Marshall 1994). Also, some higher-order activities may be becoming increasingly localized as business service supply firms themselves become more localized within the major supply centres

(Williams *et al* 1990; O'Farrell 1995), perhaps because they require specific technical or local knowledge. This is the case with some consultancy services (Harrington *et al* 1991; Tordoir 1994), although consulting and advice has also been recognized as being more of a regional or national/international service (see O'Farrell 1995; O'Farrell and Wood 1998), supplied chiefly by the major urban centres.

The potential for a cluster to develop in a given area thus depends not only on the local business base, but also on its location relative to other clusters. In reality, a great variety of inter-area exchanges occur and the existence or not of a localized cluster may depend on the extent to which other networks and supply structures exist in nearby areas. We seek to address this local overlapping of 'catchment' fields of clusters in our empirical analysis below.

Business concentration in Britain

The wide range of previous research suggests strong reasons why we expect business concentrations to arise: as a result of clustering and external agglomeration economies, the influence of local networks of exchange, local social structures and institutional embeddedness, and the transaction cost effects of transport and communications. These factors all interact with the benefits of existing supply locations, which tend to emphasize the continuing importance of proximity to existing business clusters.

Our aim in the rest of this paper is to demonstrate that business concentration is a dominant pattern in Britain, and to examine its consequences for the spatial market for business supply and demand, and for public policy. We map the pattern of business location for the whole of Britain and demonstrate the strong focus of businesses in a small range of concentrated clusters. We apply a Geographical Information Systems (GIS) methodology to this pattern and from it develop a classification of the centres of business concentration that may be interpreted as clusters. These centres are then analysed further to see how the spatial pattern of businesses varies between centres, hinterlands and more peripheral areas. In particular, we focus on the distinctions between business concentration as a whole and the location of business service companies. Finally, we assess how the pattern of business concentration relates to concepts of market coverage (as a guide to policies by private or public agents on their location to maximize potential markets), clusters and local economic development policy.

The development of the GIS used here, the choice of alternative sources of statistical information, and the way in which the alignment between the data sources is achieved is described in the Appendix. A major contribution of this paper is the assessment of business location at the micro-scale of postcodes. All previous national analyses have used local authority districts or labour market areas as the finest geographical scale of resolution. There are, however, certain difficulties in aligning the statistics at a postcode district level; how these were overcome by a very lengthy research process is described in the Appendix. From this discussion, we conclude that any misallocations as a result of inaccuracies of alignment between databases will be very minor, and are likely to affect only three areas, which experienced major postcode reforms in the early 1990s: Aberdeen, Reading and Southampton. Difficulties with analysis of these areas is borne in mind in the subsequent assessments.

Business concentration

As far as is known, a detailed map of the location of businesses in Britain has never previously been produced. We display the first such map in Figure 1, based on our analysis. This covers the entire spectrum from manufacturing to business services, and shows a number of important features. First, business is indeed highly spatially localized, chiefly in centres stretching from Merseyside and Lancashire to Bristol and the South-East. However, for most of England, south Wales and Scotland's central valley, there is a basic minimum of 100–250 businesses in any area at our scale of spatial resolution (ie in any postcode district). Few areas are totally devoid of businesses, and these are chiefly in very rural and mountainous areas.

A second phenomenon evidenced in Figure 1 is the very wide range in size of business foci. Much of the map has a low number of businesses, but there is a marked contrast with the highly concentrated centres of London, south Wales, the Midlands, the North-West and West Yorkshire, Tyneside and Scotland's central valley. Furthermore,

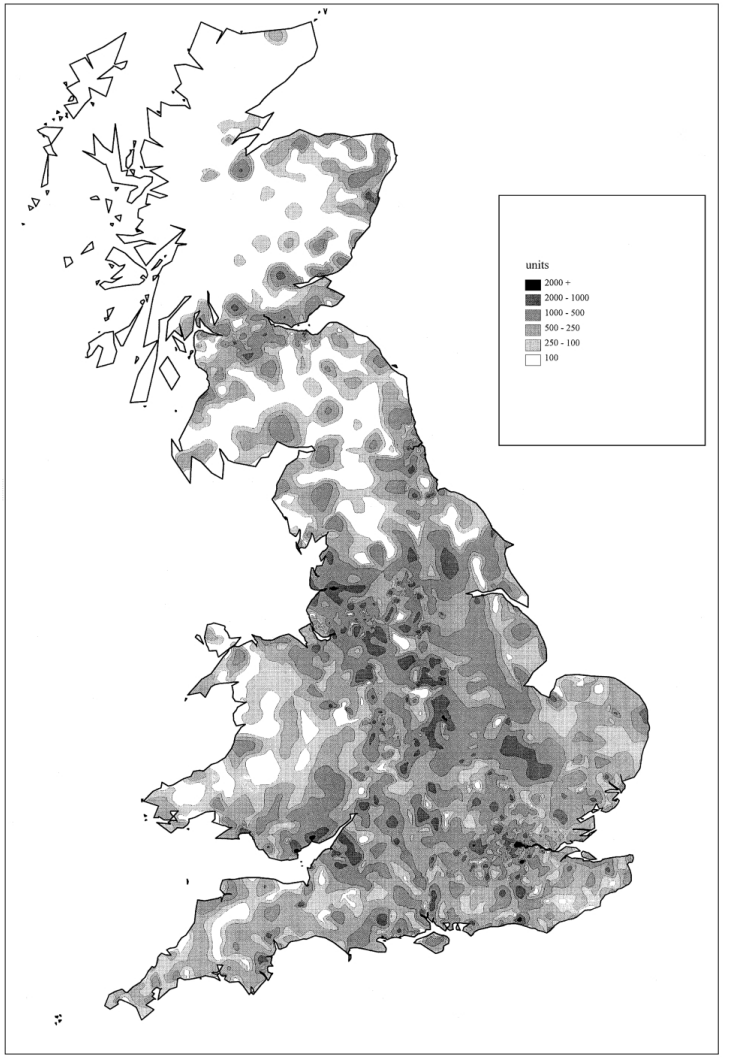

Figure 1 Distribution of businesses in Britain

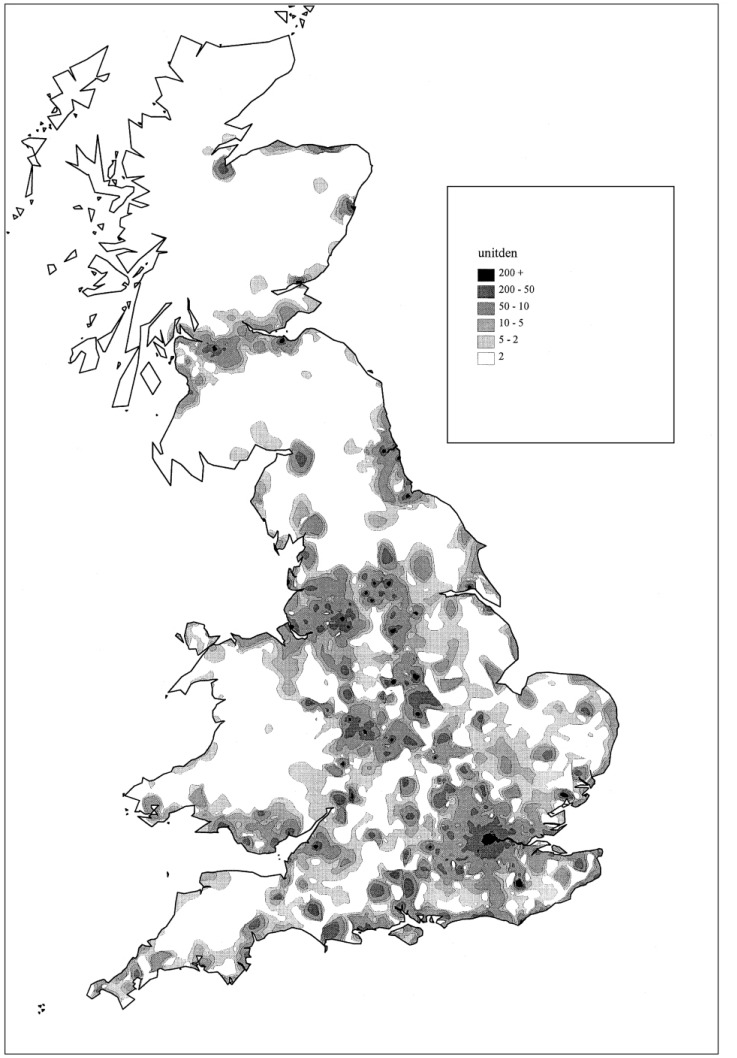

Figure 2 Density of business location in Britain (number of businesses per square kilometre)

there is quite a large number and wide range of concentrated business foci, with about a hundred locations recognizable as a 'centre', distinguished from its surrounding area and other nearby centres by the level of concentration evident on the map. However, in many areas the number of centres located in close proximity to each other is relatively large and their scale of business concentration fairly low. For example, many small centres are scattered across the outer SE, the Midlands, the North-West and West Yorkshire. This suggests that there are not only highly focused clusters of businesses in Britain, but clusters of clusters overlapping with each other. Porter argues that this overlapping cluster phenomenon is an important aspect of the Massachusetts cluster development.

These features are brought out even more clearly in Figure 2, which displays the density of businesses, measured by the number of firms per square kilometre. The role of the major regional clusters is now even clearer. However, the wide dispersal of businesses between many smaller overlapping clusters is evident across much of England, approximately between Manchester, Leeds, London and Southampton, and to a lesser extent other areas such as south Wales, the Tyne-Tees area and central Scotland.

Both the business location and business density maps confirm the general expectation of business concentration in a number of focal centres. We do not here compare these locations with those of employee location, but the pattern is similar to that analysed by Howells and Green (1988), and confirms the importance of London, regional centres and a number of 'provincial' cities and towns as the chief foci of business location.

'Clusters' of business concentration

Whilst it is clear from Figures 1 and 2 that a very large proportion of business is concentrated in a relatively small number of places, it is more difficult to move towards identifying specific clusters and measuring their extent of business concentration. To define such clusters requires criteria to be established that trade off absolute numbers and density of businesses, and to decide whether or not one area is distinct from another when concentrations are in close proximity. Inevitably any final pattern of clusters identified will depend to some extent on the criteria adopted. In our analysis here, we seek to use a fairly robust means of identifying clusters and then test the sensitivity of our criteria.

Our method closely follows the approach adopted by Champion *et al* (1987) for a different but related problem of defining Local Labour Market Areas (LLMAs). However, there are some important distinctions between identifying business clusters and the problems tackled by Champion *et al*. First, we have no available national statistics of flow information to evidence the interactions and networks between businesses, whereas Champion *et al* were able to use Census travel-to-work information to define commuter boundaries. Second, at this stage of our analysis, we cannot attempt to define a hierarchical allocation of areas to dominant or subdominant positions as Champion *et al* did, because there is no clearly established hierarchy of business services or client-business relationships on which to draw. This is a problem that requires considerable further research. Despite these differences, we see considerable advantages in maintaining an approximate comparability with Champion *et al* because they were assessing another important aspect of business geography – the local labour market – which we would expect to be interrelated closely with the concentration of businesses in most cases. Comparisons with their results are thus facilitated by taking a broadly similar approach.

Our approach begins by first identifying those major centres (postcode districts) that have the maximum degree of concentration of businesses. Second, we extend the boundaries of these centres outwards to embrace either those contiguous areas that also have high business concentrations, or those concentrations that are located so close to each other as to be essentially indistinguishable and hence form the basis of a single cluster. Third, we attach a 'catchment field' to each concentration, covering those areas within a specified radius that are expected to act as a cluster. These steps are the same as those used by Champion *et al* to identify their urban cores and commuting rings in order to define LLMAs. We do not continue to the further stage (used by Champion *et al*) of assigning the remaining parts of the map to the centres, because our focus at this stage is on the extent of major business concentration within or very close to business clusters rather than their possible maximum outer catchment boundaries. The decisions made at each stage are covered in detail below.

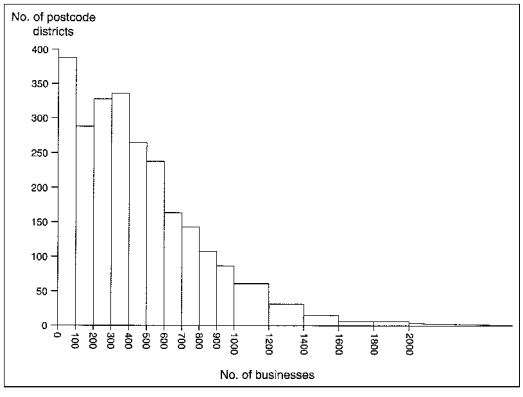

Figure 3 Frequency distribution of postcode districts by number of businesses contained

Location of main centres The key criteria used to establish the locations of the chief concentrations of businesses are minimum size and density, and the degree of distinction from adjacent concentrations. To give a feel for the selection problem involved, Figure 3 shows the frequency distribution of postcode districts with different numbers of businesses. The distribution is highly skewed, although there is a peaking around the mean of 491, with a standard deviation of 508. Much of the skew is accounted for by two extreme values of W1 and SW1 in London, which have 13 875 and 6147 businesses respectively. There is only a small number of areas with markedly high concentrations of businesses, as would be expected from the criteria used by Royal Mail to draw up postcode areas (see Appendix). To choose the major concentration centres we need to bear in mind that we will subsequently have to aggregate adjacent areas with those that have large business concentrations, and we also need to take into account the different geographical sizes of the postcode districts used in more and less urban areas. Table 1 reports the proportion of postcode districts with various concentrations of businesses. From this it can be seen that a choice of districts with 1000 or more businesses (as the size threshold for the centre of a potential cluster) heavily constrains the range to a maximum of 10 per cent of postcode districts. We would have as candidates only a narrow range of centres, thus excluding some possibly important locations in the more rural areas where the Royal Mail criteria have subdivided units in order to ensure a more equal travel component in their delivery. In contrast, at the level of 300 businesses within a district, a very wide range of areas is included that spans far beyond any normal range of possible candidates that could be considered to be major business clusters, although they may be relevant for defining some highly localized patterns. Indeed this includes 62 per cent of all districts. Our choice is therefore likely to be close to 1000, but with a level below this that takes into account the variable size and density of business concentrations in different postcode districts.

To help make this choice we need also to take into account a postcode district's size. The areal size of the districts is highly skewed, as the frequency distribution in Figure 4 demonstrates (this excludes the very extreme case of IV27 (Caithness) with an area of 3777 square kilometres). The clustering of the data is, however, very marked, with a mode of 1·2 square kilometres, a mean of 84·4 square kilometres and a standard deviation of 138·9 square kilometres. The tail of the distribution demonstrates the problem of using postcode districts as a basic unit of analysis in the rural areas. Royal Mail have had to increase the size markedly in rural areas to equalize delivery loads

Table 1 Postcode districts by number of businesses contained

Number of business per postcode district	*Number of districts*	*% of total districts*	*Number of businesses included*	*% of total businesses*	*Area covered (sq km)*	*% of total area*
>3000	8	0·31	40 293	3·14	56·69	0·03
>2000	27	1·03	85 206	6·65	374·91	0·17
>1500	65	2·49	150 362	11·73	1373·44	0·61
>1000	267	10·22	388 557	30·32	12 314·09	5·49
>750	525	20·09	610 440	47·63	29 143·85	13·00
>500	1007	38·54	905 138	70·62	64 981·86	28·99
>400	1275	48·79	1 025 356	80·00	90 065·85	40·19
>300	1608	61·54	1 142 036	89·11	120 670·61	53·84

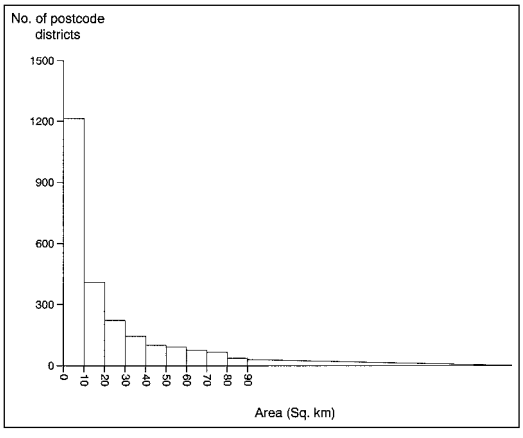

Figure 4 Frequency distribution of postcode districts by area (square kilometre)

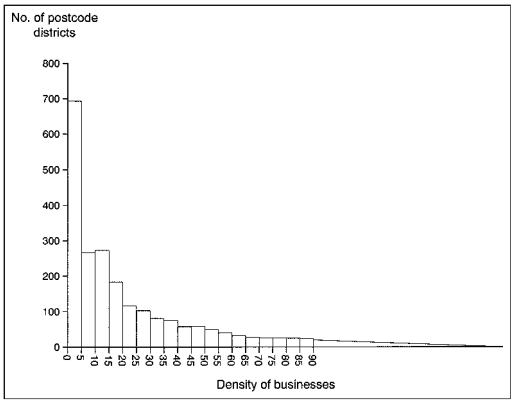

Figure 5 Frequency distribution of postcode districts by density (number of businesses per square kilometre, excluding highest 50 districts with densities exceeding 1000 businesses per square mile)

and this is a major distortion to the rural geographic frame through which the data is analysed. The reverse problem occurs in urban areas, which have been excessively subdivided in order to equalize delivery loads. These small postcode districts add to the risk that we excessively fragment our identified centres and increase their number; whereas the large rural postcode districts add to the risk that we excessively group into single clusters areas that are geographically distinct.

We can control for these effects by taking account of the density of business locations, shown in Figure 2. This distribution is even more highly skewed that that of area, as shown in Figure 5. However, even more of the tail is accounted for by a few extreme cases, which are the major centres in London and the other conurbations. The average density is 54·43 businesses per square kilometre, with a standard deviation of 211·6. The interaction of the concentration of businesses and their density, shown in Table 2, demonstrates that most of the variation in the number of clusters identified is caused by the selected minimum size of business concentration, not its density, because almost all of the main centres have high densities. This is particularly true for the main clusters of over 750 or 1000 businesses. Hence consideration of the density variable mainly allows us to control for the influence of large districts in more rural areas, which include a large number of businesses solely because of their geographical size, not because of their highly localized concentration of businesses. We choose to be conservative and adopt the least restrictive criterion in order to retain as many 'major cluster' candidates as possible at this stage of the analysis. To do this, we adopt the mean density and the 750-size criteria as the minimum qualifications, which produces a map with a wide range of possible centres, as well as some major agglomerated areas. There are 272 areas that might be considered centres of clusters, although many of these are adjacent or very close to each other. Our criteria should ensure that no significant major clusters are likely to be missed, except for cases of

Table 2 Postcode district business density and numbers of businesses

% of areas with higher density (businesses per sq km) than:	*% of areas with greater than given number of businesses*			
	>300	*>500*	*>750*	*>1000*
Lowest quartile (3·6)	56·1	36·9	19·8	10·1
Lowest third (6·1)	51·7	34·9	19·0	10·0
Median (16·7)	42·3	29·8	16·9	9·2
Mean (88·1)	19·7	15·8	10·5	6·4

arelatively small centres that are locally significant in a rural or isolated area, such as Inverness and York, or where a smaller centre is split between two or more districts, as in the case of Milton Keynes, Cambridge or Exeter. No general set of criteria will ever be able to cope with these exceptional situations, hence we reintroduce them as special cases once our general analysis is complete.

Extension and amalgamation of core areas Stage 2 of our analysis is to aggregate areas to include the *contiguous* high business concentrations that act as part of the same cluster. If we aggregate all adjacent areas identified by our size and density criteria we reduce the number of potential major centres from 272 to 126, of which 30 are formed by aggregations and 96 are single districts. This number is reduced further by aggregating the areas identified as potential clusters with those that are in very close proximity though not adjacent to other major clusters. There are very few of these, unless we adopt a very extended definition of closeness. One aggregation concerns two postcode districts within the city of Derby that have an intervening district with low density; a second aggregation is that of Cheltenham and Gloucester, and Bournemouth and Poole; a third aggregation is to join areas separated by water across which easy communication exists (this applies to Portsmouth, Fareham and Gosport). As a result of these aggregations the number of potential clusters is reduced from 126 to 121.

This approach to aggregation is conservative and retains a strong potential for many separate clusters to exist. Clearly it would be possible to introduce further aggregations. Other centres are relatively close to each other; for example Brighton and Worthing, and many centres in the Thames Valley and Hertfordshire. But there is no objective way of aggregating these without assuming some specific structure to the interbusiness relations within a cluster, which draws on knowledge we do not have.

Defining 'catchments' The third stage of the methodology is to attach a 'catchment area' to each cluster core, which is the hinterland areas that could be expected to be the main focus for business interactions and hence the basis of a business cluster. Defining the size of the hinterland is problematic and it is recognized that there is an absence of sufficient research telling us the general extent of local business interactions and networks. Hence we have to make assumptions. We apply as a first approximation a criterion of 1000 square kilometres – a radius of 17·8 kilometres – compared with previous studies, which find external interactions to be highly localized within 10–25 kilometres. In terms of defining clusters, the 1000-square-kilometre area should in many ways be a maximum since it covers the size of most large city areas (it is the size of the former county of Avon or the Isle of Thanet). It is of course only a first approximation and we test its sensitivity later, but it is relatively conservative in the sense that it will yield quite small catchments and thus allow a relatively large number of areas to remain as 'business cluster' candidates. This conservative approach has guided the decisions made at the previous steps of aggregation above. The result will be the identification of a fairly large number of potential clusters.

The 1000-square-kilometre criterion was applied to each of the 121 centres identified earlier. For those areas affected by coastline – Truro, Kings Lynn, Aberdeen and all the centres along the south coast – the sea area covered by this catchment is considered as 'lost' potential. This also applies to those clusters whose catchment areas are defined by 'hard' boundaries: cross-estuary traffic was considered impossible east of the Dartford crossing across the Thames, affecting both Chatham and Southend-on-Sea, east of the Humber Bridge, influencing Grimsby, and across the Solent. In these cases, all the area covering the estuary and inaccessible land was considered 'lost' to the centre, thus reducing its area. However, cross-river or estuary catchments were included in the case of Hull and North Lincolnshire, Liverpool and the Wirral, Edinburgh and South Fife, Southampton and the New Forest, Bristol and Chepstow, Glasgow across the Clyde, Tyneside across the Tyne and Teesside across the Tees. London is considered a special case. The aggregated area forming its core is irregular and large. The area has a distance from the centroid to its outermost point of almost 30 kilometres, far in excess of the 17·8-kilometre radius used for other areas. The solution adopted is to fill in the 'islands' and 'peninsulas' that do not satisfy the selection criteria until the 1000-square-kilometre area is reached.

When the catchments are cast over each cluster, a considerable overlapping of areas occurs. In

order to control this, the 30 largest clusters identified in Stages 2 and 3 are assumed to absorb any cluster within their 17·8-kilometre radius unless these other clusters are also within the largest 30. This removes 31 potential clusters and particularly affects areas around London, Birmingham and Manchester. The result is a group of 90 potential clusters.

However, we want also to include those areas identified earlier which are potential clusters in rural areas, or are small centres subdivided by postcode districts. To include these, we apply the joint criteria that such clusters have at least 1000 businesses irrespective of density, but should also be at least 17·8 kilometres from a cluster already defined using the 750 business/mean density criteria, and should have an identifiable large town or city within their area. The last criterion excluded a number of Scottish districts that have more than 1000 businesses in their area but have no significant town and could not, therefore, easily be viewed as a cluster. Using this approach, an additional 17 clusters are added. In addition, Milton Keynes and Bletchley is added, since although it is a significant centre, its postcode structure is so subdivided among 15 relatively small districts that none of them approach the 750 threshold. This results in a total of 108 business clusters.

Incorporating an element of sensitivity into the thresholds The fourth stage of the methodology introduces a measure of sensitivity into the analysis for both the initial selection criteria and the catchment radius. There are a number of postcode districts that exceed the definitions used on one criterion (either size or density) but fail on the other. Therefore, both threshold limits are adjusted by 10 per cent, from 48·99 to 54·43 for business density, and from 750 to 675 for number of businesses, but as above, with any clusters having to be outside an existing catchment area. This allows a further range of possible clusters to be identified which are only five in number: Folkestone, Yeovil, Llandudno, Margate and Weymouth.

As a further test of sensitivity, the catchment radius was adjusted. Reducing the radius to 15 kilometres (a 15·7 per cent reduction from 17·8 kilometres) gives an area of 707 square kilometres. The use of a smaller radius releases a number of clusters that had previously been aggregated into the catchments of others. This allows the identification of a further eleven possible clusters, including Chesterfield, Mansfield and Runcorn. In addition, the change in catchment criterion makes the London area smaller, releasing both Croydon and Watford as possible clusters. This results in identification of a total of 126 clusters, which are the ones used in the rest of the analysis.

Characteristics of the clusters

The location and catchments of the 126 clusters is shown in Figure 6. Table 3 gives statistics of the businesses within each. The clusters cover the vast majority of the total British business population and include 76·45 per cent (981 488) of the businesses recorded in the Census of Employment. This is within only approximately 33.42 per cent of the geographical area of Britain. The 30 largest clusters include 43·3 per cent, or 554 330 businesses, in approximately 9 per cent of the area. The largest ten clusters include 26 per cent of business in 3 per cent of the area. This demonstrates the highly localized and concentrated character of British business. This in turn has some profound implications for business services and local economic development, which are developed below.

The range of clusters identified in this analysis satisfies our objective of being conservative, to include as wide a range as possible. The clusters identified have the distinguishing characteristic that they are the main locations of businesses and thus are most likely to offer the main focus of clusters and hence agglomeration economies and localized business networking. They are sufficiently wide in definition that they should not exclude any primary or secondary clusters with a national, regional or major local significance, although highly localized very small clusters may have been omitted.

Table 3 reports the areas of the clusters both inclusive and exclusive of overlaps with adjacent areas, by dividing the businesses in the catchment (but not in the cores) between the overlapping clusters in proportion to their size. It should be noted that the three areas of Aberdeen, Reading and Southampton, where we noted difficulties of aligning the statistics with postcode boundaries, are not sensitive to this particular approach to the definition of centres, since they are each sufficiently distinct from other clusters in their area. Hence we conclude that any inconsistencies in the data do not affect the conclusions drawn.

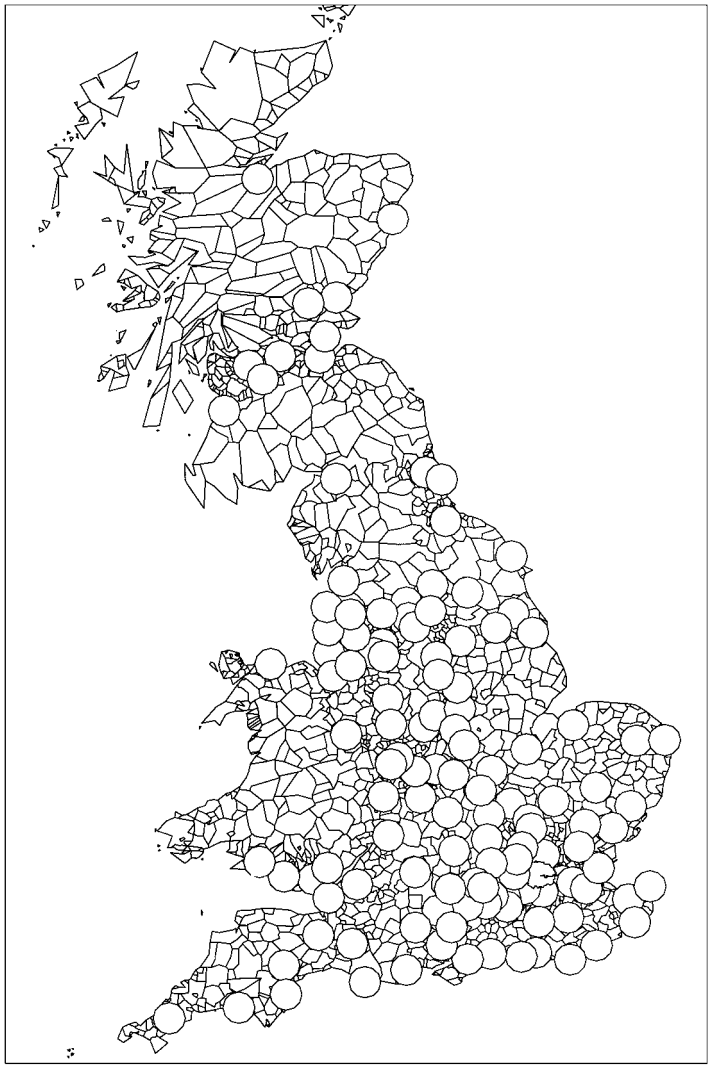

Figure 6 Main business clusters (centres of business concentration and their catchment areas)

There are considerable differences as a result of the overlaps. This shows that for many centres their identification depends less on the absolute size of their catchment than on the scale of the catchment that is uncontested by other clusters in close proximity: that is, the structure of local competition of spatial interaction is important. The cases of Plymouth, Aberdeen or Middlesborough, which have free and uncontested catchments, can be contrasted with areas such as the Thames Valley, the Midlands or the south coast. Only 27 clusters (21 per cent) are 'uncontested' in Table 3. For many of the other clusters, the area of contested overlapping catchment is as large as, or larger than, the cluster itself. This applies particularly to the London, Birmingham and Manchester areas; in areas like the Thames Valley it is clear that a business grouped within one cluster could well also be part of a cluster or network in one or more other areas; ie there are clusters of clusters, or 'metaclusters'.

Comparison can be made with the LLMAs constructed by Champion *et al*. There are of course important distinctions. Champion *et al* sought to cover the whole country and to produce a hierarchy of dominant and subdominant areas, which

Table 3 Major clusters ranked by size allowing for non-overlapping catchment (postcode suffix c indicates an aggregation of postcode areas)

No	*Postcode*	*Name*	*Total number of businesses in catchment*	*Number of businesses in catchment excluding overlapping areas*	*Difference due to overlap*
1	LONc	London	131 536	131 536	0
2	Bc	Birmingham, Wolverhampton and Walsall (with Aston)	42 019	35 098	–6921
3	Mc	Manchester (with Bolton, Bury, Oldham and Rochdale)	40 299	28 795	–11 504
4	Gc	Glasgow (with Paisley)	25 924	25 058	–866
5	LSc	Leeds (with Bradford and Wakefield)	26 591	24 232	–2359
6	Lc	Liverpool (with Birkenhead and St Helens)	20 582	19 650	–932
7	NEc	Newcastle (with South Shields)	20 535	19 320	–1215
8	CR0	Croydon	43 585	17 359	–26 226
9	BSc	Bristol	16 108	16 108	0
10	KTc	Kingston (with Sutton, Staines and Hounslow)	54 148	15 534	–38 614
11	UBc	Southall (with Slough, Staines and Hounslow)	38 888	14 753	–24 135
12	HGc	Nottingham (with Long Eaton)	14 982	14 115	–867
13	Sc	Sheffield (with Barnsley and Rotherham)	14 955	13 733	–1222
14	EHc	Edinburgh (with Leith)	13 813	13 574	–239
15	SKc	Stockport	33 683	12 977	–20 706
16	ENc	Enfield (with Romford)	27 671	12 353	–15 318
17	LEc	Leicester	12 861	12 294	–567
18	WD1	Watford	25 724	11 921	–13 803
19	WN1	Wigan	13 195	10 855	–2340
20	CVc	Coventry (with Warwick)	11 285	10 627	–658
21	DT1	Dartford	21 461	10 185	–11 276
22	CFc	Cardiff (with Barry)	10 089	9949	–140
23	ST1	Stoke-on-Trent (with Kidsgrove and Newcastle-under-Lyme)	9952	9829	–123
24	SOc	Southampton	10 528	9808	–720
25	BH13	Bournemouth and Poole (with Christchurch)	9522	9522	0
26	B91	Solihull	25 362	9286	–16 076
27	TSc	Middlesborough (with Stockton-on-Tees)	9219	9219	0
28	BB11	Burnley (with Nelson and Accrington)	9123	8930	–193
29	PO1	Portsmouth, Fareham and Gosport (with Havant)	9439	8897	–542
30	HP11	High Wycombe	10 879	8813	–2066
31	Mcc	Sale	32 869	8586	–24 283
32	BN3	Brighton and Hove	10 032	8498	–1534
33	PR1	Preston (with Blackburn)	9040	8463	–577
34	DYc	Dudley	28 815	8205	–20 610
35	HUc	Hull	8304	8198	–106
36	SS0	Southend-on-Sea (with Basildon)	8229	7987	–242
37	ABc	Aberdeen	7869	7869	0
38	AL1	St Albans	16 004	7760	–8244
39	WA7	Runcorn	10 132	7482	–2650
40	GL3	Cheltenham and Gloucester	7184	7184	0
41	RH10	Crawley	7191	7136	–55
42	DE1	Derby	8432	6764	–1668
43	OXc	Oxford	6759	6759	0
44	FY1	Blackpool (with Fleetwood and Lytham St Anne's)	7029	6756	–273
45	GU15	Camberley	14 220	6726	–7494
46	HX1	Halifax	17 141	6669	–10 472
47	HD1	Huddersfield	13 963	6631	–7332
48	DN1	Doncaster (with Bentley)	6563	6361	–202
49	CH1	Chester (with Ellesmere Port)	7467	6163	–1304
50	NN1	Northampton (with Wellingborough)	6446	6114	–332
51	FK1	Falkirk (with Grangemouth)	6090	6008	–82
52	GU21	Woking	16 018	5887	–10 131
53	RG1	Reading	9801	5771	–4030
54	NR3	Norwich	5784	5766	–18
55	SA1	Swansea (with Llanelli and Neath)	5670	5645	–25

Table 3 ***Continued***

No	Postcode	Name	Total number of businesses in catchment	Number of businesses in catchment excluding overlapping areas	Difference due to overlap
56	ML3	Hamilton (with Motherwell and Wishaw)	9760	5637	–4123
57	BD21	Keighley	11 725	5584	–6141
58	GU1	Guildford	10 449	5503	–4946
59	TN1	Tonbridge (with Royal Tonbridge Wells and Sevenoaks)	5219	5198	–21
60	PL4	Plymouth	5172	5172	0
61	MKc	Milton Keynes and Bletchley	5324	5169	–155
62	SN1	Swindon	5163	5163	0
63	TQ1	Torbay (with Teignmouth, Newton Abbot and Paignton)	5110	5100	–10
64	S40	Chesterfield	8076	5071	–3005
65	NG18	Mansfield	7418	5071	–2347
66	CM2	Chelmsford	5128	4899	–229
67	SR1	Sunderland	11 880	4808	–7072
68	RG41	Bracknell (with Wokingham)	13 879	4781	–9098
69	NP9	Newport (with Cwmbran and Pontypool)	6044	4737	–1307
70	SG1	Stevenage (with Luton)	7919	4731	–3188
71	YO1	York	4627	4627	0
72	IP1	Ipswich (with Felixstowe)	4564	4537	–27
73	CO1	Colchester	4608	4511	–97
74	WR1	Worcester (with Droitwich and Great Malvern)	4413	4413	0
75	PO19	Chichester (with Bognor Regis)	4719	4364	–355
76	MKc	Bedford	4502	4361	–141
77	PE1	Peterborough	4277	4277	0
78	DD1	Dundee	4256	4253	–3
79	BN11	Worthing	6627	4237	–2390
80	CB2	Cambridge	4188	4188	0
81	NN16	Kettering (with Corby)	4619	4038	–581
82	HP20	Aylesbury	4450	4000	–450
83	EX4	Exeter	3987	3980	–7
84	HG1	Harrogate	4181	3904	–277
85	PR9	Southport	4936	3760	–1176
86	CF31	Bridgend	3837	3734	–103
87	DN31	Grimsby	3953	3620	–333
88	HY1	Kirkcaldy	3477	3477	0
89	BN21	Eastbourne	3470	3442	–28
90	NR30	Great Yarmouth (with Lowestoft)	3483	3436	–47
91	CT1	Canterbury	3456	3319	–137
92	RG21	Basingstoke	4128	3295	–833
93	DE14	Burton-upon-Trent (with Swadlincote)	4589	3258	–1331
94	CV37	Stratford-upon-Avon	3292	3244	–48
95	BS23	Weston-super-Mare	3224	3224	0
96	ST16	Stafford	3364	3189	–175
97	TN35	Hastings (with Bexhill)	3154	3114	–40
98	KA8	Ayr	3086	3086	0
99	ME4	Chatham (with Gillingham, Rochester and Sittingbourne)	8896	3048	–5848
100	DA11	Gravesend	10 981	3048	–7933
101	LE11	Loughborough	7157	3018	–4139
102	TA1	Taunton	3011	3011	0
103	SG6	Letchworth (with Hitchen)	5964	2940	–3024
104	RG14	Newbury	3195	2885	–310
105	LA1	Lancaster (with Morecombe and Heysham)	2860	2859	–1
106	SO23	Winchester	3864	2742	–1122
107	CV21	Rugby	3791	2714	–1077
108	DN15	Scunthorpe	2963	2706	–257
109	TR1	Truro	2678	2678	0
110	CT9	Margate (with Ramsgate)	2785	2657	–128
111	CT20	Folkestone	2678	2618	–60

Table 3 ***Continued***

No	*Postcode*	*Name*	*Total number of businesses in catchment*	*Number of businesses in catchment excluding overlapping areas*	*Difference due to overlap*
112	OX16	Banbury	2601	2600	–1
113	GU13	Fleet	9365	2567	–6798
114	CA3	Carlisle	2550	2550	0
115	SY1	Shrewsbury	2549	2549	0
116	IP33	Bury St Edmunds	2346	2346	0
117	BA20	Yeovil	2300	2300	0
118	CM7	Braintree	2631	2296	–335
119	YO11	Scarborough	2193	2193	0
120	SP1	Salisbury	2202	2182	–20
121	DT4	Weymouth	2103	2103	0
122	LL30	Llandudno	2001	2001	0
123	SP10	Andover	2081	1916	–165
124	PE33	Kings Lynn	1568	1568	0
125	PH2	Perth	1234	1229	–5
126	IV2	Inverness	934	934	0

we have not found possible at this level of analysis. However, there are some very close resemblances. All of Champion *et al*'s dominant and subdominant areas are included in our clusters, demonstrating the expected symmetry of business geography and the local labour market. However, the ranking and areal size of clusters differs considerably from the LLMA ranking and size, particularly for medium-sized or smaller clusters, thus demonstrating the contrasts between labour market and business geography. Champion *et al*'s LLMAs also show similar difficulties of aggregation in the more rural areas. The areas of south-west England, central Wales, East Anglia, Lincolnshire, Cumbria and Scotland are all large functional regions in Champion *et al*'s analysis, but in our case are too dispersed to satisfy the criteria to be included in a cluster.

The relation of clusters to the location of business services

The developments made above have demonstrated how businesses as a whole are geographically concentrated in a few major centres in Britain. This pattern includes businesses across the whole spectrum from manufacturing to services. The question we now assess is how far the location of business services relates to the total pattern, as this has significance for arguments about agglomeration.

The aggregate location pattern of businesses is both a demand and a supply constraint on business services. As a demand constraint, business location acts in the same way as consumer location in a retail situation: business service suppliers will gain market advantage by locating in places that are central to demand. This is precisely the same argument that is used for the location of major retailers or facility location. The degree to which this constraint operates will, of course, depend on the extent to which demand for business services is constrained by the transaction and communication costs associated with distance. As a supply constraint, the location of business service suppliers may affect decisions on which is chosen. Insofar as the demand for services is influenced by distance, businesses will either have a more limited choice of local suppliers in some locations, or they will tend to choose from the nearest options.

Within the scope of this analysis we can only examine these effects in a generalized way. The analysis described earlier in this paper has produced clusters that cover the main sites of business concentration; moreover, each cluster has an associated immediate hinterland. We examine below how far first these clusters, and second their hinterlands, act as foci for business services. Our hypotheses are that business service firms will be highly concentrated in the clusters, and they will be more focused in the identified cluster core areas than the hinterlands. If these hypotheses are confirmed we can infer that the distance to foci of demand act as constraints on business service

Table 4 Estimates of regression coefficients b and R^2 statistics between business service numbers and total business numbers in cores and hinterlands (all coefficients significant at p≥0·001)

		Definition of explanatory variable			
		All businesses		*All businesses excluding business services*	
		Including London	*Excluding London*	*Including London*	*Excluding London*
Business services in cores	b	0·27	0·23	0·37	0·28
versus core size	R^2	0·998	0·93	0·997	0·88
Business services in cores plus hinterland	b	0·24	0·06	0·32	0·08
versus core plus hinterland size	R^2	0·88	0·76	0·85	0·75
Business services in core	b	–	0·07	–	0·09
versus hinterland size	R^2	–	0·57	–	0·58
Business services in core	b	–	0·31	–	–
versus business services in hinterland	R^2	–	0·40	–	–

location, ie that business service firms locate, or are most successful in growth or survival, in sites within clusters, and within the cores of clusters in particular.

The definition of business services used here is based on the 1992 SIC. We follow the standard definition of business services discussed in Marshall *et al* (1987), Keeble *et al* (1991) and Sassen (1991), updating these to the most recent SIC. There are 45 sector subdivisions, ranging from finance, legal, market research and advertising to business and professional organizations.

The relation of business service location to other business location is assessed in Table 4. This presents the results of regression and R^2 estimates of business service numbers in the core of the cluster, in the core plus hinterland and in the hinterland only. Because London acts as an extreme case, the results are presented for two situations: including and excluding London. The analysis uses both all businesses and all businesses excluding business service firms as explanatory variables. Clearly this analysis is extremely simple and generalized. A number of other features could be included in further developments, such as differences in cluster characteristics, local infrastructure, more detail of differences in firm type, etc. However, at an aggregate level the results displayed in Table 4 already allow extremely clear inferences to be drawn.

Our hypotheses are strongly confirmed. Business service firms are highly concentrated into clusters, and they are more concentrated in the cores of clusters than in hinterlands. The expectation of agglomeration economies leading to clustering seems to be strongly confirmed. Table 4 shows that, for all relationships examined, the location of business services closely follows the location both of all businesses, and of all businesses excluding business services. This is demonstrated by the high R^2 statistics in all cases, all of which are significant at ($p>0·001$). The relationships are stronger in all cases including London, which as an extreme case has a major effect on the total variance, although the results when London is excluded are probably more relevant as generalizable patterns. The inferences in each case are identical, however.

The R^2 statistics in each case indicate a closer relationship in cores than in hinterlands of the location of all firms, and of all firms excluding business services. The last row of estimates in Table 4 shows the relationship between business services in cores and hinterlands. This has the weakest R^2 of all, although it is still significant (at $p>0·001$). However, this relationship does have one of the highest regression coefficients, suggesting that, although the variation is higher (lower R^2), there is a stronger marginal elasticity of business service location in hinterlands to changes in the size of business service cores than is the case for most of the other relationships analysed.

The general conclusion is that business service location closely follows the location of other

businesses. There is a strong agglomeration effect, which tends to increase existing unevenness of development. Moreover, the scale of agglomeration increases with the size of cluster: business services are more highly agglomerated the larger the cluster, they are more agglomerated in cores than in clusters as a whole, and these effects are even stronger in London, which is the most highly focused cluster of all. The arguments of Romer (1986) and Krugman (1993b) of increasing returns of scale from agglomeration are therefore strongly confirmed.

Unfortunately we cannot develop analyses of rates of change of this phenomenon, but the very high degree of agglomeration is suggestive of a pattern whereby declines of manufacturing and non-service businesses are likely to encourage an even higher concentration of service businesses in the already more concentrated areas. This suggests that the expectations of horizontal spread on decentralization proposed by Sabel (1989), Scott (1988) and others are unlikely to be strong, but instead increasing agglomeration economies will reinforce existing clusters of concentration. We cannot infer from the aggregate data whether this is due to the influences of transaction and communication costs, to local networks and embeddedness or to other causes. But confirmation of the high degree of business service clustering to the location of other firms and to each other puts in context analyses of urban-rural shift (as argued by Keeble and Tyler 1995) or of the higher rates of growth of service industry employment in smaller and more provincial centres (as observed by Howells and Green 1988). Whilst these changing patterns may be occurring, their impact on the aggregate pattern of business location does not suggest a shift away from the dominance of concentrated clusters of business locations in the larger conurbations and medium-sized urban cores. We turn to the implications of this below.

Implications

The high levels of general business concentration, and the even higher concentrations of business services that we have found have some important implications. We explore three of these here: first, for concept of clusters; second, for influences on business service location and market coverage; and third, for local economic development policy.

Clusters and metaclusters

Porter has argued that clusters provide the local context of supporting conditions for competitive advantage and 'the quality of the environment it provides for achieving high and rising levels of productivity'. While the sources of competitive advantage mainly reside in companies, 'many of the necessary inputs reside in the proximate environment' (Porter 1998, 324).

Porter's concept of a cluster with a supportive proximate environment is sufficiently broad to cover nations, regions and localities. Here we have focused on identifying possible local clusters. Many of these are quite small, others are very large, and a high proportion overlap or are close to each other: there are clusters of clusters. The justification for focusing at a very local level is, first, to embrace as wide as possible a range of 'cluster' candidates, and, second, because of the empirical evidence that suggests that most interbusiness services are drawn from a very local environment of only 10–20 kilometres. Thus the relevance of Porter's proximate environment can be tested to its limit at this very local level. At the same time the overlap of clusters allows us to move forward to identify where the strongest centres and intercluster environments are likely to exist and where the highest potential returns of scale will be possible.

The size and density criteria adopted here are certainly not dissimilar to some of the clusters identified by Porter (1998, 230–33) in Portugal or Massachusetts, or the wide range of other clusters identified in Porter's (1998) Table 7·1, which range in size to locations as small as Andorra, Bermuda, Sonoma (CA) and Worcester (MA).

Our analysis strongly suggests that a high level of clustering occurs in Britain, with 76 per cent of businesses within 126 clusters. Measured in a different way, over 76 per cent of businesses are located within 15 kilometres of each other at densities of at least 49 firms per square kilometre, with no cluster having less than 675 firms (where all firms analysed have at least one employee other than the owner). At higher levels of generalization, it is clear that some of these clusters are fairly meagre even on Porter's fairly elastic scale. But Figure 6 demonstrates that most clusters in Britain are close to each other. In fact the British economy has characteristics of a very high level of overlap; at the level identified, only 21 per cent are free of some overlap with other clusters (see Table 3).

The strong overlaps between clusters suggests that Britain may have potential advantages of a close interlocking of a cluster of clusters in its main economic area. The zone from Lancashire/Yorkshire to London and the South-East is an area of almost continuous overlapping clusters. We might more correctly identify this area of Britain therefore as a *metacluster*. The consequence of this type of argument is that the area where the most supportive productive conditions occur, and where the chief competitive advantage of Britain lies, is also this metacluster. The special dominance within this region of London as a world city and internationally significant cluster of financial, media, fashion and other high-order business and non-business services will confer further mutual advantages on it, and on the metacluster as a whole.

Porter's concept of clustering derives in part from the expectation that there will be close supply chain links and interdependence within clusters. It also derives in part from a recognition that clusters benefit from 'commonalties and complementarities'. At the scale of a metacluster, the main competitive advantage for the British economy would appear to lie in the overlapping of advantages of very local closeness within the microclusters, as well as broad intercluster overlaps. At the level of the metacluster, it will be commonalities of factor conditions that are most important to business growth rather than close supply chain interlinkages. However, each level of geographical scale should be complementary in allowing a very flexible and dynamic base for choosing suppliers, finding clients and markets, and developing commonalities and complementarities that lift the competitive potential of the whole. In this sense, Britain may offer more advantages for the application of the cluster concept than has been recognized until recently. Hence the relevance of the concept as now promulgated in the DTI (1998) Competitiveness White Paper may have strong potential for economic development. The challenge for government will be to develop its thinking at both the micro- and metacluster level. Combining these two scales in a joined-up way will be a considerable challenge.

Business service location and market coverage

The clusters identified here also have profound implications for the development of business services. In consumer services there is a long-established understanding of the relationship between the pattern of demand and attempts by retail suppliers to seek locations central to that demand. The results of our analysis suggest that similar forces of localization also apply to business services. This is also suggested in the many micro-level behavioural surveys reviewed earlier. Of course, despite the power of the retail analogy, we recognize that the processes and locational demands are very different for non-retail businesses. However, our results do suggest that agglomeration is as important a force for business services as it is for retailing, even though an increasing number of business services may theoretically be footloose and supplied at a regional, national or even international level. Hence, our results suggest that many business services have a close geographical 'market' similar to that of retailing.

These results have important implications for the location of business service suppliers including policy supports. This has already been recognized by Esparza and Krmenec (1996), Lentnek *et al* (1995) and Phillips *et al* (1998), who suggest the development of location-allocation models based on spatial interaction principles that can simultaneously take account of the variable pattern of demand across different areas, whilst controlling for spatial price competition between different potential supply points and suppliers. Lentnek *et al* and Phillips *et al* believe that such models are a long way away, and would be further away for our analysis of a large and complex area the size of Britain. Indeed, there have been only a few attempts to combine locational and price equilibrium models. Lentnek *et al* quote d'Aspremont *et al* (1979), Eaton and Lipsey (1982), Gabsewicz and Thisse (1986), Eaton *et al* (1989) and Mulligan and Fik (1989), but none of these provide solutions for the large-scale case, and none are extendible to a goal of encompassing multiple differentiated services with varying and non-linear supply functions in a market of demand functions that is probably also differentiated by firm type.

Our analysis suggests that even without this level of sophistication, some developments may be possible because of the dominance of a highly concentrated pattern of business locations. We have mapped these concentrations and identified the chief centres that can act as foci of either demand or supply. The resulting clusters give the potential for a high level of coverage of the country

from a relatively small number of supply points, and also demonstrate the differentiation of the country into two distinct types of area for business service development:

1 The majority of businesses are located in clusters that are highly accessible to a major supply centre (within 15 kilometres), and many businesses will have several alternative supply centres to choose from. Conversely, in many cases there are alternative supply centres in clusters that can access the majority of British businesses. This means that a viable system of business service supply can be expected to develop in these areas. These are areas that have sufficient critical mass and agglomeration economies to the service supplier, and hence are likely to be the focus of many business supplier locations.
2 A smaller number of British businesses (approximately 24 per cent) are not within the clusters identified in this paper, but are in more rural areas. The analysis in this paper suggests that these areas may have greater difficulties in supporting localized business service delivery, and hence will have to draw their services from more distant locations. They may thus experience higher service supply costs to the supplier and/or higher delivery costs of access to the client and may have greater difficulty in establishing networks or drawing on the benefits of local embeddedness. They will be areas for which IT, e-commerce and other communications networks may be more relevant than travel to obtain access. This may affect not only the method of service supply, but also the range of services that can be offered.

In the analysis, we have had to restrict attention to an aggregate of business services. The analysis needs to be extended to assess the range of suppliers of business services, and their differentiation of the market and geographical coverage, particularly to investigate different economic structures of the supplier (compare O'Farrell and Moffat 1995). We have also assumed that each cluster is identical in type. In effect we have assumed that the supply and demand functions are linear. However we would expect the supply function, at least, to be non-linear as a result of the effect of the increasing scale and agglomeration economies of large service centres. We also know that the scale economies available to the supplier have an effect on the type of businesses that are attracted to, or are viable in, or can themselves achieve larger sizes and growth in, different locations. This produces agglomeration economies for the client as well as the supplier. As a result we would expect service centres to be more dominant the larger they are and thus to absorb a wider range of the geographical catchment of the localized service demand in their proximity. The result is likely to be a range of supply centres differentiated by their regional, subregional or more local significance. The existence of such a hierarchy is indicated in the analysis of business centres by Bennett and Graham (1998), but further investigation of these characteristics needs to be undertaken, as in the Champion *et al* approach, to identify dominant and subdominant cores for LLMAs. This is an important area for further investigation.

Local economic development policy

The importance of business concentration, in the context of cluster theory, throws emphasis on policy interventions that focus on improving local factor conditions as a means of enhancing competitive advantage. Most local factor conditions depend on local markets: for factor inputs, local demand and supply, industrial interdependencies and the structure of firm strategy and competition. Policy initiatives can play an important role in improving these conditions. At a local level, major efforts can be devoted to improving education, training, public research and infrastructure. Exchange of information can be stimulated and common approaches can be developed to improve synergies between businesses, and between public and private agents. Barriers to market entry or growth can be reduced, particularly for small firms, by improving access to 'business supports', for example through provision of information, advice and improved access to venture capital.

Local economic development initiatives rest on an assumption that interventions and support within a relatively local area can have significant benefits to the economy of that locality and do not seep away to the wider regional, national or international level. The scale of most local economic initiatives in Britain has focused on local authority areas, with TECs and LECs based primarily on the same boundaries or on small groups of local authorities. More recently, Regional Development Agencies (RDAs) in England have been set up to

mirror the role of similar scale bodies in Scotland, Wales and Northern Ireland. Again, these also assume that the benefits of policy initiatives, albeit at a regional scale, will stay relatively localized and not seep away to wider areas. Our analysis suggests that the high extent of overlapping of business clusters means that highly localized initiatives are very inefficient from a local perspective and would be better focused at a regional or national level, for the metacluster as a whole or for significant parts of it.

An important thrust of local initiatives has developed around business supply chains, local business networks and improving the supply of business support and advisory services. Important elements of this agenda are the DTI's Regional Supply Network initiative, local purchasing initiatives and the local network of Business Links (BL) and, similarly, Business Shop (BS) and Business Connect (BC) in Scotland and Wales respectively. These all focus on the locality, at various scales, as a nexus of relations between businesses and their external local environment, either with other businesses or with external support organizations. Local government has also been significant in contributing to these initiatives or developing similar initiatives of its own, all of which depend to some extent on the concept of a local cluster of concentration of businesses as a valid focus for policy. The scope for these initiatives is also called into question by the results of this paper.

At one level, our results give considerable support to the relevance of local initiatives. The high degree of localization of businesses as a whole, and business service suppliers in particular, suggests that locally targeted initiatives can reach a large proportion of the whole economy. Local targeting within identified business clusters and their immediate catchments is therefore an efficient way of accessing a large proportion of the economy. The analysis shows that using some or all of the 126 centres that cover 76 per cent of businesses could allow a highly targeted approach.

These results reinforce the approach of using a fairly limited number of supply points to act as foci for business support initiatives. This provides a strong indication to local government and other agents on the relevant scale of their economic initiatives. For local government, it suggests a strong focus of attention in the metropolitan districts, London, the unitary authorities and at county level elsewhere. For Business Link in England, there are 80 hubs with over 200 satellite offices, whilst BS and BC have about 20 access points within their integrated regional networks. Our analysis shows that the 100 major BL/BS/BC hubs in existence are approximately equal to the number of major business clusters, and are thus roughly in line with the market demand, although their locations are not always coterminous. However, the relevance of 200 satellites is open to question. We devote further detailed analysis to the relation of BL/BS/BC locations to the actual pattern of business concentrations in a later paper.

At a second level of analysis, our results cast some doubts on the relevance of the very local level to policy supports: highly local cluster supports for business misses the real dynamics and structure of most of the British economy as a metacluster. These local supports may also suffer from severe dead-weight effects as localities compete with each other in a zero-sum game. The structure of business clusters and the metacluster suggests that regional and national focuses, rather than the local level, may be the most effective levels for action. Certainly, in terms of improving generic factor supply-side conditions, much of the policy responsibility in any case rests at national level: for education and vocational training and for the environment of regulation and compliance. Thus whilst the local level remains important for some purposes (probably related to the smallest firms), the most effective systemic contributions are likely to be at national or regional level. This has some implications for how TECs and BLs work together and whether their large number and high degree of localization is needed.

The reform of TECs and development of a Small Business Service to replace BLs in 45 areas was announced in June 1999. This seems a better way forward. To the extent to which a hierarchy exists this may also give support to a policy focus grouping some policy supports into regional centres with a wider geographical scale of coverage. The BL Network Company, which is an 'association' of local BL outlets, is already trying to develop centres of expertise, whilst the DTI has also been encouraging the development of regional specialization. None of these developments is very significant as yet. In Scotland and Wales a regional focus of more specialist advisory expertise was built into their systems from the outset and might be copied in England. For local government the development of regional expertise may be able to draw on the new RDAs.

Whilst the results confirm the relevance of local and regional clusters in focusing policy initiatives for the vast majority of British businesses, an important problem remains for the 24 per cent of businesses located in more rural areas distant from the main business centres. These are the main areas that may suffer from the uneven development of business location and policy initiatives based on business clusters and the metacluster. The more peripherally located businesses present a major policy challenge. Although they equate to only 24 per cent of businesses, they represent a considerable number: over 300 000 businesses with one employee or more. But they are relatively widely dispersed over 62 per cent of the geographical area of the country: their average density is only 2·18, compared to 11·52 businesses per square kilometre for the 126 clusters.

The ability to offer these businesses support via localized centres and local authority action will be very limited unless very large resources are available. In the past the Rural Development Commission (RDC) has been the main policy agency offering rural business support in England, backed up chiefly by county-level local government initiatives. The RDC offered a national enquiry and response service to all rural areas, with a network of local offices, and a subsidized portfolio of business advisors and consultants who could travel to rural businesses to offer on-site assessments and supports. The RDC, however, has been superseded, with its main supports and staff transferred to the new RDAs. Yet, having a regional focus for operations will not fully solve the problem for the rural-based firms. The results of our analysis suggest strongly that these businesses will require similar structures of support to that developed by the RDC, ie a range of consultants and advisors who can travel to businesses to give on-site assessments. Hence, whilst the uneven development of businesses in the British economy has some advantages for policy initiatives by allowing a concentration of initiatives and supports in a relatively small number of locations, the needs of more rural and peripheral firms must not be neglected if they are to receive similar levels of support.

Conclusion

This paper has made a first attempt at assessing the concentration of businesses in Britain at a high level of spatial resolution. It has sought to map and identify the major business clusters and to assess to what extent they are also foci for business service location. The analysis has demonstrated that businesses are indeed highly concentrated: businesses that are either in a major cluster, or within 15 kilometres of a core, cover 76·45 per cent of all businesses in only 33 per cent of the geographical area. The largest 30 clusters cover 43 per cent of businesses in 9 per cent of the area, and the largest ten clusters cover 26 per cent of businesses in 3 per cent of the area. Hence, the levels of concentration increase as we focus on the larger clusters. The overwhelming conclusion of the analysis is that there are increasing returns of scale with agglomeration, and that business is *highly urbanized* and is chiefly focused on a relatively small number of clusters. This confirms earlier analyses that demonstrate the importance of urban locations (Pred 1977; Goddard 1978; Coffey and Polèse 1987; Marshall 1994) or the conclusion by Wood *et al* (1993) that business service firms are either predominantly urban-based or are closely accessible to urban areas. There is also an indication of a non-linear or hierarchical effect that larger clusters are relatively more important as foci than smaller clusters. This hierarchy may not necessarily be a rigid one with discrete steps, although analysis by Bennett and Graham (1998) does suggest that there are fairly distinct differences between London, a group of five or six 'regional' clusters, and the next group of secondary clusters.

A second conclusion is that business service firms are even more highly localized than businesses in general. This should be no surprise, since business service firms rely on the demand from other firms, including other service firms, for their existence. The general pattern of increasing returns of scale deriving from agglomeration thus appears to affect all firms (as suggested by Romer 1986, Krugman 1993a and others), but is greater for business services than for other sectors. Our analysis confirms a high degree of clustering of business services to the main business centres. Thus 83·2 per cent of all business services are located in the 126 clusters and their 15-kilometre hinterlands, 50·1 per cent in the largest 30 clusters and 31·8 per cent in the largest ten clusters. This pattern of clustering confirms the influences found in many microlevel studies of business service demand-supply interactions: that a high proportion of external sources of supply to firms, particularly business services, is sought within the nearest

10–25 kilometres. *Distance thus does appear to matter a great deal* to the location of all businesses, and to business services firms most of all.

Unfortunately, given the available data, we cannot develop rates of change in importance of this phenomenon, nor assess whether concentration is increasing or decreasing. Other analyses suggest that concentration was decreasing in the 1970s and 1980s, although at a relatively modest rate (Howells and Green 1988). However, there is some suggestion that in the 1990s this pattern may be reversing, with increasing concentration now returning to the larger urban centres (Keeble 1998). The direction and speed of change is an important issue to resolve. However, comparable information at the spatial level used here across the whole country is not readily available for either an earlier time period (because earlier employment censuses were not postcoded by NOMIS) nor for a later period (since no further full Census has yet been undertaken). What we can conclude, however, is that business concentrations are presently so high in urban areas, particularly the largest centres, that it will take a very long time to change the pattern in any fundamental way. Clustering and agglomeration look set to remain the dominant patterns for the foreseeable future.

The implications of these findings have been assessed in three areas: the implications for the concept of clusters, for location of business service firms and for local economic development policy. We conclude that existing business concentration is a strong force that will encourage the further clustering (or improved endogenous growth potential) of other businesses in the same locations. Business service firms seeking the largest market coverage will also tend to cluster in the same areas, thus contributing further to uneven development.

This conclusion emphasizes the importance of the cluster concept. But the scale of the phenomenon identified, with a metacluster including the majority of businesses across the British economy, tends to suggest that clusters are most relevant as foci for 'commonalities and complementarities' (Porter 1998, 199) rather than as intense local networks of supply chains or embeddedness, although the two phenomena will undoubtedly both be present and overlap with each other.

The implications of these results for local economic development policy suggest that a focus of policy on 100–120 centres will provide most of what is needed to provide local support to businesses in Britain as a whole. This is roughly in line with the network of TECs/LECs and Business Link/Shop/Connect hubs. Within these networks, however, a much stronger national and regional focus of supply structure would fit better with the metacluster phenomenon: to provide more specialist services in line with the different scales of business concentration that we have recognized, with less potential for dead-weight resulting from local competition. For local government there is the more difficult conclusion that only some areas have a major role to contribute to economic development policy. This chiefly relates to the metropolitan districts, London and the unitary authorities. In other areas, particularly those dispersed rural areas distant from the main business centres, local government, as well as other agents, ought perhaps to focus their actions through subregional collaborations at county level, or to develop initiatives jointly with regional agents such as the RDAs. This represents a considerable challenge.

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Appendix: Data sources and their alignment to postcode districts

Data sources

The statistics available on business locations in Britain are far from satisfactory. There are only two sources that allow detailed geographical disaggregation on a uniform basis for the country as a whole. The VAT register is one, as it provides a net count of the number of businesses, as well as start-ups and failures over the previous quarterly period. Unfortunately it gives no size information, and the sector disaggregations presently available are limited to categories defined by Customs and Excise and cannot readily be related to other sectoral statistics such as the SIC. A second source is the Census of Employment; until 1993 this was based on a three-yearly sample Census, and full Censuses in 1981 and 1993. Since 1993, the Census has been replaced by Annual Employment Surveys (AES), for which about 110 000 businesses have been surveyed each year since 1995. The AES does not give a large enough sample to allow detailed spatial analysis, so that the 1993 Census is the most recent full coverage of businesses available other than the VAT Register. The Census is based on PAYE payroll points, and thus excludes self-employed businesses and other businesses where employees are below the PAYE threshold. In theory the VAT record and the Census of Employment data have been integrated through the IDBR (Inter-Departmental Business Register), but full integration has not yet been achieved in the sense that the entry for an individual business can be read off in terms of both its VAT or Census of Employment record at a given location.

For the analysis here, the Census of Employment is chosen because (i) it offers information on both size and sector of business, (ii) although it excludes most self-employed it does include almost all businesses with employees, which we would expect to be the main sources of supply and demand influencing geographical concentration and (iii) many of the previous misallocations of larger businesses to PAYE locations that affected earlier Censuses were overcome in 1993 by respondents allocating their employees and sites to actual work locations in multi-site businesses (such a business is then counted as a different business on each site). Other researchers have been less confident in using the Census of Employment because misallocation of multi-site business had a significant impact on where the employees of large firms are located; but this problem does not arise for 1993 (see Thomas and Smith 1995; supplemented by personal communication). The Census contains 1·28 million businesses, which is 45·6 per cent of the total number of businesses identified in the radically revised estimates of business numbers calculated by DTI (1997) using the IDBR. The revision upwards in 1997 to a population of 3·7 million from the previous estimate of 2·81 million is largely the result of the number of self-employed PAYE but non-VAT businesses identified from the Inland Revenue records. For our purposes, therefore, the Census of Employment is satisfactory. It was accessed through the National On-line Manpower Information System (NOMIS) for 1993.

Aligning NOMIS and postcodes

The data on business location were aligned with a GIS using postcode districts, recorded in NOMIS. Postcodes in the UK make reference to four successively more detailed geographical levels: postal areas, districts, sectors and units. The first one or two characters of the postcode define the area, the addition of the third and fourth defines the district and sector respectively, and the entire postcode relates to the unit. There are approximately 120 areas, 2700 districts, 9000 sectors and 1·6 million unit codes in the UK as a whole. The present research uses the districts as the basis for identifying business area. This is the finest level of postal geography for which NOMIS data are available and is sufficiently detailed for our analysis.

Districts are the first three characters in a postcode; eg EC2 for part of the City of London, or EH1 for part of Edinburgh. The criteria that should be applied to analyses using any areal-based spatial units are that the basic units are small relative to the attribute being measured or analysed (so that sufficient geographical detail is available) and that the units are as relatively internally homogenous and of as equal a size as possible (to retain their comparability) (see, for example, Raper *et al* 1992). Postcode districts satisfy these criteria at our level of analysis. They also have the advantages that (Raper *et al* 1992): (i) they are a single uniform system covering the whole country; (ii) they are continuously updated with new addresses; (iii) there is a fixed hierarchy of areas; (iv) they are easily handled by computer; and, most important, (v) they are closely linked to the 'perceived

structure' of the geography of an area. Royal Mail make extensive use of natural boundaries or communication access routes to draw postcode boundaries, such as roads, railways, rivers and bridges. As a result, Raper *et al* (1992, 102) argue that postcodes are a close 'representation of the geography . . . of the settlement and business activity' of an area – which is exactly what we need for our analysis. The disadvantages of postcodes are that (i) there is no topological information available that relates one area to another; (ii) the equality of the area size and number of addresses covered works less well in rural areas; (iii) it is personnel-related for the needs of Royal Mail rather than related to general business communication characteristics; (iv) there are some significant non-geographic postcodes for large organizations (such as DVLC and the NEC) and PO Box numbers. Despite these disadvantages, postcodes provide a very applicable base for the needs of defining business geography. Royal Mail make major efforts to equalize the size of delivery areas from the point of view of their personnel (to ensure that a postman's walk is a roughly equal load). This is decided through a complex mix of criteria, chiefly delivery volumes and the transport or other logistical aspects of delivery, which is why rural areas become larger in size and smaller in number of addresses. At the district level, many of the inequalities in volume are evened out, with major contrasts remaining only for the highly ruralized/dispersed areas such as parts of East Anglia, Wales and Scotland. Moreover, the volume of delivery is decided chiefly on the basis of the location and volume of business, as opposed to residential activity. This is because business mail makes up over 80 per cent of all mail – social mail forms less than 10 per cent – therefore postcode areas mainly reflect business use (Raper *et al* 1992, 47–8). However, it is important to remember that a postman's walk is not very relevant to business services, which are often supplied via communications networks or where goods are collected or delivered by means of a car or van journey.

Postcodes are updated frequently by Royal Mail. The updates are predominantly undertaken at the unit and sector level and so most changes do not affect our level of analysis. The 1993 Census of Employment data use postcode districts as at September 1993. Unfortunately it is not possible to obtain a map of postal boundary data that exactly corresponds with the date of the Census, as Royal Mail keep no detailed historical record and there are no online or historical sources. Instead the closest postcode map files (in our case for 1995) are used and changes that have occurred since 1993 are reconstructed. The vast majority of these changes are of minor significance. But three postal areas of the UK have been significantly affected since September 1993: Aberdeen, Southampton and Reading, where substantial changes at the sector level have led to the creation of new districts and the removal of old ones. The details of the changes are documented in a series of postcode updates published by Royal Mail. With these documents, and through consultation with staff at Royal Mail address management, the spatial breakdown of the 1993 Census can be matched to the 1995 map of postcode districts. The method used allocates the share of businesses within 1993 postcode districts to the map of 1995 districts in correspondence to the percentage of old postcode sectors allocated within the new districts. For example, from the old postcode district of AB1, approximately 20 per cent of sectors were allocated to the new district AB10, 5 per cent to AB25, 25 per cent to AB11, 20 per cent to AB12, 20 per cent to AB15, 5 per cent to AB13 and 5 per cent to AB14. Thus to approximate the spatial breakdown of businesses in 1995 postal geography, the businesses recorded with AB1 have been allocated to new districts on the basis of the share of postcode sectors that went to those new districts. This is the most accurate approach possible in the absence of data on the businesses located in the old areas. Given the attempt by Royal Mail to equalize areas, it should be approximately correct.

Non-geographical postcode districts that are single points, such as PO Boxes, allocated to large users including competition holders, catalogue services, British Telecom and charities were allocated to the actual districts within which the non-geographical postcodes were located using information from the Royal Mail. There are 57 such districts, but 36 had no establishment data, so that only 21 required allocation. There were also 33 extra districts in the NOMIS data that could not be identified in the postcode map files. Of these, eight were old districts containing zero values which did not need to be reallocated, a further 15 could be directly allocated to single new districts and the remaining ten were allocated using the same method described as that used for Aberdeen, Southampton and Reading. A full list of all relations between the 1993 NOMIS and postcode locations is available on request.