THE GEOGRAPHIC DISTRIBUTION OF PRODUCTION ACTIVITY IN THE UK

Michael P. Devereux
University of Warwick and Institute for Fiscal Studies

Rachel Griffith
Institute for Fiscal Studies

Helen Simpson
Institute for Fiscal Studies

September 1999

Abstract
There has much recent academic and policy interest in the issue of spatial clustering of economic activity, with most attention paid to the geographic concentration of high-tech industries. This paper describes patterns of geographic and industrial concentration in UK production industries at the 4-digit industry level. Several measures are used, including a new simple and intuitive measure of agglomeration. Conditioning on industrial concentration, many of the most geographically concentrated industries are not high-tech industries. We find that the most agglomerated industries are relatively low-tech and that they have lower entry and exit rates and higher survival rates as well as lower job creation and job destruction rates. Within industries we find that the most concentrated region has, on average, lower entry and exit rates but higher job creation rates and lower job destruction rates.

Acknowledgements: The authors would like to thank Stephen Redding, David Stout and John Van Reenen for helpful comments. The analysis contained in this paper was funded by the Leverhulme Trust under grant F/368/I and the development of the ARD data was funded by the ESRC Centre for Microeconomic Analysis of Fiscal Policy at the Institute for Fiscal Studies. This report has been produced under contract to ONS. All errors and omissions remain the responsibility of the authors.

JEL classification: R12, R3

Keywords: geographic concentration, agglomeration

Correspondence: m.p.devereux@warwick.ac.uk; rgriffith@ifs.org.uk; hsimpson@ifs.org.uk; IFS, 7 Ridgmount Street, London, WC1E 7AE UK.

Executive Summary

There are many examples of industries that are geographically concentrated. Although much attention and policy interest is currently focussed on high-tech clusters, such as in Silicon Valley (California) and Sophia Antipolis (France), the phenomenon is not limited to high-tech industries.

This paper describes patterns of geographic concentration in UK production industries at the 4–digit industry level, using employment data from the population of production plants in the UK, for the year 1992.

We use alternative existing measures of geographic concentration, and present a new measure, which is both simple and informative. This new measure allows us to investigate how much of observed geographic concentration of an industry can be explained by industrial concentration. That is, it enables us to distinguish between industries that are geographically concentrated due to the presence of a single large plant in a particular region, and those that are geographically concentrated due to a number of smaller, un-related plants in a region. The theoretical literature that emphasises incentives for firms to locate near to each other, points to the second case as being particularly interesting. We define the 'excess' of geographic concentration over industrial concentration as the extent to which an industry is 'agglomerated'. We also examine the extent of 'co-agglomeration' – that is geographic concentration between two or more industries.

As has been found in studies using US and French data, we also find a significant degree of geographic concentration in some industries. In some cases this is almost entirely explained by high industrial concentration. But in others, such as ceramics and lace, high geographic concentration is combined with low industrial concentration.

Using data from 1985 to 1992 we find patterns of agglomeration to be highly persistent. We examine differences in plant entry and exit and job creation and job destruction between agglomerated and non-agglomerated industries. We also look within 4-digit industries at how these factors are acting to re-enforce or reduce the extent of agglomeration.

1. Introduction

There are many examples of geographically concentrated industries, including the often cited clusters of high-tech firms in Silicon Valley (California), Route 128 (Boston), Cambridge (UK) and Sophia Antipolis (France). But the phenomenon is neither recent, nor restricted to high-tech industries. Other examples abound: the US carpet industry in Dalton, Georgia; the UK ceramics industry around Stoke-on-Trent, an area known as "The Potteries"; the UK lace industry centred in Nottingham. There are also examples of industries clustering across countries, e.g. the financial centres in London, Tokyo and New York.

Understanding how and why these clusters form and persist is an issue of considerable interest both from an academic and policy perspective. In this paper we use plant level data to describe the geographic distribution of production activity in the UK. We consider how much of the geographic concentration that is observed can be explained by industrial concentration.

Alternative measures of geographic concentration are used and a new measure, which is both simple and informative, is proposed. This measure allows us to distinguish between industries where activity is concentrated in one region because: (i) a large number of (smaller) unrelated plants are located there, and (ii) one (or a small number) of larger plants are located there. This distinction is important as our main interest lies in studying the role of externalities in the formation and persistence of agglomerations. This means that we are primarily interested in the case where non-related plants choose to locate near to each other. However, it is worth noting that the second case may have arisen endogenously because the externalities were so great a firm chose to internalise them by purchasing all plants. We use the term "agglomeration" in this paper to refer to geographic concentration over and above that which would be expected given the pattern of industrial concentration in the industry; a more precise definition and measure is given in Section 2.

The extent of geographic concentration, and the reasons for it, has implications for a broad range of policy issues. Throughout the world governments expend considerable sums with the aim of attracting firms or industries to specific locations. For example, the UK has Regional Development Agencies, although within the European Union the process is controlled by provisions on state aids. In the US individual State governments offer enticements of various forms for firms to relocate to their region.[1]

If firms have incentives to locate near to other firms within the same or other industries, then there are several policy implications. First, if one region can create a location which new entrants want to join, then there may be large potential gains for that region. Second, if this process has already occurred, it may be prohibitively expensive for a region – and outweigh any gains it may perceive - to try to attract activity from an industry which is already localised elsewhere. Third, how large an impact clusters have on productivity and technology transfer between firms is important in assessing any gains or losses that might result from using fiscal policy to distort firms' location choices.

This paper investigates geographic concentration and agglomeration using a cross section of data for the year 1992. Part of the observed difference in geographic concentration between industries is likely to reflect the different pattern of their development. For well established industries the pattern of geographic concentration observed now will depend on the entire history of that industry and the dynamic processes that shaped it. We also have relatively new industries, which are in earlier stages of their development, the location of which will reflect more recent factors. However, in this paper, we analyse only the position in 1992. In future work we hope to consider the dynamic aspects of agglomeration and clustering more explicitly.

The layout of the paper is as follows. The next section discusses some methodological issues involved in measuring geographic concentration, agglomeration and coagglomeration. Section 3 describes the plant level data, presents measures of the geographic concentration of total production activity in the UK and uses a number of measures to look at patterns of geographic and industrial concentration at the 2-digit and 4-digit industry level. Section 4 looks at plant entry and exit, and section 5 summarises and concludes.

[1] See, inter alia, Hines (1996) and Head, Ries and Swenson (1995).

2. Measures of geographic concentration and agglomeration

There are numerous statistical measures that aim to summarise inequality and concentration in distributions, and these have been applied to many economic issues. For example, the Herfindahl index is a commonly used measure of industrial concentration and the Gini coefficient[2] has been used to describe geographic concentration.[3] More recent papers by Ellison and Glaeser (1997) and Maurel and Sedillot (1999) have proposed indices which are specifically designed to measure agglomeration – that is geographic concentration conditional on industrial concentration. In this section we discuss these measures and some of their properties and propose a new measure of agglomeration which is similar to that of Ellison and Glaeser and that of Maurel and Sedillot but which we find both simpler and more intuitive. In section 3 we apply these measures to UK plant level data.

The alternative measures we discuss are:

- an agglomeration index proposed by Ellison and Glaeser (1997), g_{EG};
- an agglomeration index proposed by Maurel and Sedillot (1999), g_{MS};
- a new agglomeration index, a, based on measures of industrial (M) and geographic (F) concentration;
- a locational Gini coefficient, calculated both relative to total manufacturing (L_R) and absolute (L_A);
- a coagglomeration measure proposed by Ellison and Glaeser (1997), g_{EG}^{C};
- an alternative coagglomeration measure, $C(r)$.

In the Appendix we also consider a concentration index, denoted CI, which is the proportion of firms in the top 3 regions in each industry.

---

2 The Gini coefficient is a measure often used to describe inequality in the distribution of income across a population.

3 See, inter alia, Krugman (1991b) and Amiti (1998).

There are three main distinguishing features between these measures. The first is whether they are a measure of geographic concentration or agglomeration. The Gini coefficients and concentration index are measures of geographic concentration, they do not condition on industrial concentration, while the others are all measure of agglomeration, that is they look at geographic concentration conditional on industrial concentration. A second difference is that the Ellison and Glaeser (1997) and Maurel and Sedillot (1999) measures are both explicitly derived from an underlying location choice model of firm behaviour, while the others (including ours) are not.

The third difference lies in what underlying geographic distribution the observed distribution is compared to. In most empirical work on industry location, the Gini coefficient is measured relative to the geographic distribution of total manufacturing - see, for example, Krugman (1991b) and Amiti (1998). They use a relative Gini, so that they measure the distribution of employment in an industry relative to the distribution of total manufacturing employment. Hence the Gini takes a value of zero if the industry's employment is located in each region in the same proportion as total manufacturing employment. If manufacturing activity is not uniformly distributed, then an industry which was uniformly spread over all regions would appear as being geographically concentrated since it would have a relatively high proportion of employment in regions which had little other activity.

Ellison and Glaeser (1997) and Maurel and Sedillot (1999) also calculate their measures relative to total manufacturing. Ellison and Glaeser (1997) develop an index which they state, *"is scaled so that it takes on a value of zero not if employment is uniformly spread across space, but instead if employment is only as concentrated as it would be expected to be had the plants in the industry chosen locations by throwing darts at a map"* (p.890). This seems puzzling, however, as in practice their index is based on the difference between the proportion of the industry's employment in each region and the proportion of total manufacturing employment in each region. Maurel and Sedillot (1999) propose an index very similar to Ellison and Glaeser, except that it is derived from an estimator of the probability that two plants in the same industry will be located in the same region. Both measures control for the degree of industrial concentration, and are hence both are measures of agglomeration, rather than geographic concentration.

We propose a simpler and more intuitive approach.[4] As in the other two papers, we aim to test alternative theories of geographic concentration and agglomeration against the null hypothesis that the distribution of production activity is randomly distributed. Divergences from this distribution may reflect some process by which firms in the same industry locate near to each other. But before we proceed we need to consider more precisely what we mean by a “random distribution”.

Consider K geographic regions of equal geographic size and an industry with N plants. Then the process of “throwing darts at a map” would imply that plants are distributed randomly in geographic space. Plants would be randomly allocated to regions and the expected number of plants in each region would be N/K – that is in expectation a uniform distribution. However, an alternative definition of “randomly distributed” is to consider that the location of plants is determined by the location of individuals whom are chosen randomly to set up plants; and that they do so in the region where they reside. This is attractive given the high degrees of observed geographic concentration both with regard to industry employment and the total population, relative to land space. In this paper we follow the approach based on total population. That is, we use regions – based on UK postcodes – which vary in the geographic area they cover, and which are roughly based around urbanisations. We assume that a firm is equally likely to choose to locate in any of these regions, so defined; hence the probability of choosing any given region is $1/K$.

We can now define a number of alternative measures. A starting point is the Herfindahl index of industrial concentration,[5] defined for an individual industry as:

$$H = \sum_{n=1}^{N} z_n^2 \qquad (1)$$

which measures the distribution of plant size, where z_n is the n^{th} plant’s share of industry employment (or any other size measure), $n=1\ldots N$. The value of the Herfindahl is determined both by the number of plants in the industry and the size distribution of those

[4] In a separate paper, Dumais, Ellison and Glaeser (1997), they state that their measure can be closely approximated with something very similar to what we are proposing here.

[5] The Herfindahl is a widely used measure of industrial concentration, although there are alternative measures.

plants. For an industry with N firms, the Herfindahl index has a minimum value of $1/N$, reflecting equally sized firms. Therefore in general the Herfindahl will be higher for industries that have a small number of firms.

A natural analogue of this measure for geographic concentration is

$$J = \sum_{k=1}^{K} s_k^2 \tag{2}$$

where s_k is the k^{th} region's share of industry employment, $k=1\ldots K$. One natural way to examine the agglomeration of an industry - that is, geographic location conditional on industrial concentration - would be simply to consider the difference between these two measures: $J - H$.

Such a measure is attractive for the case in which $N<K$. Suppose for example that there is an arbitrary size distribution of N plants, but with only one plant in any single region. In this case $J=H$ and hence the difference is zero. This coincides with a natural measure of agglomeration: in this case, although there is an unequal distribution of production activity across regions, this can be wholly explained by differences in the size of firms – industrial concentration rather than geographic concentration. However, this measure is less attractive for the case in which $N>K$. Suppose for example that there were N equally sized firms equally distributed between regions, but that $N>K$. In this case $J>H$: since $J-H>0$, the measure suggests – incorrectly – that the industry is agglomerated.

This problem can be overcome using measures related to the coefficient of variation (CV). To see this, begin with the relationship between the Herfindahl index and the coefficient of variation, and define a measure M such that:

$$M = \sum_{n=1}^{N} \left(z_n - \frac{1}{N} \right)^2 = \frac{CV(z_n)^2}{N} = H - \frac{1}{N} \tag{3}$$

where $CV(z_n)^2$ is the squared coefficient of variation of the share in employment of each plant in the industry. A similar relationship exists for the geographic equivalent, J:

$$G = \sum_{k=1}^{K} \left(s_k - \frac{1}{K} \right)^2 = \frac{CV(s_k)^2}{K} = J - \frac{1}{K} \tag{4}$$

where $CV(s_k)^2$ is the squared coefficient of variation of the shares in employment in each region in the industry. *M* measures the distribution of employment across plants in the industry, controlling for the number of plants. Any uniform distribution of employment across plants would yield $H = 1/N$ and hence $M = 0$, irrespective of *N*. Similarly, *G* measures the distribution of employment across regions, controlling of the number of regions. Any uniform distribution of employment across regions would yield $J = 1/K$ and hence $G = 0$, irrespective of *K*. In fact, the measure of *G* shown in equation (4) is very close to equivalent measures - also denoted *G* - in Ellison and Glaeser (1997) and Maurel and Sedillot (1999). Each of these other papers attempts to control for differences in the size of regions - measured by total employment. The difference between them is in the way that they control for such differences. However, in the case where regions are all of equal size, then both measures in these other two papers reduce to the definition of *G* in (4).

The difference between *G* and *M* might be seen as an alternative measure of agglomeration to the difference between *J* and *H*. However, in the case in which $N<K$, the maximum number of regions in which a plant might be sited is *N* rather than *K*. This makes no difference to the computation of *J* since adding regions with no employment leaves *J* unaffected. However, it clearly affects *G*. For the purposes of considering agglomeration we therefore make use of a term $K^* = min[N, K]$, which is the maximum number of regions in which an industry might be located, given *N* and *K*. This suggests an adjustment to the measure of *G*. Instead of using *G* we define a measure *F* as an index of geographic concentration:

$$F = \sum_{k=1}^{K^*} \left(s_k - \frac{1}{K^*} \right)^2 = J - \frac{1}{K^*} \qquad (5)$$

We define *F* as a measure of geographic concentration and *M* as a measure of industrial concentration, where *F* controls for the maximum number of regions in which employment may be located and *M* control for the total number of plants. To see the main implication of using *F* rather than *G*¸ consider two industries, *A* which has 2 equally-sized firms located in different regions and *B* which has 10 equally-sized firms located in different regions. Suppose that *K=100*. For both industries, *F*=0, reflecting their equal distribution across regions. However, for industry A, $G=0.24$ and for industry B, $G=0.09$.

A natural measure of "agglomeration" - or excess geographic concentration - is the difference between F and M:

$$\alpha = F - M \ . \tag{6}$$

α lies between -1 and +1. It takes on positive values if our measure of the distribution of employment across regions (F) exceeds that across plants (M) - this is a more precise definition of what we mean by agglomeration. The opposite is also clearly true: it takes negative values if $F<M$.[6] If both distributions are uniform, then $\alpha = F = M = 0$. More generally, $\alpha = 0$ whenever the distributions across plants and regions are equal ($F=M$).

This measure is closely related to those of Ellison & Glaeser (1997) and Maurel and Sedillot (1999). Ellison & Glaeser (1997) use a term $G_{EG} = \sum_{k=1}^{K} (s_k - x_k)^2$, where x_k is the k^{th} region's share of total manufacturing employment, $k=1\ldots K$ and define an index of agglomeration as

$$\gamma_{EG} = \frac{G_{EG} / (1 - X) - H}{(1 - H)} \tag{7}$$

where $X = \sum_{k=1}^{K} x_k^2$. For large and reasonably uniform K, $X \to 0$, and $\gamma_{EG} \to (G_{EG} - H)/(1 - H)$. There are three main differences from our measure of agglomeration, α. First, this has a scaling term $(1 - H)$. Second, G_{EG} attempts to control for differences in overall size - measured by total manufacturing employment - across regions. Third, this measure is based on a comparison of G and H; from the analysis above, however, it seems more natural to compare G with M, and H with J. This is because H and J are both defined in terms of the sum of squared shares of industry employment, and G and M are both defined relative to the mean (or uniform) share. Maurel and Sedillot (1999) develop an index which has an identical expression to (7) -

[6] This can arise if, for example, and industry is uniformly distributed geographically, so that $F=0$, but is industrially concentrated, $M=0$. For an extreme example, suppose that $K=2$, $N=4$ with 2 firms having employment of 999 each and 2 firms having employment of 1 each. If each region contains one of each type of firm, then $J=0.5$, $F=G=0$, $H=0.48$, $M=0.46$ and $\alpha=-0.46$.

denoted below as g_{MS} - but with replaces Ellison and Glaeser's G_{EG} term with $G_{MS} = \sum_{k=1}^{K} s_i^2 - \sum_{k=1}^{K} x_i^2$ [7]. This measure has the same properties as Ellison and Glaeser's; it differs in that it is derived from an estimator of the probability that two plants in the same industry will be located in the same region.

All of these measures are based on the geographic proximity of firms within the same industry. However, it is possible that any externalities which generate geographic concentrations within an industry might also generate geographic concentrations between two or more industries. This may be the case if two industries are vertically related, for example. It is of course possible to use the measures above to analyse the overall pattern of geographic and industrial concentration for any set of firms, whether they come from one or more industries. However, it is also useful to consider the extent to which concentrations arise within and between specific industries. Following the approach of Ellison and Glaeser (1997) we term the concentration between industries as coagglomeration. Their measure of coagglomeration is based on the difference between G_{EG} applied to the group of industries and the weighted average of G_{EG} for each individual industry, where the weights are based on the size of each industry. It is possible to show that their measure of the coagglomeration of *r* industries is equal to:

$$g_{EG}^{C} = \frac{G_{EGr} - \sum_{j=1}^{r} \left\{ G_{EGj} w_j^2 \right\}}{(1-X)\left(1 - \sum_{j=1}^{r} w_j^2\right)} \qquad (8)$$

where $w_i = T_i / \sum_{j=1}^{r} T_j$ and T_i is total employment in industry *i*, and where G_{EGr} is Ellison and Glaeser's measure applied to the overall set of industries, *r*. In the special case assumed above, in which underlying employment is assumed to be uniformly distributed across regions, so that $G_{EG}=G$ as defined in (4), then for $r=2$ and industries A and B, it is possible to show that $g_{EG}^{C} = K^2 \, cov(s_A, s_B)/(K-1)$.[8]

---

[7] Strictly, Maurel and Sedillot define their measure relative to *(1-X)*.
[8] Derivations of these expressions are available on request from the authors.

In effect then, the Ellison and Glaeser measure is close to the covariance of the shares of employment in each industry across regions. This is intuitive: two industries with a random geographic distribution would tend to generate a covariance of zero and hence $g^C_{EG} = 0$. If the industries tended to locate in the same regions then $g^C_{EG} > 0$, and if they tended to locate in different regions then $g^C_{EG} < 0$.

It is tempting to develop a similar measure of coagglomeration based on α (our proposed measure of agglomeration), rather than *G* (the scaled measure of geographic concentration in equation (4)). However, there are two reasons for not doing so. The first is that in analysing coagglomeration, there is no need to differentiate between geographic concentration and agglomeration. In analysing "coagglomeration" we are interested in whether industries are located in the same regions, rather than whether firms in different industries are located in the same regions.[9] This reflects the fact that, using w_i^2 as a weight, then $H_r - \sum_i w_i^2 H_i^2 = 0$, so this difference plays no role in any coagglomeration measure.[10] The second is that in analysing coagglomeration, there is no need to control for cases in which either *N>K* or *N<K*. This also reflects the fact that we are interested in whether industries are located in the same regions, rather than whether firms in different industries are located in the same regions. It is possible to use the covariance of employment shares in each region to analyse this whether *N>K* or *N<K*. Below, we therefore use a slightly simplified version of the Ellison and Glaeser measure as our measure of coagglomeration:

$$C(r) = \frac{G_r - \sum_{i=1}^{r} w_i^2 G_i}{\left(1 - \sum_{i=1}^{r} w_i^2\right)} \quad . \qquad (9)$$

In the two firm case, this is

[9] Consider two comparisons for example. Industry A consists of 100 equally-sized firms located 10 each in 10 different regions. Industry B consists of 91 firms; 90 firms account for 1% of total employment in the industry each, and are located 10 each in 9 different regions, while 1 firm accounts for the other 10% of employment and is located in a different region. In analysing the coagglomeration of each of A and B with a third industry C, the differences in industrial concentration are not relevant.

[10] That is, it is possible also to consider both the EG measure and our measure as reflecting the difference in *G-H* between the aggregate of all firms and the weighted average of individual industries, since the *H* terms cancel out.

$$C(A,B) = \frac{G_{A+B} - \sum_{i=1}^{2} w_i^2 G_i}{\left(1 - \sum_{i=1}^{2} w_i^2\right)} = \sum_{k=1}^{K} s_{Ak} s_{Bk} - \frac{1}{K} = K.cov(s_A, s_B) \qquad (9a)$$

There are two differences: (i) we use the measure of G defined in (4) rather than G_{EG}, and (ii) we do not divide by *1-X*. In Table 5 below we also present the Ellison Glaeser measure for comparison. Like Maurel and Sedillot (1999) we also attempt to show the proportion of G_r which is accounted for by geographic concentration "within" each industry, and "between" the industries. We do so by rearranging (9) to yield:

$$G_r = \sum_{i=1}^{r} w_i^2 G_i + \left(1 - \sum_{i=1}^{r} w_i^2\right) C(r). \qquad (9b)$$

where the "within" geographic concentration is given by the first term on the RHS of (9b) expressed as a proportion of G_r and the "between" geographic concentration is given by the second term on the RHS of (9b) expressed as a proportion of G_r.

In the next section we focus primarily on empirical estimates of F, M, a, and g_{EG} and *C(r)*. In the Appendices we also show the Maurel and Sedillot measure, g_{MS}, and a basic concentration index defined as the proportion of firms in an industry in the top 3 regions, denoted *C*. For comparison with other work, we also present the "locational Gini coefficient", measured relative to total manufacturing:

$$L_R = \frac{2}{K^2 \overline{Y}} \left[\sum_{k=1}^{K} l_k \left(Y_k - \overline{Y}\right) \right], \qquad (10)$$

where Y_k is the share of the industry's employment in region k expressed as a proportion of the share of total manufacturing employment in region k, l_k denotes the position of the region in the ranking of Y_k, and $\overline{Y}$ is its mean across regions. This is the measure used by Krugman (1991b). In general, $0 \le L \le 1$. However, for $N < K$ then $1 - N/K \le L \le 1$. For the purposes of comparison, we also present in the Appendices an "absolute" Gini coefficient, L_A. This is defined as in (8), except that Y_k is in this case defined simply as the share of the industry's employment in region k - it is not in this case expressed as a proportion of the share of total manufacturing employment in region k.

3. Patterns of geographic and industrial concentration in the UK

In this section we first discuss the data used, then look at patterns of geographic and industrial concentration in total UK production activity. In the course of presenting these results we discuss a number of issues relating to the appropriate level of industry and regional aggregation. In the final part of this section we summarise the patterns of geographic and industrial concentration at the 4-digit level. Tables with the results for 214 industries are given in Appendix B.

3.1. The data

The empirical analysis presented below uses plant level data known as ARD which is the data underlying the Annual Census of Production in the UK.[11] The ARD contains some basic information on the population of production plants in the UK.[12] This includes the location of the plant (postcode and local authority), the 4-digit industrial classification and the number of employees. A broader range of information on output and inputs is available at the establishment level. An establishment can be a single plant or a group of plants (which can be at different addresses). This information is available for all establishments with over 100 employees and a sample of those with below 100.

[11] Now called the Annual Business Inquiry (ABI).

[12] The ARD contains two types of data – non-selected and selected data. To construct a dataset of all production establishments it is necessary to combine the non-selected and selected data. See Oulton (1997) and Griffith (1999) for a description of the ARD data.

Table 1: Descriptive statistics, 1992

Number of 4-digit industries	216
Number of plants in population	157,600
Number of plants incorporated	102,568
Number of plants incorporated & production	97,832
Number of plants incorporated & production & active	96,577
Number of "firms" (non-related plants within the same region)[b]	90,282
Average employment per "firm"	47

[b] This is the number of observations after aggregating plants that are in the same industry and postcode and are owned by the same firm.

Table 1 shows some descriptive statistics. Our data includes information on plants in 216 4- digit production industries (using the 1980 SIC classification). These include energy and water supply, extraction and all manufacturing industries.

After combining the non-selected and selected data for 1992 we have a total of 157,600 plants.[13] From the population of plants, we restrict ourselves to plants which are part of incorporated companies, (thus excluding publicly owned corporations, partnerships, sole-traders and charities), plants that are strictly engaged in production activity (rather than distribution or administration), and plants that are active in that year (excluding those that are not yet in production). This leaves us with 99,577 plants. From the theoretical discussion above it is clear that we are interested in looking at agglomerations of plants that are *not* under common ownership, thus where we observe two plants in the same industry, in the same postcode that are under common ownership we aggregate them and call them a firm. This leaves us with 90,282 firms (non-related plants).[14]

Average employment in these plants in 1992 was 47 employees. Table 2 shows the size distribution of plants. Half of plants have fewer than 10 employees, while 91 percent have fewer than 100 employees.

[13] We use the word plant to refer to what is called a local unit in the ARD. We drop 3963 plants which are duplicate entries.

[14] We have also excluded 6 plants in two industries – public gas supply (1620) and nuclear fuel product (1520) – because they contain only one firm (and the confidential nature of the data means that we can not show these industries separately).

Table 2: Size distribution of plants

Number of employees	Percentage of plants	Percentage of employment
0 – 9[a]	50.6	4.2
10 – 49	32.6	15.7
50 – 99	7.6	11.3
100 – 199	4.7	13.9
200+	4.5	54.9

[a] There are 29 plants with 0 employees.

3.2. The concentration of total production

Table 3 shows three measures of agglomeration calculated for total production – a , g_{MS} , g_{EG} together with the geographic concentration measures F , the locational Gini coefficient, and the concentration index and the industrial concentration measure M . One issue that arises in constructing these measures is what level of regional unit to use for analysis. We have data available on both administrative and postcode level.

Table 3: Geographic and industrial concentration measures for total production

Number of regional units	Local authority 446	Postcode 113	County 65
a	0.005	0.007	0.014
F (geographic concentration)	0.0051	0.0077	0.0143
M (industrial concentration)[a]	0.0005	0.0005	0.0003
g_{MS}	0.005	0.007	0.014
g_{EG}	0.005	0.007	0.014
Locational Gini	0.489	0.415	0.488
Concentration index	0.308	0.326	0.416

Notes: Measures are: a =*F-M*: agglomeration measure, *F*: geographic concentration (equation (5)), *M*: industrial concentration (equation (3)), g_{MS} : Maurel and Sedillot (1999) agglomeration measure (p.9), g_{EG} Ellison and Glaeser (1997) agglomeration measure (equation (7)), locational gini (equation (10)), and concentration index (p.4).
The 8 central London postcodes are aggregated to form a single postcode. 14 central London local authorities are aggregated to form a single local authority. Greater London, which covers a larger geographic area, is aggregated to form a single county.
[a] The level of industrial concentration can change with different geographic regions because of the way we construct "firms" (non-related plants).

There are three levels of administrative regions in the UK: region (11), county (65) and local authority (446). Column two uses local authority boundaries to define geographic regions. Column three uses counties (these are broadly like US States). The geographic region we prefer is the postcode area. This is the first two letters of the postcode, for example S for Sheffield and BS for Bristol.[15] This is used in column two. Postcode areas correspond most closely to travel to work areas and areas of local economic activity (these are similar to US metropolitan areas). This gives us geographic areas that cross local authority and county borders and which are centred around cities or towns, which we might think of as centres of economic activity. Appendix C, Map 1 shows the geographic distribution of production employment over postcode areas.

In general, moving to a larger geographic unit increases the geographic concentration measure F, and consequently a. Similarly g_{MS}, g_{EG} and the concentration index also increase as the number of geographic regions decreases. In calculating the Gini coefficient we are faced with the problem of what to do with industry-regions where there is no activity (not all industries have plants in every postcode). We can either calculate the Gini only across those regions in which there is some activity, or we can treat each of the 113 postcode areas as a possible location, and if an industry has no activity in a particular region assign it a zero. We take the latter approach.

3.3. Agglomeration at the industry level

In this section we describe patterns of agglomeration at the 4-digit industry level for 1992. We present our proposed measure of agglomeration, a, and its components – geographic concentration (F) and industrial concentration (M) - and the Ellison and Glaeser measure, g_{EG} which is defined relative to the geographic distribution of total manufacturing employment. Appendix B lists all the measures discussed for each industry.

Figure 1 shows the distributions of the a, F, M and g_{EG} across 4-digit industries. The two agglomeration measures - a and g_{EG} - have similarly skewed distributions. None of the industries have a value of a below zero, and over half the values lie between 0 and 0.017. However, over 25 industries have a value of g_{EG} below zero, with half lying below 0.008. Geographic concentration, *F*, is less skewed than industrial concentration.

[15] Each UK postcode identifies an average of 15 individual delivery points. They have four levels. There are 124 areas which have an average of 183,000 delivery points. These are divided into 2,900 districts of which there are an average of 21 per area and which have an average of 8,197 delivery points within them. These are further broken down into 9,000 sectors and within this into units. For example, the post code GU9 8AQ is in the area GU (Guildford), the district GU9, the sector GU9 8 and the units are identified by GU9 8AQ.

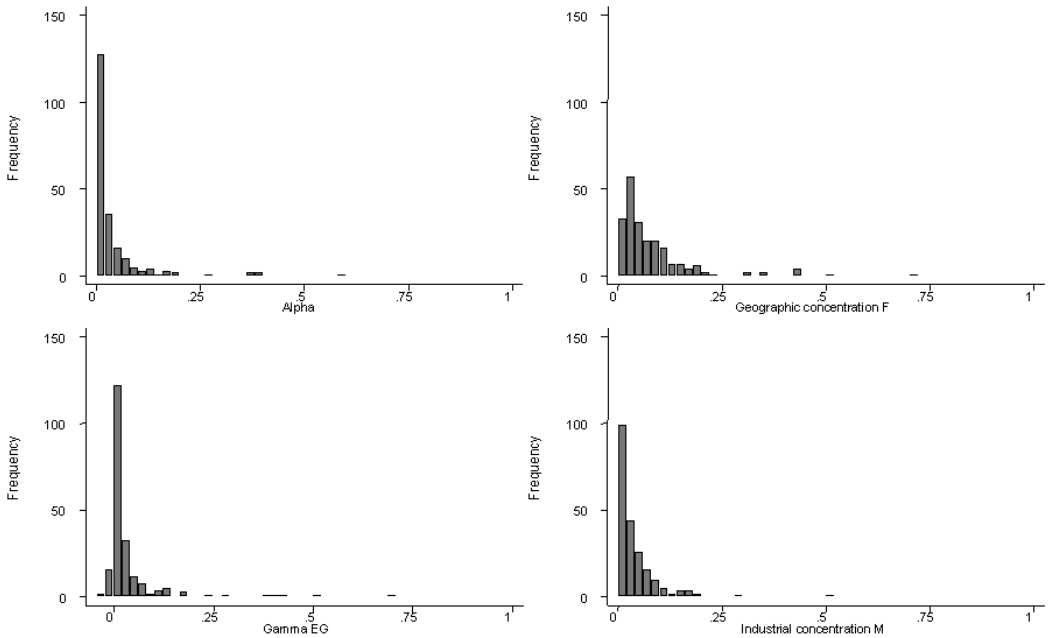

Figure 1: Distribution of measures

Appendix A presents the correlation between each of the measures and the number of firm level observations in each industry. The correlations between the three agglomeration measures are all positive and very high, despite the fact that g_{MS}, and g_{EG} are defined as relative to manufacturing industry as a whole. However, as would be expected, the correlation with the number of firms in the industry is, in each case, low. By contrast, there is a strong negative correlation between the locational Ginis, L_R and L_A, and the number of firms, and a weaker correlation between the concentration index, C and the number of firms in the industry.

While the correlations indicate similarities between the measures, it is also important to ascertain whether they rank industries similarly according to the degree to which they are agglomerated. Table A2 presents rank correlations between the measures. Again there is a strong positive correlation between each of the three agglomeration measures.

Table 4 summarises the pattern of agglomeration at the 4-digit industry by showing the means of a and g_{EG} (across 4-digit industries) for each 2-digit industry, and the percentage of 4-digit industries in each quartile of a across all 4-digit industries (the fourth quartile containing the most agglomerated industries). The 2-digit industries are ordered by the mean of a. We use a, in order to identify agglomerated industries, as it can be interpreted intuitively when broken down into its components F and M – geographic and industrial concentration, as in Table 6. We also report g_{EG}, in order to compare our results with those for the US and France which use this measure.

Textiles (43) and Extraction of other minerals (23) top the table with mean values of a far in excess of all other 2-digit industries. The 4-digit industry spinning and weaving (4340) is in fact the most agglomerated industry (see Table 6) and 11 of the other 4-digit industries within textiles are in the fourth quartile. Textiles are found to be highly agglomerated in many countries.[16] The agglomeration of extraction of minerals (this includes stone, clay, sand, gravel, salt) on the other hand is clearly driven by the fact that their main inputs are physically immobile and geographically concentrated. The other notable feature of Table 4 is the group of industries at the bottom of the table with very low mean a - water supply (17) and manufacture of office equipment (33). In general, it appears that less technologically advanced industries are more agglomerated, while the more technology oriented ones are not. For example, if we use the proportion of investment that is spent on computer purchases[17] as an indicator of technological sophistication, and correlate it with our agglomeration measure a we find a negative and significant correlation.

[16] See Maurel and Sedillot (1999) Table 2, Elison and Glaeser (1997), Table 4, Krugman (1991b) Appendix D.

[17] Taken from the selected ARD sample, the proportion of computer investment is calculated at the plant level and averaged across all plants within each 4-digit industry. The average proportion ranges from –88% (3246 process engineering contractors) to 64% (3286 other industrial and commercial machinery).

Table 4: Summary of agglomeration in 4-digit industries, by 2-digit industry

2-digit industry	Mean a [a]	% of 4-digit industries in quartile (by a) 1	2	3	4	Mean g_{EG}	Number of 4 digit industries
43 Textiles	0.160	0	7	13	80	0.168	15
23 Extraction of other	0.145	0	0	33	67	0.192	3
31 Manufacture of other	0.060	0	21	43	36	0.051	14
24 Manufacture non-metal	0.051	25	33	17	25	0.045	12
44 Leather	0.050	0	0	50	50	0.037	2
26 Production of man-ma	0.048	0	0	0	100	0.043	1
35 Motor vehicles and p	0.045	0	40	20	40	0.041	5
47 Paper and paper prod	0.045	9	36	27	27	0.034	11
14 Mineral oil processing	0.044	0	0	0	100	0.040	2
16 Production and distr	0.044	0	0	0	50	0.001	1
22 Metal manufacture	0.043	0	0	43	57	0.031	7
36 Manufacture of trans	0.042	0	33	50	17	0.038	6
45 Footwear and clothing	0.042	0	23	46	31	0.031	13
49 Other manufacturing	0.037	29	29	29	14	0.022	7
41 Food drink and toba	0.032	23	15	23	38	0.023	13
42 Sugar and its by-pro	0.019	36	45	9	9	0.010	11
48 Rubber and plastic	0.018	67	11	11	11	0.014	9
32 Mechanical engineering	0.017	35	23	35	8	0.010	26
25 Chemical industry	0.014	30	40	25	5	0.008	20
34 Electrical and elect	0.014	47	27	13	13	0.009	15
37 Instrument engineering	0.014	50	17	33	0	0.008	6
11 Coal extraction and	0.011	50	0	50	0	0.014	2
46 Timber and wood	0.009	44	56	0	0	0.002	9
33 Manufacture of office	0.007	50	50	0	0	0.004	2
17 Water supply industry	0.003	100	0	0	0	-0.031	1

Notes: Quartiles boundaries are by a, 1: (0, 0.0092), 2: (0.0093, 0.0168), 3: (0.0171, 0.0378), 4: (0.0381, 0.5929).

Measures are: $a = F - M$: agglomeration measure (equations (3), (5)), and g_{EG}: Ellison and Glaeser (1997) agglomeration measure (equation (7)).

[a] Mean is unweighted.

An alternative analysis of a 2-digit industry group is to consider the measures of co-agglomeration discussed above. Table 5 shows our measure of co-agglomeration calculated for 2-digit industry groups (column 1). It also shows the geographic concentration of the 2-digit industry, G_r (column 2), the percentage of G_r accounted for by "between" sub-industry variation (column 3), and the Ellison and Glaeser measure of co-agglomeration.

There is a considerable difference in the extent to which 2-digit industries have a high degree of geographic concentration (G_r), and in the extent to which they exhibit co-agglomeration of their 4-digit sub-industries, although these two measures are clearly positively correlated. However, 2-digit industries with a high geographic concentration differ in how far that this is driven by "between" industry geographic concentration. Paper and paper products (47) exhibits both high co-agglomeration with a high proportion due to geographic concentration between its 11 sub-industries. "Between" industry concentration could be driven by a number of factors including vertical relationships, shared technology or skills, or a similar geographic distribution of demand. However for the two primary product 2-digit industries with the highest geographic concentration, this is mainly due to "within" 4-digit industry geographic concentration. The Ellison and Glaeser measure, which is calculated relative to the geographic distribution of employment, produces a similar ranking of the 2-digit industry groups to our absolute measure.

Table 5: Co-agglomeration by 2-digit industry

2-digit industry	*C(r)*	G_r	% "between" 4-digit industries	g_{EG}^{C}
14 Mineral oil processing	0.053	0.096	25.3	0.051
11 Coal extraction	0.042	0.356	1.3	0.042
44 Leather	0.030	0.049	29.9	0.021
35 Motor vehicles and parts	0.023	0.046	28.7	0.015
43 Textiles	0.023	0.044	43.3	0.018
47 Paper and paper prod	0.023	0.026	74.6	0.011
31 Manufacture of other	0.023	0.025	80.7	0.013
22 Metal manufacture	0.022	0.040	42.5	0.013
45 Footwear and clothing	0.014	0.019	63.4	0.004
24 Manufacture non-metal	0.012	0.034	30.7	0.007
49 Other manufacturing	0.012	0.017	58.3	0.002
33 Manufacture of office	0.007	0.031	4.0	0.008
37 Instrument engineering	0.007	0.010	42.2	0.003
25 Chemical industry	0.007	0.010	57.2	0.005
41 Food, drink and tobacco	0.006	0.008	57.4	0.003
32 Mechanical engineering	0.006	0.007	80.0	0.001
42 Sugar and its by prod	0.005	0.010	37.6	0.000
46 Timber and wood	0.005	0.007	53.7	0.000
48 rubber and plastic	0.005	0.007	52.7	0.001
34 Electrical and elec	0.004	0.007	58.3	0.002
36 Manufacture of trans	0.003	0.023	6.2	0.001
23 Extraction of other	0.001	0.038	1.6	0.002
26 Production of man-ma	-	0.138	0	-
16 Production and distri	-	0.120	0	-
17 Water supply industry	-	0.095	0	-

Note: Measures are: *C(r)*: coagglomeration (equation (9)), G_r: geographic concentration (equation (9b)), % "between" 4-digit industries given by $[(1-\sum_{i=1}^{r} w_i^2)C(r)]/G_r$ (equation (9b)), and g_{EG}^{C}: Ellison and Glaeser coagglomeration measure (equation (8)).

Table 6 shows the 20 most agglomerated 4-digit industries as measured by a . The table shows the number of firms in each industry, the geographic concentration measure, F , the industrial concentration measure, M , and again g_{EG}. Appendix C, Maps 2-5, show the geographic distribution of employment for the 4 digit industries 2489 (ceramic goods), 4395 (lace), 4910 (jewellery), and 4363 (hosiery).

While all of these industries display high geographic concentration, it is interesting to note the variation in industrial concentration (M). For example, ceramic goods (2489), has high geographic concentration and low industrial concentration and thus appears second in the table in terms of agglomeration. Pedal cycles (3634), on the other hand, has quite high geographic concentration coupled with high industrial concentration, and so appears much lower down the table.

Table 6: 20 most agglomerated industries

4-digit industry	Number of firms	a	F	M	g_{EG}
4340 Spinning and weaving*	23	0.593	0.709	0.116	0.690
2489 Ceramic goods*	353	0.393	0.425	0.032	0.404
4395 Lace*	61	0.385	0.421	0.036	0.387
2330 Extraction salt*	5	0.378	0.431	0.053	0.519
4350 Jute and polypropyle*	27	0.374	0.437	0.063	0.427
3162 Cutlery*	64	0.272	0.358	0.086	0.287
4385 Other carpets	39	0.197	0.307	0.110	0.228
4910 Jewellery*	802	0.181	0.189	0.009	0.140
4363 Hosiery*	800	0.177	0.186	0.010	0.166
3161 Handtools*	173	0.174	0.206	0.032	0.165
3634 Pedal cycles	46	0.162	0.358	0.196	0.173
4752 Periodicals	1662	0.140	0.148	0.008	0.107
4322 Weaving cotton silk*	200	0.139	0.151	0.013	0.138
3523 Caravans	70	0.132	0.155	0.024	0.137
4721 Wall coverings	28	0.131	0.183	0.052	0.139
4310 Woollen*	402	0.125	0.132	0.007	0.131
4535 Men and boys shirts	311	0.116	0.141	0.025	0.104
4240 Spirit distilling*	93	0.106	0.142	0.035	0.107
4364 Warp knitted fabrics	60	0.104	0.138	0.035	0.096
2235 Other steel forming *	65	0.098	0.112	0.014	0.079

Notes: * indicates that the industry was also in the top 20 in 1985.
Measures are: a =*F-M*: agglomeration measure, *F*: geographic concentration (equation (5)), *M*: industrial concentration (equation (3)), g_{EG} Ellison and Glaeser (1997) agglomeration measure (equation (7)).

Table 7 shows the 20 least agglomerated industries. For these industries the measures of geographic concentration (F) and industrial concentration (M) are very close, thus tending to cancel each other out in the measure of agglomeration - although production is unequally distributed across regions, this is almost entirely explained by industrial concentration. The clearest example of this is Chemical treatment of oils and fats (2563) which has a very high level of geographic concentration (higher in fact than all but the most agglomerated industry in Table 6, see also Appendix C, map 6), but industrial concentration is of a similar level. This is driven by the small number of firms in the industry and the distribution of firm size.

Other industries, such as Ready mix concrete (2436) and Builders carpentry (4630) simply have low levels of geographic concentration and low levels of industrial concentration.

Interestingly, in our data we never observe $a < 0$, although this is possible – that is industrial concentration is never greater than geographic concentration.

It is striking is that a number of these industries, for example pharmaceutical products, are classified as high-tech. Attention has been drawn to the clustering of such industries, therefore we might have expected to find these industries to be geographically concentrated. Examination of the data for individual industries, for example pharmaceutical products does reveal a number of groups of firms located in what we might classify as clusters, despite the low level of geographic concentration of employment in the industry. However it may be more appropriate to investigate the existence of such clusters, for example in the Cambridge area, at a narrower industry definition than 4-digit industries.

Table 7: 20 least agglomerated industries

4-digit industry	Number of firms	a	F	M	g_{EG}
3212 Wheeled tractors	31	0.005	0.192	0.187	-0.003
2420 Cement, lime, plaster	164	0.005	0.039	0.034	-0.002
2563 Chemical treatment of oils	15	0.004	0.514	0.511	-0.009
3262 Ball bearings	86	0.004	0.095	0.090	-0.006
3453 Electronic sub-assemblies	379	0.004	0.022	0.018	0.004
2436 Ready mix concrete	400	0.004	0.015	0.011	-0.006
4630 Builders carpentry	1125	0.004	0.009	0.005	0.001
2569 Adhesive film	54	0.003	0.086	0.083	-0.011
1700 Water supply industry	44	0.003	0.081	0.078	-0.031
4290 Tobacco industry	23	0.003	0.072	0.069	-0.011
3435 Electrical equipment	241	0.003	0.028	0.025	0.003
2570 Pharmaceutical products	368	0.003	0.019	0.017	0.003
3441 Telegraph and telephone ap	359	0.002	0.065	0.063	-0.006
4833 Plastic floor coverings	29	0.001	0.100	0.099	-0.009
3301 Office machinery	91	0.001	0.066	0.065	0.001
2591 Photographic materials	53	0.000	0.180	0.179	0.005
2515 Synthetic rubber	12	0.000	0.173	0.173	-0.014
4664 Cork and basketware	12	0.000	0.144	0.144	0.000
4200 Sugar and its by-products	14	0.000	0.088	0.088	-0.045
1115 Manufacture of solid	5	0.000	0.047	0.047	-0.006

Note: Measures are: a =*F*-*M*: agglomeration measure, *F*: geographic concentration (equation (5)), *M*: industrial concentration (equation (3)), g_{EG} Ellison and Glaeser (1997) agglomeration measure (equation (7)).

Table 17 in Appendix B shows some additional information on the top 20 agglomerated industries. Columns two and three list the two postcode areas with the highest proportion of industry employment, column four shows the total number of firms in the industry, columns five to eight show the number of firms and the proportion of employment in these two postcodes and columns nine and ten show the average firm size in the top postcode and in all others.

One interesting feature that can be seen from Table 17 is the difference between two types of industries – those which have single agglomeration which contains a large number of firms, and those which either have two agglomerations or which have only a few large firms in the most agglomerated region. Examples of the single agglomeration type include ceramic goods in Stoke-on-Trent, hosiery in Leicester, periodicals in London and woollens in Bradford. The second type includes jewellery which has two agglomerations, one in Birmingham and one in London, pedal cycles, which has only a small number of firms in the postcode area with the highest proportion of employment, but a larger number of firms in Birmingham accounting for only 17% of employment, and mens and boys shirts which has an equal number of firms in Northern Ireland and Leicester, but the Northern Ireland firms account for over fives times as much employment.

In some industries the first and second postcodes are adjacent to each other and may thus indicate a larger agglomeration. Examples include ceramic goods in Stoke on Trent and Derby, lace and warp knitted fabrics in Nottingham and Derby, hosiery in Leicester and Nottingham, weaving of cotton and silk in Blackburn and Oldham, and other steel forming in Birmingham and Dudley.

It is also notable that in the majority of the top 20 most agglomerated industries average firm size, as measured by the number of employees, is far higher in the agglomerated postcode than in the other postcodes. This is most likely due to the presence of at least a few large firms in the 1st postcode area (e.g. in other carpets), which may be indicated by a high level of industrial concentration (see M in Table 6).[18]

4. The dynamics of agglomeration

One issue of interest is whether these patterns of agglomeration are changing over time. Do industries become geographically concentrated in one region and stay there, or does the degree of geographic concentration and its location change, and if so, how is this change related to industry age and characteristics? What role do entry, exit, job creation

[18] A high value of M does not necessarily imply that large firms are present in the agglomerated region.

and job destruction play in reinforcing agglomerations? Unfortunately we do not have comparable data on plant locations that span a long time period. Looking at the list of the 20 most agglomerated industries it is clear that many of these agglomerations initially formed in the last century or before.

In this section we describe how agglomeration patterns have changed over a short time period 1985 – 91. We describe entry and exit rates and job creation and job destruction patterns in agglomerated and non-agglomerated industries. It should be noted that in this section we calculate entry and exit rates and job creation and destruction rates using the data at the plant level, rather than the firm level as described in section 3.1.

Our agglomeration measure (a) is highly correlated over the period 1985-1992. The correlation between the 1985 values and 1992 values is 0.92. There is a high degree of persistence in agglomerated industries (though interestingly geographic and industrial concentration as less persistent, with the 1985-1992 correlations being 0.89 and 0.78 respectively). As shown in Table 6, 13 of the top 20 most agglomerated industries were also in the top 20 in 1985. Of the other seven, only one was not in the top quartile, 3634 Pedal cycles was just above the median level of agglomeration in 1985.

While there is strong persistence in general, there are a small number of industries that change their geographic or industrial concentration, or the location of the agglomeration. Four industries move from the highest quartile based on α in 1985 to below the median in 1991. These are shown in Table 8. Industry 2581 (Soap and detergents) decreased in size both in terms of numbers of plants and numbers of employees, and saw an increase in industrial concentration, and subsequently a decrease in agglomeration. Industry 4336 (Throwing/texturing of Continuous filament yarn) also experienced an increase in industrial concentration and a decrease in agglomeration. This was driven by changes in the distribution of employment across plants - the number of plants and industry employment remained fairly stable over the period as there was little entry and exit. 3165 (Domestic heating/cooking appliances (non-electrical)) became less geographically concentrated. Between 1985 and 1991 there was both exit from and a decrease in employment in the three postcode areas with the highest employment in 1985. 3434 (Electrical equipment for motor vehicles) decreased in size over the period, both in terms of the number of plants and total employment. There was a fall in industrial concentration and a larger fall in geographic concentration. Birmingham, which had the highest employment in the industry in 1985, saw significant job destruction. This was due to the exit of plants that were replaced by smaller entrants, and to decreases in employment among surviving plants.

Table 8: Industries that change agglomeration status

Industry	1985 Rank	1985 F	1985 M	1985 Emp.	1991 Rank	1991 F	1991 M	1991 Emp.
2581 Soap and detergents	40	0.121	0.064	10,941	124	0.111	0.097	8,114
3165 Domestic heating/cooking appliances (non-electrical)	49	0.100	0.054	9,889	114	0.068	0.052	8,028
3434 Electrical equipment for motor vehicles	33	0.149	0.080	27,027	111	0.056	0.040	19,946
4336 Throwing/texturing of Continuous filament yarn	50	0.094	0.050	1,646	127	0.104	0.091	1,623

Note: Measures are: *F*: geographic concentration (equation (5)), *M*: industrial concentration (equation (3)).

There are four industries which remain in the top quartile of agglomerated industries throughout the period, but where the region in which employment is concentrated changes. These are shown in Table 9. In three of the industries - 2235 (other steel drawing and forming), 3452 (records and tapes) and 4150 (fish processing) - the regional distribution becomes more even. Records and tapes (3452) is notable in that the number of plants in Central London almost halves over the period, falling by 40, and employment falls among those that remain, making the regional distribution more even by 1992. In 4721 (wall coverings) the concentration becomes more pronounced with Blackburn and Lancaster gaining a larger share. This is due to a fall in the number of plants and employment in the industry as a whole, but with less of a fall in these regions.

Table 9: Industries where region shifts

Industry / Region	% employment 1985	% employment 1991
2235 (other steel drawing and forming)		
Dudley (DY)	24.9	15.0
Birmingham (B)	25.4	19.3
3452 (records and tapes)		
Southall (UB)	19.7	18.8
Central London (LO)	43.9	16.8
4150 (fish processing)		
Doncaster (DN)	24.6	17.0
Aberdeen (AB)	11.4	19.3
4721 (wall coverings)		
Blackburn (BB)	24.9	34.1
Lancaster	[a]	[a]

[a] Figures not available for data confidentiality reasons

4.1. The role of entry and exit

There is a large amount of theoretical and empirical work on the entry and exit process of firms. Disney, Haskel and Heden (1999) use the same data set as is used here to model the entry, exit and survival of UK manufacturing plants over the period 1974-91. Their findings suggest: entry and exit rates are positively correlated at the industry level; entrants face high exit rates in their early years (20% exit within one year, 50% within four years); and more recent cohorts face greater risk of exiting. In this section we first look at entry, exit, survival, job creation and job destruction rates in agglomerated and non-agglomerated industries. We then ask whether entry, exit, survival, job creation, and job destruction have reinforced or reduced the extent of industry agglomeration.

We follow Disney et al and classify plants as entrants (not present in t-1, present in t), exitors (present in t, not present in t+1), one-year (present in t, not in t-1 or t+1), survivors (present in t-1, t, t+1). We calculate mean entry, exit, one year and survival rates for each industry for the years 1985-1991. Entry, exit, one-year, and survivor rates are defined as the number of entrants, exitors, one-years and survivors respectively, divided by the total number of plants for each year. Job creation rates for each industry-year are defined as

$$\text{job creation rate} = \frac{\text{Employment in entrants} + \text{Increase in no. jobs in existing plants}}{\text{Total employment}}$$

where the increase in the number of jobs in existing plants is calculated only for plants where employment increases. Similarly job destruction rates are defined as,

$$\text{job destruction rate} = \frac{\text{Employment in exitors} + \text{Decrease in no. jobs in existing plants}}{\text{Total employment}}.$$

Annual rates are calculated by industry and then an industry average annual rate is calculated for the period 1985-1991. Table 10 and Table 11 show these annual rates for the 20 most agglomerated and 20 least agglomerated industries listed in section 3.3. There appears to be little difference in these rates between the two groups of industries. Despite the fact that the most agglomerated industries are more traditional, low-low tech industries, their entry and job creation rates are not very different from the least agglomerated industries, or than the mean rates across all industries. The only difference that arises is in the survivor rates, where the most agglomerated group have a 3 percentage points higher survivor rate (although these are not significantly different).

Table 10: 20 most agglomerated industries - mean entry, exit, one-year, survivor, job creation and job destruction rates, 1985-1991

4-digit industry	Entrants	Exitors	One-year	Survivor	Job creation	Job destruction
4340 Spinning and weaving	0.05	0.10	0	0.83	0.01	0.07
2489 Ceramic goods	0.10	0.11	0.04	0.75	0.04	0.04
4395 Lace	0.06	0.10	0.03	0.81	0.06	0.07
2330 Extraction salt	0	0.07	0	0.94	0.01	0.04
4350 Jute and polypropylene	0.06	0.09	0.02	0.83	0.04	0.06
3162 Cutlery	0.08	0.09	0.02	0.80	0.07	0.08
4385 Other carpets	0.11	0.14	0.05	0.71	0.13	0.07
4910 Jewellery	0.11	0.13	0.06	0.70	0.09	0.11
4363 Hosiery	0.11	0.14	0.06	0.69	0.04	0.11
3161 Handtools	0.08	0.12	0.04	0.75	0.05	0.10
3634 Pedal cycles	0.10	0.17	0.04	0.71	0.20	0.20
4752 Periodicals	0.15	0.16	0.08	0.61	0.09	0.12
4322 Weaving cotton silk	0.08	0.10	0.04	0.79	0.04	0.03
3523 Caravans	0.08	0.10	0.01	0.81	0.09	0.02
4721 Wall coverings	0.09	0.12	0.02	0.77	0.06	0.15
4310 Woollen	0.07	0.12	0.02	0.77	0.03	0.09
4535 Men and boys shirts	0.11	0.14	0.07	0.68	0.06	0.09
4240 Spirit distilling	0.05	0.08	0.02	0.85	0.07	0.15
4364 Warp knitted fabrics	0.05	0.13	0.01	0.82	0.04	0.10
2235 Other steel forming	0.09	0.07	0.03	0.81	0.11	0.03
Mean	***0.08***	***0.11***	***0.03***	***0.77***	***0.07***	***0.09***
Mean all industries	**0.10**	**0.12**	**0.04**	**0.74**	**0.07**	**0.09**

Table 11: 20 least agglomerated industries – mean entry, exit, one-year, job creation, and job destruction rates, 1985-1991

4-digit industry	Entrants	Exitors	One-year	Survivor	Job creation	Job destruction
3212 Wheeled tractors	0.07	0.13	0.03	0.77	0.02	0.08
2420 Cement, lime, plaster	0.11	0.11	0.05	0.73	0.02	0.07
2563 Chemical treatment of oils	0.09	0.15	0.05	0.73	0.04	0.11
3262 Ball bearings	0.11	0.09	0.02	0.78	0.04	0.06
3453 Electronic sub-assemblies	0.12	0.12	0.04	0.71	0.06	0.09
2436 Ready mix concrete	0.07	0.07	0.01	0.84	0.12	0.10
4630 Builders carpentry	0.12	0.13	0.04	0.70	0.08	0.09
2569 Adhesive film	0.15	0.12	0.09	0.64	0.13	0.06
1700 Water supply industry	0.10	0.05	0.08	0.80	0.22	0.09
4290 Tobacco industry	0.04	0.11	0.02	0.83	0.01	0.13
3435 Electrical equipment	0.11	0.12	0.04	0.72	0.05	0.11
2570 Pharmaceutical products	0.09	0.12	0.04	0.75	0.03	0.05
3441 Telegraph and telephone	0.18	0.14	0.10	0.59	0.04	0.09
4833 Plastic floor coverings	0.15	0.17	0.07	0.62	0.09	0.07
3301 Office machinery	0.13	0.15	0.05	0.66	0.08	0.12
2591 Photographic materials	0.12	0.13	0.08	0.68	0.08	0.05
2515 Synthetic rubber	0.06	0.10	0.02	0.82	0.01	0.04
4664 Cork and basketware	0.08	0.17	0.01	0.71	0.14	0.14
4200 Sugar and its by-products	0.02	0.05	0	0.95	0	0.05
1115 Manufacture of solid	n/a	n/a	n/a	n/a	N/a	n/a
Mean	***0.10***	***0.11***	***0.04***	***0.74***	***0.07***	***0.08***
Mean all industries	**0.10**	**0.12**	**0.04**	**0.74**	**0.07**	**0.09**

Table 12 gives information on the geographic distribution of entry for the 20 most agglomerated industries. It shows the number of entrants over the years 1986-1991, the percentage of those entrants that locate in the most agglomerated region,[19] and the two measures of geographic concentration (F) and agglomeration, (a) calculated only over entrants. Entry to many of the most agglomerated industries is also geographically concentrated. In these cases entry is also concentrated in the most agglomerated regions (the top postcode area[20]). For example, 4340 (spinning and weaving) and 3162 (cutlery) show both high geographic concentration and agglomeration among entrants and over 50% of entrants locating in the agglomerated region. On the other hand, in industries like 4535 (men and boys shirts) entry is acting against agglomeration, with only 6% of entrants going into the largest postcode areas.

[19] These are listed in Appendix B, Table 17.
[20] Defined in section 3.3.

Table 12: 20 most agglomerated industries - geographic distribution of entry

4-digit industry	No. entrants	% entrants to the top postcode area	F entrants	a entrants
4340 Spinning and weaving	11	64	0.760	0.501
2489 Ceramic goods	268	33	0.144	0.133
4395 Lace	32	66	0.311	0.214
2330 Extraction salt	0	-	-	-
4350 Jute and polypropylene	14	29	0.436	0.280
3162 Cutlery	40	53	0.447	0.413
4385 Other carpets	30	[a]	0.072	0.035
4910 Jewellery	652	17	0.148	0.143
4363 Hosiery	729	34	0.150	0.138
3161 Handtools	118	23	0.192	0.167
3634 Pedal cycles	24	[a]	0.428	0.018
4752 Periodicals	1599	38	0.142	0.138
4322 Weaving cotton silk	118	13	0.145	0.107
3523 Caravans	34	15	0.148	0.011
4721 Wall coverings	22	18	0.253	0.026
4310 Woollen	244	20	0.135	0.108
4535 Men and boys shirts	258	6	0.074	0.033
4240 Spirit distilling	53	21	0.129	0.081
4364 Warp knitted fabrics	23	35	0.157	0.083
2235 Other steel forming	32	19	0.157	0.087

[a] Figure not available for data confidentiality reasons

To compare industries more generally and in more detail, we calculate the proportion of entrants in each region, out of all entrants in that industry-year, and the equivalent proportion for exitors and survivors. For job creation (destruction) we calculate the proportion of jobs created (destroyed) in each region, out of all jobs created (destroyed) in that industry-year.

We then calculate a relative measure for entrants, exitors and survivors defined as the ratio of the proportion above to the proportion of plants in that industry in that region. We also calculate an equivalent relative measure for job creation and job destruction defined as the ratio of the proportion above to the proportion of industry employment in that region. If entrants, exitors, survivors and job creation and destruction were distributed across regions in just the same way that plants and employees were, then these ratios would take a value of unity.

Pictorial examples of components of these relative measures are shown for a single industry (the ceramic goods industry (2489)) in maps 7-10 in Appendix C. The geographic distributions shown are the average for the period 1985-1991. Map 7 shows the distribution of industry employment, (shown by the shaded areas), and the distribution of job creation, (shown by the overlaid dots, each representing 1% of total job creation). Map 8 the distribution of industry employment, and the distribution of job destruction.

Map 9 the distribution of plants in the industry, and the distribution of entrants, and Map 10 the distribution of plants in the industry, and the distribution of exitors. Comparing the maps we can see that entry and exit are more geographically dispersed than job creation and destruction which are concentrated around the agglomerated region. It is interesting to note that the significant amount of entry and exit in the London area does not play a role in job creation or destruction. Job creation and destruction appear to follow a similar geographic pattern, pointing to little change in the extent and location of agglomeration in the industry.

We regress the relative measures against an indicator that equals one for the region in each industry that has the highest proportion of industry employment, (the agglomeration) and a full set of industry dummies. The coefficient on this indicator will capture differences in exit, entry, job creation or destruction rates between agglomerations and non-agglomerations within an industry. We then interact the indicator with our measure of agglomeration, capturing whether differences between regions are greater in more agglomerated industries.

The results of these regressions, reported in Table 13, show that relative exit and entry rates are lower in agglomerated regions and even more so in industries that are agglomerated. Relative job creation rates are higher in agglomerated regions, but not in more agglomerated industries. Job destruction is lower in agglomerated regions, but not in more agglomerated industries. Thus we see that agglomerated region are on the whole more static than less agglomerated regions. Exit rates are reinforcing agglomeration while entry rates are pushing in the opposite direction. Job creation rates are acting in favour of agglomeration, though not in the most agglomerated industries, while job destruction rates are working against agglomerations, though again, not in the most agglomerated industries.

Table 13: Differences between regions

	Relative exit rate	Relative entry rate	Relative job creation rate	Relative job destruction rate
Indicator [a]	-1.32	-1.61	0.292	0.294
	0.06	*0.09*	*0.010*	*0.011*
Indicator interacted with agglomeration (a)	-7.64	-10.95	-0.549	-0.799
	0.91	*1.72*	*0.120*	*0.208*
Time dummies	Yes	Yes	yes	Yes
4-digit industry dummies	Yes	Yes	yes	Yes

[a] indictor of region with highest proportion employment
Note: Sample is of 210 industries over 1986-1990. Numbers in italics are robust standard errors.

5. International comparisons

Empirical investigations into the extent of agglomeration have also been carried out using US and French data. Looking at 2-digit industry groups, Ellison and Glaeser (1997) use a US state-industry employment dataset. This means that the US measure is based on a more aggregated regional unit (a State) than our calculations for the UK (which are based on postcodes). Table 14 shows which of the 20 most agglomerated industries in the UK were also found to be agglomerated in the US and French studies (based on g_{EG} which is the only measure presented in all three studies). Four of these industries were also identified by Ellison and Glaeser (1998) as being amongst the 15 most agglomerated 4-digit industries in the US.

Table 14: Comparison of g_{EG}, g_{MS} for UK top 20 agglomerated industries

4-digit industry	UK		US		France	
	g_{EG}	rank	g_{EG}	Rank	g_{MS}	rank
4340 Spinning and weaving	0.690	1				
2330 Extraction salt	0.519	2				
4350 Jute and polypropylen	0.427	3				
2489 Ceramic goods	0.404	4				
4395 Lace	0.387	5				
3162 Cutlery	0.287	6			0.28	19
4385 Other carpets	0.228	7	0.38	6		
3634 Pedal cycles	0.173	8				
4363 Hosiery	0.166	9	0.44, 0.40	3, 5		
3161 Handtools	0.165	10				
4910 Jewellery	0.140	11	0.32, 0.30	8, 10		
4721 Wall coverings	0.139	12				
4322 Weaving cotton silk	0.138	13				
3523 Caravans	0.137	14				
4310 Woollen	0.131	15			0.44, 0.42, 0.25	7, 9, 20
4240 Spirit distilling	0.107	16	0.48	2		
4752 Periodicals	0.107	17			0.40	10
4535 Men and boys shirts	0.104	18				
4831 Plastic coated textiles	0.102	19				
4364 Warp knitted fabrics	0.096	20				

Note: industry mapping between UK and US industry codes are not exact. The ones used are: UK 4240 (spirit distilling) matches US 2084 (Wines brandy, brandy spirits); UK 4363 (Hosiery) matches US 2252 (Hosiery not elsewhere classified) and 2251 (Women's hosiery); UK 4385 (Other carpets) matches US 2273 (Carpets and rugs); UK 4910 (Jewellery) matches US 3961 (Costume jewellery) and 3915 (Jewellers' materials lapidary). Industry mapping between UK and France industry codes are: UK 3162 (Cutlery) matches France (Cutlery); UK 4310 (Woollen) matches France (Combed wool spinning mills), (Wool preparation), (Carded wool weaving mills); UK 4752 (Periodicals) matches France (Periodicals).

Maurel and Sedillot (1999) using French data at the 4-digit level find the most localised industries to be extractive industries, suggesting the importance of access to natural resources in firms' location decisions. They also find industries such as cotton and wool mills, and cutlery to be agglomerated. In addition, at the 2-digit level some high-technology industries such as pharmaceutical goods and radio and television communication equipment are found to be geographically concentrated.

Table 15: Comparison of g_{EG} for US top 20 agglomerated industries

US	g_{EG}	Rank	UK	g_{EG}	Rank
2371 Fur goods	0.63	1	4560 Fur goods	n/a	
2084 Wines brandy brandy spirits	0.48	2	4240 Spirit distilling	0.107	16
2252 Hosiery not elsewhere classified	0.44	3	4363 Hosiery	0.166	9
3533 Oil and gas field machinery	0.43	4	3254 Construction equipment	0.012	89
2251 Women's hosiery	0.40	5	4363 Hosiery	0.166	9
2273 Carpets and rugs	0.38	6	4384 Pile carpets 4385 Other carpets	0.068, 0.228	26, 7
2429 Special product sawmills not elsewhere classified	0.37	7	4610 Sawmilling	0.004	150
3961 Costume jewelry	0.32	8	4910 Jewellery	0.140	11
2895 Carbon black	0.30	9	2516 Dyestuff and pigments	0.032	49
3915 Jewelers' materials lapidary	0.30	10	4910 Jewellery	0.140	11
2874 Phosphatic fertilizers	0.29	11	2513 Fertilisers	0.011	99
2061 Raw cane sugar	0.29	12	4200 Sugar	-0.045	213
2281 Yarn mills except wool	0.28	13	4340 Spinning and weaving	0.690	1
2034 Dehydrated fruits vegetable soups	0.28	14	4147 Fruit and vegetables 4239 Misc. foods (inc. soup)	0.036	43
3761 Guided missiles space vehicles	0.25	15	3640 Aerospace equipment	0.011	94

Note: industry mapping between UK and US industry codes are not exact.

Table 15 shows how the corresponding UK industries compare with the 15 most agglomerated US industries.[21] Six of these are also amongst the 15 most agglomerated UK 4-digit industries. Those that are not will in part be due to the very different nature of the industries. For example, the UK does not have a raw cane sugar industry – the closest match is the sugar industry, which mainly consists of processing. However, other industries where there seems to be a much closer match have very different rankings. Table 16 shows the same comparison with the French top 20 agglomerated industries, based on the g_{MS} measure. Here there is a slightly lower correspondence, with only four of the French industries ranking in the top 20 within the UK

[21] Note that the industry matchings are only approximate.

Table 16: Comparison of g_{MS} for French top 20 agglomerated industries

France	g_{MS}	Rank	UK	g_{MS}	Rank
Extraction of slate	0.88	1	2310 Extraction of stone, clay	0.005	101
Extraction of iron ore	0.88	2	2100 Extraction and preparation of metalliferous ores	n / a	
Made-to-measure clothing	0.80	3	4532 Men's and boy's tailored outerwear 4533 Women's and girl's tailored outerwear	0.004, 0.027	113, 57
Extraction of minerals for chemical industry and fertilisers	0.76	4	2396 Extraction of other minerals n.e.s.	0.031	47
Steel pipes and tubes	0.69	5	2220 Steel tubes	0.028	52
Extraction of coal	0.53	6	1113 Deep coal mines	0.020	70
Combed wool spinning mills	0.44	7	4310 Woollen and worsted industry	0.118	17
Vehicles hauled by animals	0.42	8	3650 Other vehicles	-0.003	174
Wool preparation	0.42	9	4310 Woollen and worsted industry	0.118	17
Periodicals	0.40	10	4752 Periodicals	0.136	13
Watch-making	0.38	11	3740 Clocks, watches	-0.008	198
Flat glass	0.37	12	2471Flat glass	0.002	121
Screw cutting	0.36	13	3137 Bolts, nuts, etc.	0.080	24
Lawn and garden equipment	0.36	14	3286 Other industrial and commercial machinery	-0.003	171
Carded wool weaving mills	0.34	15	4310 Woollen and worsted industry	0.118	17

Other studies have used the Gini coefficient measure to examine the extent of agglomeration. Krugman (1991) uses US data, and Amiti (1998) examines the geographic concentration of industries in the EU. Following Krugman she uses a locational Gini coefficient for each industry measured relative to the geographic distribution of manufacturing. Using data for the year 1990, she finds geographic concentration within the EU to be highest in the following industries: pottery, china and earthenware, leather products, footwear, misc. petroleum and coal products, tobacco, printing and publishing, and textiles.

6. Conclusions

This paper has investigated the geographic concentration of production industries in the UK at a very disaggregated level both by industrial classification and regional unit of analysis. It has drawn on earlier work to develop a simple and intuitive measure of geographic concentration and agglomeration - defined as being the "excess" of geographic concentration over that which would be expected given the industrial concentration of the industry. This measure of agglomeration is simply the difference between measures of geographic concentration and industrial concentration and thus can easily be decomposed into these factors. It is closely related to other measures used in the literature.

We apply this measure to examine the pattern of production activity in the UK. As in the US and France we find a significant degree of geographic concentration in some industries. In some cases (such as chemical treatment of oils and fats) a very high measure of geographic concentration can be almost entirely explained by an equally high industrial concentration. However, in other cases such as ceramics, a high measure of geographic concentration is associated with a low industrial concentration. Although comparisons across countries are problematic due to differences in industry definitions and datasets, we find a number of similarities in the pattern of agglomeration between the UK, the US and France. Those industries that are most agglomerated appear to be the older and relatively low-tech industries.

We find that these patterns have remained fairly stable over the period 1985 to 1991. Analysis of entry, exit, job creation and job destruction rates finds little difference between the most and least agglomerated groups of industries. Within industries we find that exit rates are acting to re-enforce agglomeration, while entry rates are acting in the opposite direction. Job creation rates are found to re-enforce agglomeration and job destruction rates to act against, although in both cases, not in the most agglomerated industries.

The next step in this research is to identify characteristics of industries that are highly agglomerated. In particular, we wish to examine whether reasons put forward in the literature for some industries being highly agglomerated are consistent with UK evidence. We also wish to examine in more detail the extent to which industries, in particular those that have vertical linkages, are coagglomerated.

Appendix A

Table A1: Correlation between measures

	Number firms	a	g_{EG}	g_{MS}	L_R	L_A
a	-0.090					
g_{EG}	-0.093	0.988				
g_{MS}	-0.077	0.995	0.994			
L_R	-0.660	0.314	0.301	0.290		
L_A	-0.580	0.374	0.346	0.346	0.966	
C*I*	-0.110	0.676	0.649	0.668	0.454	0.529

Table A2: Spearman rank correlation

	a	g_{EG}	g_{MS}	L_R	L_A
g_{EG}	0.875				
[reject independence?]	*yes*				
g_{MS}	0.979	0.894			
[reject independence?]	*yes*	*yes*			
L_R	0.340	0.273	0.236		
[reject independence?]	*yes*	*yes*	*yes*		
L_A	0.416	0.319	0.317	0.975	
[reject independence?]	*yes*	*yes*	*yes*	*yes*	
C*I*	0.630	0.505	0.583	0.583	0.638
[reject independence?]	*yes*	*yes*	*yes*	*yes*	*yes*

Table A3: Quartile distribution of industries

Quartile	Any one of six measures	All of six measures
1 (lowest)	116	6
2	136	3
3	127	1
4 (highest)	97	19

Note: Six measures are: a , g_{EG}, g_{MS} , L_R , L_A and C.

Table A4: Quartile rankings

Industrial concentration (M)	1	2	3	4
Geographic concentration (F)				
1	36	17	0	0
2	10	27	17	0
3	4	7	25	18
4	4	2	12	35

Appendix B

Table 17 shows the two most concentrated regions for the 20 most agglomerated industries.

Table 17: Most agglomerated regions

4-digit industry	1st postcode	2nd postcode	Total number firms	Number firms in postcode		% employment in postcode		Average firm size (employment)	
				1st	2nd	1st	2nd	1st	Other
4340 Spinning and weaving	Northern Ireland	-[a]	23	13	-	86.2	-	146	-
2489 Ceramic goods	Stoke on Trent	Derby	353	132	15	65.4	4.1	206	65
4395 Lace	Nottingham	Derby	61	36	9	63.5	13.6	53	44
2330 Extraction salt	-[a]	-	5	-	-	-	-	-	-
4350 Jute and polypropyle	Dundee	-[a]	27	10	-	67.0	-	304	-
3162 Cutlery	Sheffield	-[a]	64	42	-	54.6	-	48	-
4385 Other carpets	Wakefield	-[a]	39	5	-	54.8	-	276	-
4910 Jewellery	Birmingham	London	802	181	215	38.0	22.0	19	9
4363 Hosiery	Leicester	Nottingham	800	330	55	38.2	19.2	61	70
3161 Handtools	Sheffield	Walsall	173	47	6	44.4	7.9	68	32
3634 Pedal cycles	-[a]	Birmingham	46	-	10	-	17.0	-	34
4752 Periodicals	London	Tunbridge Wells	1662	555	46	38.5	3.6	29	23
4322 Weaving cotton silk	Blackburn	Oldham	200	37	19	34.9	14.9	142	60
3523 Caravans	Kingston upon Hull	-[a]	70	15	-	38.4	-	171	-
4721 Wall coverings	Blackburn	-[a]	28	8	-	37.8	-	186	-
4310 Woollen	Bradford	Huddersfield	402	92	5	30.1	16.6	95	66
4535 Men and boys shirts	Northern Ireland	Leicester	311	32	34	36.1	7.1	222	45
4240 Spirit distilling	Glasgow	Edinburgh	93	14	8	30.8	12.2	272	108
4364 Warp knitted fabrics	Nottingham	-[a]	60	16	-	27.9	-	78	-
2235 Other steel forming	Birmingham	Dudley	65	17	6	25.2	13.3	84	88

[a] Figures cannot be provided for data confidentiality reasons.

Key to table: All measures calculated using employment; "firm" means the aggregation of all related plants in an industry-region; measures calculated using the 113 post code areas; a =F-M, our proposed agglomeration measure; F : geographic concentration (equation (5)); M : industrial concentration (equation (3)); g_{MS} : Maurel and Sedillot (1999) measure of agglomeration (p.9); g_{EG} : Ellison and Glaeser (1997) measure of agglomeration (equation (7)); L_R : locational Gini coefficient calculate relative to total manufacturing (equation (10)); L_A : locational Gini coefficient calculate absolute (equation (10)); CI : concentration index, the share of total industry employment in the top three regions.

4-digit industry	**Number of "firms"**	**Rank on a**	a	F	M	g_{MS}	g_{EG}	L_R	L_A	CI
1113 Deep coal mines	14	78	0.023	0.315	0.292	0.020	0.034	0.978	0.972	0.500
1115 Manufacture of solid	5	209	0.000	0.047	0.047	-0.017	-0.006	0.970	0.968	0.600
1401 Mineral oil refining	28	47	0.042	0.113	0.072	0.031	0.044	0.951	0.943	0.321
1402 Other treatment petr	93	42	0.047	0.108	0.060	0.035	0.035	0.865	0.893	0.151
1610 Production and distr	36	44	0.044	0.101	0.057	0.032	0.001	0.889	0.905	0.306
1700 Water supply industr	44	201	0.003	0.081	0.078	-0.013	-0.031	0.909	0.899	0.136
2210 Iron and steel	54	32	0.065	0.136	0.072	0.055	0.058	0.934	0.943	0.407
2220 Steel tubes	154	48	0.041	0.067	0.026	0.028	0.025	0.828	0.857	0.292
2234 Manufacture steel wi	306	82	0.021	0.032	0.011	0.011	0.011	0.695	0.739	0.219
2235 Other steel forming	65	20	0.098	0.112	0.014	0.086	0.079	0.915	0.927	0.462
2245 Aluminium	256	90	0.019	0.038	0.019	0.009	0.011	0.786	0.784	0.180
2246 Copper brass	155	46	0.043	0.070	0.028	0.030	0.027	0.838	0.860	0.277
2247 Other non-ferrous me	187	104	0.017	0.043	0.026	0.005	0.007	0.847	0.813	0.310
2310 Extraction stone cl	252	105	0.017	0.026	0.009	0.005	0.015	0.676	0.638	0.147
2330 Extraction salt	5	4	0.378	0.431	0.053	0.498	0.519	0.988	0.986	1.000
2396 Extraction other min	113	50	0.040	0.190	0.150	0.031	0.042	0.888	0.913	0.204
2410 Structural clay prod	186	97	0.018	0.033	0.015	0.005	0.011	0.732	0.757	0.145
2420 Cement lime plaste	164	190	0.005	0.039	0.034	-0.009	-0.002	0.810	0.812	0.104
2436 Ready mix concrete	400	196	0.004	0.015	0.011	-0.007	-0.006	0.527	0.580	0.073
2437 Other building produ	665	150	0.010	0.014	0.004	0.001	0.008	0.523	0.588	0.138
2440 Asbestos goods	26	117	0.014	0.121	0.108	-0.001	0.012	0.948	0.944	0.231
2450 Working of stone	1048	191	0.005	0.012	0.007	-0.003	0.007	0.518	0.504	0.097
2460 Abrasive products	73	79	0.023	0.069	0.046	0.008	0.001	0.841	0.872	0.192

4-digit industry	**Number of “firms”**	**Rank on *a***	*a*	*F*	*M*	g_{MS}	g_{EG}	L_R	L_A	*CI*
2471 Flat glass	210	118	0.014	0.056	0.042	0.002	0.000	0.764	0.805	0.162
2478 Glass containers	37	36	0.057	0.122	0.065	0.047	0.051	0.937	0.940	0.297
2479 Other glass products	314	119	0.014	0.032	0.018	0.004	0.009	0.793	0.756	0.169
2481 Refractory goods	134	34	0.061	0.082	0.020	0.049	0.050	0.843	0.869	0.261
2489 Ceramic goods	353	2	0.393	0.425	0.032	0.403	0.404	0.858	0.905	0.453
2511 Inorganic chemicals	149	98	0.018	0.064	0.046	0.005	0.013	0.864	0.863	0.161
2512 Basic organic chemic	150	68	0.030	0.111	0.081	0.020	0.031	0.887	0.884	0.113
2513 Fertilisers	93	134	0.012	0.178	0.166	-0.002	0.011	0.889	0.914	0.215
2514 Synthetic resins and	468	151	0.010	0.028	0.018	0.001	0.004	0.654	0.688	0.098
2515 Synthetic rubber	12	210	0.000	0.173	0.173	-0.017	-0.014	0.968	0.967	0.250
2516 Dyestuff and pigment	87	53	0.038	0.093	0.055	0.025	0.032	0.906	0.895	0.218
2551 Paints	274	135	0.012	0.035	0.023	0.001	0.004	0.784	0.785	0.146
2552 Printing ink	98	75	0.027	0.084	0.057	0.013	0.011	0.940	0.881	0.184
2562 Formulated adhesives	181	110	0.016	0.035	0.020	0.003	0.006	0.775	0.784	0.133
2563 Chemical treatment o	15	197	0.004	0.514	0.511	-0.008	-0.009	0.973	0.978	0.333
2564 Essential oils and f	54	111	0.016	0.086	0.070	0.001	-0.003	0.917	0.911	0.185
2565 Explosives	31	174	0.007	0.120	0.112	-0.008	0.011	0.946	0.937	0.226
2567 Misc chemicals for i	429	140	0.011	0.027	0.016	0.001	0.006	0.646	0.695	0.110
2568 Formulated pesticide	74	76	0.025	0.094	0.069	0.011	0.027	0.909	0.901	0.149
2569 Adhesive film	54	202	0.003	0.086	0.083	-0.013	-0.011	0.885	0.904	0.130
2570 Pharmaceutical produ	368	203	0.003	0.019	0.017	-0.008	0.003	0.722	0.687	0.125
2581 Soap	150	83	0.021	0.064	0.043	0.008	0.009	0.828	0.862	0.147
2582 Perfumes and cosmeti	228	141	0.011	0.035	0.024	0.000	0.007	0.784	0.784	0.197
2591 Photographic materia	53	211	0.000	0.180	0.179	-0.016	0.005	0.957	0.933	0.189
2599 Other chemicals	104	127	0.013	0.056	0.043	-0.002	0.009	0.866	0.847	0.154
2600 Production of man-ma	30	40	0.048	0.113	0.065	0.037	0.043	0.929	0.937	0.300
3111 Ferrous metal foundr	403	71	0.029	0.037	0.008	0.020	0.020	0.697	0.753	0.228
3112 Non-ferrous metal fo	296	60	0.033	0.040	0.006	0.023	0.020	0.741	0.752	0.247
3120 Forging pressing	960	27	0.069	0.073	0.004	0.062	0.055	0.631	0.733	0.264
3137 Bolts nuts etc.	567	23	0.088	0.096	0.008	0.080	0.070	0.710	0.794	0.353

4-digit industry	**Number of "firms"**	**Rank on *a***	*a*	*F*	*M*	g_{MS}	g_{EG}	L_R	L_A	*CI*
3138 Heat and surface tre	841	64	0.032	0.035	0.003	0.023	0.020	0.540	0.655	0.213
3142 Metal doors	509	120	0.014	0.021	0.007	0.004	0.008	0.604	0.639	0.169
3161 Handtools	173	10	0.174	0.206	0.032	0.170	0.165	0.859	0.886	0.387
3162 Cutlery	64	6	0.272	0.358	0.086	0.291	0.287	0.975	0.974	0.781
3163 Metal storage vessel	87	84	0.021	0.048	0.027	0.005	0.006	0.829	0.832	0.241
3164 Packaging products o	290	136	0.012	0.022	0.010	0.001	0.005	0.664	0.693	0.172
3165 Domestic heating app	83	91	0.019	0.071	0.052	0.004	0.004	0.898	0.894	0.229
3166 Metal furniture	355	152	0.010	0.020	0.010	0.000	0.004	0.694	0.690	0.186
3167 Domestic utensils of	148	37	0.053	0.094	0.040	0.042	0.035	0.807	0.859	0.264
3169 Other finished metal	4104	87	0.020	0.021	0.001	0.012	0.012	0.378	0.551	0.179
3204 Fabricated steelwork	660	121	0.014	0.026	0.012	0.006	0.018	0.763	0.664	0.111
3205 Boilers	1240	164	0.008	0.017	0.009	0.000	0.006	0.586	0.618	0.138
3211 Agricultural machine	298	99	0.018	0.028	0.011	0.007	0.021	0.795	0.732	0.158
3212 Wheeled tractors	31	192	0.005	0.192	0.187	-0.011	-0.003	0.965	0.960	0.258
3221 Metal-worked machine	1091	80	0.023	0.028	0.005	0.015	0.014	0.588	0.658	0.215
3222 Engineers small tool	1097	56	0.037	0.040	0.003	0.029	0.027	0.551	0.665	0.279
3230 Textile machinery	246	65	0.032	0.056	0.024	0.021	0.026	0.865	0.862	0.293
3244 Processing machinery	303	160	0.009	0.019	0.010	-0.001	0.007	0.641	0.640	0.106
3245 Machinery for chemic	402	142	0.011	0.020	0.008	0.001	0.005	0.647	0.669	0.142
3246 Process engineering	40	35	0.058	0.106	0.047	0.047	0.028	0.914	0.918	0.275
3251 Mining machinery	123	49	0.041	0.069	0.028	0.027	0.032	0.841	0.857	0.244
3254 Construction equipme	239	92	0.019	0.042	0.024	0.008	0.012	0.789	0.796	0.134
3255 Lifting equipment	1164	165	0.008	0.016	0.008	-0.001	0.000	0.543	0.607	0.139
3261 Power transmission e	1344	175	0.007	0.013	0.006	-0.001	0.006	0.538	0.573	0.117
3262 Ball bearings	86	198	0.004	0.095	0.090	-0.012	-0.006	0.907	0.906	0.174
3275 Machinery for wood	327	100	0.018	0.034	0.017	0.007	0.012	0.668	0.711	0.138
3276 Machinery for printi	222	69	0.030	0.061	0.031	0.019	0.022	0.795	0.828	0.221
3281 Combustion engines	244	93	0.019	0.068	0.049	0.009	0.017	0.837	0.838	0.115
3283 Fluid power equipmen	417	161	0.009	0.020	0.011	-0.001	0.007	0.722	0.692	0.134
3284 Refrigerating and ve	823	176	0.007	0.013	0.006	-0.001	0.003	0.556	0.584	0.115

4-digit industry	Number of “firms”	Rank on a	a	F	M	g_{MS}	g_{EG}	L_R	L_A	CI
3285 Weighing machines	168	106	0.017	0.072	0.056	0.005	-0.008	0.794	0.825	0.113
3286 Other industrial and	415	177	0.007	0.022	0.015	-0.003	0.003	0.634	0.665	0.133
3287 Pumps	272	143	0.011	0.032	0.021	0.000	0.005	0.689	0.738	0.096
3288 Industrial valves	217	115	0.015	0.034	0.019	0.003	0.007	0.780	0.777	0.129
3289 Other engineering	4188	182	0.006	0.008	0.002	-0.002	0.003	0.386	0.455	0.123
3290 Ordnance small arms	78	162	0.009	0.047	0.038	-0.007	-0.002	0.862	0.857	0.295
3301 Office machinery	91	207	0.001	0.066	0.065	-0.016	0.001	0.861	0.847	0.143
3302 Electronic data proc	1023	128	0.013	0.035	0.022	0.005	0.008	0.739	0.755	0.163
3410 Insulated wires	259	129	0.013	0.038	0.025	0.002	0.010	0.807	0.786	0.151
3420 Basic electrical equ	1423	166	0.008	0.021	0.013	0.000	-0.001	0.472	0.633	0.115
3432 Batteries	137	81	0.022	0.059	0.037	0.008	0.007	0.852	0.867	0.146
3433 Alarms and signallin	371	137	0.012	0.031	0.020	0.002	0.004	0.704	0.733	0.111
3434 Electrical equipment	351	101	0.018	0.059	0.041	0.009	0.008	0.792	0.833	0.174
3435 Electrical equipment	241	204	0.003	0.028	0.025	-0.009	0.003	0.778	0.718	0.145
3441 Telegraph and teleph	359	206	0.002	0.065	0.063	-0.008	-0.006	0.755	0.807	0.150
3442 Electrical instrumen	892	183	0.006	0.013	0.007	-0.003	0.007	0.560	0.569	0.081
3443 Radio and electronic	727	153	0.010	0.029	0.019	0.002	0.014	0.745	0.751	0.117
3444 Other components for	779	193	0.005	0.011	0.006	-0.004	0.006	0.563	0.550	0.105
3452 Records and tapes	107	38	0.050	0.111	0.061	0.038	0.035	0.929	0.926	0.495
3453 Electronic sub-assem	379	199	0.004	0.022	0.018	-0.006	0.004	0.725	0.706	0.116
3454 Other electronic con	313	43	0.046	0.093	0.047	0.038	0.046	0.771	0.808	0.153
3460 Domestic electric ap	246	154	0.010	0.042	0.032	-0.002	0.005	0.846	0.818	0.175
3470 Electric lamps	990	194	0.005	0.018	0.012	-0.003	0.000	0.672	0.650	0.163
3510 Motor vehicles and e	189	39	0.050	0.104	0.054	0.041	0.041	0.875	0.899	0.143
3521 Motor vehicle bodies	229	155	0.010	0.028	0.017	-0.001	0.005	0.720	0.712	0.135
3522 Trailers	131	112	0.016	0.034	0.018	0.001	0.009	0.801	0.787	0.168
3523 Caravans	70	14	0.132	0.155	0.024	0.122	0.137	0.914	0.899	0.329
3530 Motor vehicle parts	1084	102	0.018	0.024	0.006	0.010	0.011	0.597	0.664	0.141
3610 Shipbuilding	843	107	0.017	0.101	0.084	0.011	0.021	0.858	0.876	0.189
3620 Railway and tramway	57	108	0.017	0.162	0.145	0.004	0.006	0.935	0.935	0.175

4-digit industry	**Number of “firms”**	**Rank on *a***	*a*	*F*	*M*	g_{MS}	g_{EG}	L_R	L_A	*CI*
3633 Motor cycles	32	58	0.035	0.064	0.029	0.021	0.016	0.901	0.901	0.312
3634 Pedal cycles	46	11	0.162	0.358	0.196	0.194	0.173	0.948	0.965	0.370
3640 Aerospace equipment	543	144	0.011	0.033	0.022	0.002	0.011	0.721	0.751	0.127
3650 Other vehicles	43	145	0.011	0.131	0.120	-0.003	0.003	0.957	0.933	0.140
3710 Precision instrument	1250	178	0.007	0.012	0.005	-0.002	0.004	0.548	0.574	0.108
3720 Medical equipment	371	146	0.011	0.023	0.012	0.001	0.005	0.714	0.715	0.167
3731 Spectacles	180	94	0.019	0.042	0.022	0.007	0.006	0.770	0.777	0.156
3732 Optical instruments	100	61	0.033	0.134	0.101	0.021	0.032	0.890	0.898	0.160
3733 Photographic euipmen	91	167	0.008	0.108	0.100	-0.008	0.003	0.901	0.902	0.220
3740 Clocks and timing de	116	168	0.008	0.049	0.042	-0.008	-0.005	0.849	0.831	0.172
4115 Margarine and cookin	12	26	0.078	0.149	0.071	0.077	0.090	0.972	0.963	0.500
4116 Oil processing	31	28	0.069	0.118	0.049	0.059	0.044	0.945	0.940	0.290
4121 Slaughterhouses	247	130	0.013	0.021	0.008	0.001	0.010	0.706	0.689	0.117
4122 Bacon curing	474	195	0.005	0.016	0.011	-0.004	0.002	0.598	0.634	0.154
4123 Poultry slaughter	127	77	0.024	0.047	0.022	0.010	0.021	0.854	0.824	0.181
4126 Animal by-products	65	95	0.019	0.049	0.030	0.003	0.005	0.856	0.850	0.215
4130 Milk products	258	169	0.008	0.019	0.011	-0.003	0.002	0.681	0.665	0.182
4147 Fruit and vegetables	189	52	0.039	0.055	0.017	0.027	0.036	0.809	0.813	0.190
4150 Fish processing	198	29	0.068	0.119	0.052	0.060	0.074	0.921	0.895	0.333
4160 Grain milling	115	109	0.017	0.024	0.008	0.001	0.005	0.753	0.751	0.165
4180 Starch	9	41	0.048	0.203	0.154	0.050	0.016	0.972	0.973	0.556
4196 Bread and flour conf	989	184	0.006	0.011	0.005	-0.003	0.001	0.519	0.546	0.164
4197 Biscuits and crispbr	65	96	0.019	0.056	0.037	0.004	0.000	0.877	0.884	0.215
4200 Sugar and its by-pro	14	212	0.000	0.088	0.088	-0.017	-0.045	0.929	0.938	0.214
4213 Ice cream	116	185	0.006	0.095	0.090	-0.010	0.000	0.879	0.886	0.164
4214 Chocolate	191	138	0.012	0.058	0.047	0.000	0.000	0.799	0.821	0.147
4221 Compound animal feed	285	131	0.013	0.020	0.007	0.002	0.015	0.741	0.692	0.140
4222 Pet foods	153	156	0.010	0.047	0.037	-0.004	0.000	0.777	0.801	0.255
4239 Misc. foods	657	170	0.008	0.020	0.012	-0.001	0.004	0.677	0.683	0.148
4240 Spirit distilling	93	18	0.106	0.142	0.035	0.097	0.107	0.923	0.936	0.398

4-digit industry	**Number of “firms”**	**Rank on *a***	*a*	*F*	*M*	g_{MS}	g_{EG}	L_R	L_A	*CI*
4261 Wines cider and per	31	122	0.014	0.181	0.167	0.001	0.025	0.970	0.955	0.258
4270 Brewing and malting	175	85	0.021	0.039	0.018	0.008	0.007	0.770	0.770	0.131
4283 Soft drinks	166	147	0.011	0.027	0.017	-0.003	0.004	0.785	0.759	0.139
4290 Tobacco industry	23	205	0.003	0.072	0.069	-0.013	-0.011	0.935	0.930	0.261
4310 Woollen	402	16	0.125	0.132	0.007	0.118	0.131	0.889	0.902	0.500
4321 Spinning cotton	70	45	0.044	0.069	0.024	0.030	0.035	0.869	0.884	0.357
4322 Weaving cotton silk	200	13	0.139	0.151	0.013	0.131	0.138	0.884	0.897	0.375
4336 Continuous filament	23	157	0.010	0.087	0.077	-0.005	-0.003	0.925	0.934	0.391
4340 Spinning and weaving	23	1	0.593	0.709	0.116	0.701	0.690	0.981	0.987	0.696
4350 Jute and polypropyle	27	5	0.374	0.437	0.063	0.406	0.427	0.980	0.976	0.556
4363 Hosiery	800	9	0.177	0.186	0.010	0.173	0.166	0.883	0.907	0.559
4364 Warp knitted fabrics	60	19	0.104	0.138	0.035	0.094	0.096	0.932	0.938	0.617
4370 Textiles finishing	417	62	0.033	0.039	0.005	0.024	0.030	0.792	0.808	0.273
4384 Pile carpets	180	30	0.067	0.089	0.022	0.057	0.068	0.855	0.868	0.233
4385 Other carpets	39	7	0.197	0.307	0.110	0.215	0.228	0.961	0.962	0.282
4395 Lace	61	3	0.385	0.421	0.036	0.396	0.387	0.969	0.976	0.836
4396 Rope	78	70	0.030	0.071	0.041	0.016	0.020	0.942	0.871	0.192
4398 Narrow fabrics	126	25	0.079	0.093	0.014	0.066	0.064	0.866	0.895	0.373
4399 Other misc. textiles	328	54	0.038	0.073	0.036	0.029	0.042	0.872	0.844	0.220
4410 Leather tanning	156	57	0.036	0.059	0.023	0.023	0.025	0.812	0.831	0.333
4420 Leather goods	416	33	0.064	0.070	0.006	0.055	0.048	0.769	0.822	0.483
4510 Footwear	380	31	0.067	0.081	0.015	0.059	0.063	0.839	0.853	0.529
4531 Weatherproof	201	72	0.029	0.043	0.013	0.018	0.019	0.766	0.796	0.259
4532 Men and boys tailore	423	132	0.013	0.028	0.015	0.004	0.007	0.781	0.754	0.364
4533 Women and girls tail	666	59	0.035	0.054	0.019	0.027	0.015	0.790	0.816	0.691
4534 Work clothing for me	214	123	0.014	0.029	0.015	0.002	0.006	0.780	0.763	0.332
4535 Men and boys shirts	311	17	0.116	0.141	0.025	0.110	0.104	0.787	0.844	0.379
4536 Womens and girls wea	1822	73	0.029	0.035	0.006	0.021	0.009	0.618	0.715	0.639
4537 Hats	71	24	0.084	0.109	0.025	0.072	0.070	0.928	0.913	0.549
4538 Gloves	54	51	0.040	0.109	0.068	0.028	0.037	0.940	0.915	0.426

4-digit industry	**Number of “firms”**	**Rank on *a***	*a*	*F*	*M*	g_{MS}	g_{EG}	L_R	L_A	*CI*
4539 Other dress industri	448	63	0.033	0.050	0.017	0.025	0.016	0.751	0.796	0.536
4555 Soft furnishings	225	67	0.031	0.048	0.017	0.020	0.022	0.823	0.826	0.240
4556 Canvas goods	336	124	0.014	0.023	0.009	0.003	0.006	0.661	0.698	0.152
4557 Household textiles	268	55	0.038	0.057	0.019	0.028	0.031	0.823	0.846	0.231
4610 Sawmilling	728	186	0.006	0.010	0.004	-0.003	0.004	0.596	0.522	0.104
4620 Semi-finished wood	152	125	0.014	0.042	0.028	0.000	0.002	0.817	0.797	0.164
4630 Builders carpentry	1125	200	0.004	0.009	0.005	-0.005	0.001	0.478	0.509	0.148
4640 Wood containers	477	187	0.006	0.012	0.006	-0.004	0.003	0.596	0.594	0.130
4650 Other wooden article	511	139	0.012	0.018	0.005	0.003	0.000	0.559	0.635	0.162
4663 Brushes and brooms	97	113	0.016	0.049	0.032	0.001	-0.001	0.842	0.834	0.216
4664 Cork and basketware	12	213	0.000	0.144	0.144	-0.017	0.000	0.961	0.951	0.250
4671 Wood furniture	2422	158	0.010	0.013	0.003	0.002	0.004	0.468	0.573	0.164
4672 Shop and office fitt	866	116	0.015	0.018	0.003	0.007	0.003	0.513	0.591	0.206
4710 Pulp and paper	307	86	0.021	0.030	0.009	0.010	0.022	0.744	0.731	0.134
4721 Wall coverings	28	15	0.131	0.183	0.052	0.129	0.139	0.955	0.954	0.500
4722 Household paper prod	105	114	0.016	0.047	0.030	0.001	0.001	0.859	0.848	0.124
4723 Stationery	726	133	0.013	0.020	0.007	0.004	0.004	0.631	0.638	0.202
4724 Paper and pulp packa	247	171	0.008	0.022	0.014	-0.004	0.003	0.712	0.703	0.121
4725 Board packaging	795	163	0.009	0.012	0.003	0.000	0.003	0.497	0.584	0.132
4728 Other paper and boar	127	148	0.011	0.029	0.018	-0.004	0.003	0.786	0.758	0.150
4751 Newspaper	767	66	0.032	0.038	0.007	0.023	0.012	0.361	0.525	0.194
4752 Periodicals	1662	12	0.140	0.148	0.008	0.136	0.107	0.719	0.756	0.387
4753 Books	1350	22	0.090	0.099	0.009	0.084	0.062	0.660	0.766	0.405
4754 Other publishing	8130	74	0.029	0.030	0.001	0.022	0.013	0.387	0.537	0.270
4811 Rubber tyres	38	188	0.006	0.093	0.087	-0.010	-0.011	0.936	0.929	0.211
4812 Other rubber	530	179	0.007	0.014	0.007	-0.002	0.001	0.596	0.617	0.106
4820 Retreading	44	88	0.020	0.054	0.034	0.005	0.017	0.919	0.858	0.159
4831 Plastic coated texti	19	21	0.094	0.227	0.133	0.100	0.102	0.960	0.960	0.368
4832 Plastic semi-manufac	418	189	0.006	0.015	0.009	-0.004	0.008	0.709	0.623	0.096
4833 Plastic floorcoverin	29	208	0.001	0.100	0.099	-0.016	-0.009	0.949	0.939	0.241

4-digit industry	**Number of “firms”**	**Rank on *a***	a	F	M	g_{MS}	g_{EG}	L_R	L_A	CI
4834 Plastic building pro	531	180	0.007	0.013	0.006	-0.002	0.003	0.598	0.596	0.122
4835 Plastic packaging	631	159	0.010	0.015	0.005	0.000	0.008	0.628	0.626	0.108
4836 Plastics other	2123	172	0.008	0.010	0.002	0.000	0.003	0.375	0.474	0.146
4910 Jewellery	802	8	0.181	0.189	0.009	0.177	0.140	0.818	0.845	0.527
4920 Musical instruments	79	149	0.011	0.063	0.052	-0.005	-0.007	0.892	0.870	0.228
4930 Photographic	320	89	0.020	0.038	0.018	0.010	0.007	0.799	0.748	0.306
4941 Toys and games	246	181	0.007	0.037	0.030	-0.005	0.005	0.820	0.780	0.134
4942 Sports goods	239	126	0.014	0.025	0.011	0.002	0.002	0.704	0.716	0.130
4954 Misc. stationers goo	114	103	0.018	0.053	0.035	0.003	0.005	0.831	0.825	0.246
4959 Other manufacturing	2808	173	0.008	0.010	0.002	0.000	0.001	0.367	0.481	0.160

References

Arrow, K (1962), "The economic implications of learning by doing" *Review of Economic Studies*, 29, 155-173

Disney, R.., Haskel, J. and Heden, Y. (1999) "Entry, exit and survival in UK manufacturing" Queen Mary and Westfield College, draft paper.

Dumais, G., Ellison, G. and Glaeser, E. (1997) "Geographic concentration as a dynamic process", NBER working paper 6270.

Ellison, G. and Glaeser, E. (1997) "Geographic concentration in US manufacturing industries: a dartboard approach" *Journal of Political Economy*, 105:5, 889-927

Glaeser, E, Kallal, H. Scheinkman, J. and Shleifer, A. (1992) "Growth in cities" *Journal of Political Economy*, 100, 1126-1152.

Griffith, R. (1999) "Using the ARD establishment level data: an application to estimating production functions" *Economic Journal*, 109, F416-F442.

Head, K., Ries, J. and Swenson, D. (1995) "Agglomeration benefits and location choice: evidence from Japanese manufacturing investments in the United States", *Journal of International Economics*, 38, 223-247.

Henderson, J (1994) "Where does an industry locate?" *Journal of Urban Economics*, 35, 83-104

Henderson, J (1995) "Industrial development in cities" *Journal of Political Economy*, 103, 1067-1090

Hines, J.R. (1996) "Altered States: taxes and the location of foreign direct investment in America", *American Economic Review*, 86, 1076-1094.

Hoover, E. (1936) *Location Theory and the Shoe and Leather Industries*, Harvard University Press: Cambridge MA

Jacobs (1969) *The Economics of Cities*, Vintage: New York

Jaffee, A.B., Traijtenberg, M. and Henderson, R. (1996) "Geographic localisation of knowledge spillovers as evidenced by patent citations", QJE.

Krugman, P.R. (1991a) "Increasing returns and economic geography" *Journal of Political Economy*, 99, 483-499.

Krugman, P.R. (1991b) *Geography and Trade*, Cambridge, USA: MIT Press.

Krugman, P.R. (1994) *Rethinking International Trade*, Cambridge, USA: MIT Press.

Marshall, A (1890) *Principles of Economics*, MacMillan: London

Maurel, F. and Sedillot, B. (1999) "A measure of the geographic concentration in French manufacturing industries", *Regional Science and Urban Economics*, 29(5), 575-604.

Oulton, N. (1997) "The ABI respondents database: a new resource for industrial economics research" *Economic Trends* No. 528, November 1997,

Romer, P. (1990) "Increasing returns and long-run growth" *Journal of Political Economy*, 94,1002-37.

Swann, G.M.P., Prevezer, M. and Stout, D (1998) *The dynamics of industrial clustering: international comparisons in computing and biotechnology*, Oxford University Press.

Venables, A. (1994) "Trade policy under imperfect competition: a numerical assessment" in Krugman, P. and Smith, A. (eds) *Empirical Studies of Strategic Trade Policy*, Chicago: Chicago University Press.