

**Classification of occupations for economically active:  
Factor analysis of Registration Sub-Districts (RSDs) in 1891**

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# Classification of occupations for economically active: Factor analysis of RSDs in 1891

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Working Paper 8: ESRC project ES/M010953: Drivers of Entrepreneurship and Small Business,  
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## 1. Introduction.

This paper discusses how census data for 1851-1911 can be used to classify the occupations of the economically active population within Registration Sub-Districts (RSDs) for England and Wales using a factor analysis methodology applied to all occupations. This first analysis is based on 1891 as a pilot for the other census years. The paper uses the database for Entrepreneurs 1851-1911 referred to in this and other project Working Papers developed by ESRC project ES/M010953 *Drivers of Entrepreneurship and Small Businesses*. For this paper the I-CeM source for 1891 is used.

The original population census returns for individuals/householders in the 1891 census are derived from the original Census Enumerators Books (CEBs). Individuals followed a census instruction to give their main occupation. This information provides the basis of the assessments in this paper which seek to identify groups of occupations in different RSDs. It is recognised that the population census was not perfect in the design of questions about occupations, or in the classification and processing of the householder's returns. This constrains the data and the interpretations possible. A fuller discussion of the nature of the data, and their limitations, is given in the ESRC project WP 2: *Employers and the self-employed in the censuses 1851-1911: The census as a source for identifying entrepreneurs, business numbers and size distribution*.

This paper first discusses the methodology (Section 2). Section 3 applies the method to classification of the entire economically active population (all workers, employers and own account). Section 4 compares the RSDs for loadings on each factor using their mapped outputs. Section 5 compares then develops the same analysis solely for females occupied. Section 6 classifies the RSDs using their factor scores to produce a classification of each RSD. The paper forms a stepping stone towards the classification of entrepreneurs using a similar methodology.

The results in this working paper are used as a base against which to compare specific classifications of entrepreneurs reported in subsequent research.

## **2. Methodology.**

### ***2.1. Method of factor analysis used***

The purpose of factor analysis is reveal patterns in a set of variables by grouping them into a limited number of groups based on shared variance (Yong and Pearce, 2013). Factor analysis relies on the correlation coefficients between pair-wise variables. To examine whether variables have common features, either the correlation or covariance matrices can be used. The former is a commonly used matrix because it is usually easier to interpret relative to the covariance matrix.

Among the two main factor analysis techniques, Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA), we apply the former, specifically PCA (principal component analysis). Although there is no consensus in the literature whether principle components analysis is preferred to factor analysis (Osborne and Costello, 2005), in most cases both procedures will produce similar results, especially when the number of variables per factor is large (Goldberg and Velicer, 2006) and in large datasets (Osborne and Costello, 2005), both of which are pertinent to our analysis.

An important decision in EFA is determining the optimal number of factors (Goldberg and Velicer, 2006; Osborne and Costello, 2005), where factors represent substantially independent (uncorrelated) patterns of relationships between variables (Rummel, 1967, 1970). The most commonly applied method is to retain those factors that have eigenvalues greater than one, although this is among the least accurate methods (Osborne and Costello, 2005). We opted to retain two different numbers of factors in the analysis here, 12 and 25, as well as using guidance in the automatic cut-offs in Stata. These selections help to examine various possibilities for possible explanatory factors. A final choice is made by noting that extracting too many factors may result in a large error variance deriving from spurious and small sample effects, while extracting too few factors may omit important valuable common variance (Yong and Pearce, 2013).

After a first stage of component-factor analysis is conducted, the result is the original, unrotated factor matrix. This is difficult to interpret and usually has little scientific utility (Goldberg and Velicer, 2006). Instead, we apply the commonly used method of “orthogonal” factor rotation to achieve an outcome where each factor has a correlation of exactly zero with all the other factors. The alternative is to use “oblique” factor rotation whereby factors are permitted to have some correlation with each other. The decision between the two rotational algorithms entails a trade-off between lower-level factors within a single domain (i.e. a large number of factors at the lower level of the trait hierarchy) and broad factors at the highest level of the structure (Goldberg and Velicer, 2006). In addition, we applied the “varimax” algorithm (Kaiser, 1958), which is the most commonly used procedure for “orthogonal” factor rotation (Goldberg and Velicer, 2006; Osborne and Costello, 2005). The resulting factor loadings determine how much the variable has contributed to the corresponding factor, whereby a larger factor loading implies that the variable’s contribution is larger and vice versa (Rummel, 1967, 1970; Yong and Pearce, 2013). All calculations were undertaken in Stata.

Some robustness testing of the results of the 12 and 25 factors was undertaken by comparing against earlier stages of the analysis. In these stages, an initial exploration of the factors using only those sectors with the main entrepreneur categories was used. This was 43 sectors, excluding Public admin, clergy; Clerks, weighers, telegraph, non-theological students and apprentices; Domestic and service staff, cooks; Labourers & transport staff (including family on farms). A further stage was to subdivide mining into coal and other mining, and subdividing public administration etc. by extracting military personnel. The resulting factor analysis of the intermediate stages of 43 and 48 occupational variables are very similar to those for the full 50 sectors reported here suggesting that the results are stable for the 1891 data.

## ***2.2. Spatial level and Census data used***

The purpose of the analysis is to classify spatial areas to common occupational characteristics. The spatial basis chosen is census Registration Sub-Districts (SRDs) in England and Wales. There were 2110 of these in 1891. This base is used as it aggregates small units, thus smoothing potential errors and noise in the data. It also brings residential locations together with workplace for most of the population. Some employers and workers will still be located a long way from their residence, but for most small businesses and their workers the location of employment and residence will be in the same RSD; this would not be the case if parishes were used.

The Census data extracted had careful pre-screening and cleaning to ensure that the subsequent analysis used consistent definitions and was not distorted by spurious entries, or occupationally inactive population. Hence, although many younger people were engaged in occupations, this was often inconsistently recorded by enumerators and may not properly separate full and part-time activity. To ensure consistency, the data used excluded everyone under 15. Also excluded was anyone who was retired, listed only as ‘pensioner’ or ‘former’, living on own means, unemployed, and students, scholars, or pupils.

Because the aim is a classification of locations it was important to focus on those that were permanent or longer-term residents. As a result boarders, visitors and lodgers were excluded, as were those in institutions or ships. Whilst some boarders and institutional inmates will have been long-term residents with full-time occupations in that locality, these categories include many for whom the relationship to the locality was unclear.

Because the focus of this analysis is subsequently on entrepreneurs, for consistency anyone who gave no answer to the employment status question as to whether they were employer, own account, or worker was also excluded. This means that the workforce covered in this paper is only those who explicitly acknowledged their status as workers, employers, or own account. Similarly excluded were all with nil or illegible answers to the employment status question.

### ***2.3. Aggregation of occupations into 50 occupational groups***

The occupational categories used are based on aggregations to 50 occupational groups. These groups are described in detail Working Paper 5. Aggregation is essential for the factor analysis to converge. The original I-CeM coding offers two categories for c. 400 and c.750 occupational categories. Both of these levels contain many occupations with very small numbers of people. When disaggregated around the 2110 RSDs this results in many RSDs having zero entries or very small numbers than can distort the analysis. Aggregating to 50 occupational categories overcomes most of these difficulties, though it is accepted that this approach imposes an order and grouping on the occupations from the outset.

### 3. Classification of entire economically active population.

This Working Paper assesses factor analysis as a method for classifying RSDs using the information on all occupational groups. It is likely that many groups do not have specific differences from the general occupational norm; i.e. there are similar shares of entrepreneurs in many occupations, and groups of occupations, to those across other the entire working population. In such cases the occupations reflect the general character of entrepreneurship in the whole economy. Hence an analysis of all economically active provides a base for our main concern here (reported in other working papers), to identify occupations and locations that differ significantly from that norm in terms of entrepreneurial location. As noted, this is undertaken with 12-factor and 25-factor analyses. As summarised above, this is for all census respondents who were household residents, with a stated occupation, aged 15 and over, and excluding institutions, the unemployed, retired, students, etc. The focus on residents of that locality also excludes boarders, visitors and lodgers (even though some of these may be long-term residents).

#### 3.1 12-Factor study.

The 12-factor analysis of the entire economically active is given in Table 1 for the factor variance, and Table 2 for the factor loadings. In this and subsequent factor loading tables the potentially significant loadings above a value of 0.2 are identified (marked in yellow) and where they are the highest loading for all factors for that occupation they are marked brown. Negative loadings are highlighted in blue where their value is smaller than -0.5.

As shown in Table 1 the explanatory power of the factor analysis tails off after 6 or seven factors: 53% of the explained variance is accounted for by the first four factors, and 80% by the first eight. Overall the explanatory power for 12 factors is 59% of the total variance, which is highly significant, but indicates that there is considerable variation not explained by the factor analysis. This can be compared with an automatic cut-off proved by Stata which had 13 factors.

The characteristics of the first group of factors draw out useful distinctions. The discussion here focuses exclusively on the occupational group loadings on a factor where they are the *highest* for that occupational group (i.e. highlighted in brown in Table 2).

Factor	Variance	Difference	Proportion	Cumulative
Factor1	6.30818	2.94156	0.1262	0.1262
Factor2	3.36662	0.26862	0.0673	0.1935
Factor3	3.09801	0.36207	0.0620	0.2555
Factor4	2.73594	0.40559	0.0547	0.3102
Factor5	2.33035	0.29543	0.0466	0.3568
Factor6	2.03492	0.13347	0.0407	0.3975
Factor7	1.90145	0.11487	0.0380	0.4355
Factor8	1.78658	0.00719	0.0357	0.4712
Factor9	1.77939	0.38887	0.0356	0.5068
Factor10	1.39052	0.00688	0.0278	0.5346
Factor11	1.38364	0.20734	0.0277	0.5623
Factor12	1.17630	-	0.0235	0.5858

**Table 1:** Factor analysis for all economically active (for workers, employers and OA jointly), 12-factor variance.

Number of obs = 2,110

Method: principal-component factors

Rotation: orthogonal varimax (Kaiser off) Number of params = 534

LR test: independent vs. saturated: chi2 (1225)= 6.2e+04 Prob>chi2 = 0.0000

Note that farming has only one marginally significant positive loading (0.1959 on Factor 9 – rural industries); its loadings are mainly negative, and its highest loading in this analysis is -0.60. This indicates that it is widespread across all areas, and where it plays a role it is loaded in the opposite direction to many other occupations (especially heavy industry and coal). In fact it is negatively loaded on all factors except Factor 9; its highest negative loading is on Factor 2 (-0.60) and next highest on Factor 1 (-0.36).

‘Other Mining’ also has no significant positive loading, with a high negative on factor 11 (-0.53) for clothing and agricultural produce. Mining and quarrying, like farming, is thus usually too widespread in distribution to have significant RSD loadings.

50ID	50ID	factor1	factor2	factor3	factor4	factor5	factor6	factor7	factor8	factor9	factor10	factor11	factor12
1	farming, fishing, market gardeners, horse breeding and keeping	-0.3573	-0.6029	-0.1759	-0.2709	-0.0617	-0.1247	-0.1957	-0.0457	0.1959	-0.1449	-0.094	-0.1602
2	coal mining	-0.0982	0.5471	-0.0413	-0.1503	-0.277	-0.1914	-0.1446	-0.1492	-0.105	-0.0226	-0.2037	0.2873
3	other mining & quarrying, brickmaking, gravel, salt works	-0.0464	0.0554	0.0936	-0.1874	-0.1786	-0.0454	0.1243	-0.0593	0.1603	0.0868	-0.5279	0.1017
4	construction operatives (masons, bricklayers, thatcher, plumbers etc.)	0.0875	-0.1161	0.2389	-0.0469	0.7552	-0.0225	-0.0338	-0.0698	0.1264	-0.0208	0.0201	0.0279
5	machinery mf	0.2129	0.6191	-0.0825	0.1649	0.163	0.2932	0.1206	0.0797	0.3242	0.1116	0.0975	-0.1036
6	tool & weapons mf	0.0452	0.0597	-0.02	-0.0209	-0.0294	-0.0281	-0.0083	0.755	0.0486	-0.0023	0.0795	0.0481
7	iron & steel mf, bolts and nails	-0.0444	0.6592	-0.0076	-0.0319	0.0248	-0.1248	-0.0666	0.1543	0.208	-0.0651	0.1389	-0.1085
8	blacksmiths	-0.3975	0.2122	-0.1404	-0.1878	0.1628	0.0251	-0.213	-0.0056	0.6087	-0.1499	-0.1193	-0.071
9	other metal mf (copper, tin, brass, whitesmiths, etc.)	0.053	0.4917	0.0306	0.0529	-0.0571	-0.1298	-0.1043	0.2912	0.0077	-0.08	0.0206	-0.202
10	ship, road & rail vehicle mf	0.0173	0.1814	0.0762	-0.0002	0.1393	0.6191	-0.0735	0.1372	0.3343	0.0477	0.1322	-0.0984
11	earthenware & glass mf	-0.031	0.0927	-0.0542	0.0181	0.0046	0.0091	-0.02	0.1733	-0.0284	-0.0215	0.0024	0.8049
12	gas, coke and chemical mf	0.1596	0.2782	-0.144	0.1853	0.0592	0.0913	-0.0367	-0.1494	0.0668	0.0213	0.0648	0.1925
13	leather, fur, hair & bone mf	0.1663	0.0586	0.0281	0.5328	-0.0234	-0.0097	0.1195	0.1359	0.002	0.1928	-0.0492	-0.1105
14	wood mf (sawyers, coopers, cane workers)	0.0715	0.0285	0.0479	0.7276	0.0515	0.0457	-0.0331	0.0424	0.1071	0.0863	0.0644	0.1441
15	furnishing mf (cabinet makers, french polishers, undertakers)	0.2157	0.0688	0.262	0.4945	0.0749	-0.0148	0.0319	0.202	-0.0688	0.0401	-0.1046	-0.0358
16	printing & paper mf (paper, cardboard, printers, bookbinders)	0.3339	0.1049	0.0622	0.5773	-0.0404	0.0228	0.0612	0.1696	-0.2156	-0.0351	-0.0542	-0.1477
17	waterproof goods mf (floor & oil cloth, rubber etc.)	0.0923	0.0771	-0.1021	0.0519	0.0441	0.0606	0.0244	0.054	-0.0605	0.4023	0.0124	-0.078
18	woollen mf (woollen goods, carpets, blanket, flannel)	-0.0144	0.0814	-0.0411	-0.0312	-0.0004	-0.0582	0.7586	-0.0172	-0.0208	-0.1271	-0.0851	0.0074
19	cotton & silk mf (incl ribbon, weaving, dyeing, bleaching etc.)	0.0397	0.1748	-0.1765	-0.0682	-0.2991	-0.0887	0.3598	-0.055	-0.3309	0.0929	0.3304	-0.1168
20	other textile mf (flax, hemp, rope, jute, lace, tape, thread)	0.0219	0.0886	-0.0216	0.0631	-0.0368	-0.0504	0.7223	-0.0375	-0.0855	0.0925	0.1011	-0.0566
21	clothing mf (tailors, milliners, hosiery, hats, gloves, umbrellas, buttons, leather)	-0.0498	0.022	-0.0126	-0.0189	-0.0303	-0.0587	-0.0194	-0.0478	-0.1662	0.6198	0.1924	0.063
22	shoe, boot, clog mf	-0.0466	-0.043	0.1154	0.1335	-0.041	-0.0452	-0.0343	-0.0205	0.0142	0.6069	-0.1709	-0.1085
23	agric produce mf (millers, refiners, bakers, confectioners)	-0.1742	-0.3454	0.0122	0.1965	-0.1107	0.012	-0.0389	-0.1303	0.4792	-0.1271	0.1695	-0.0405
24	drink & tobacco mf (malsters, brewers, distillers, tobacco & pipes)	0.0694	0.047	0.3317	0.4054	0.0327	-0.0309	-0.0207	-0.0697	0.0257	-0.0021	0.1087	0.0814
25	watch & instrument mf	0.3071	0.0658	0.0528	0.1262	0.0765	0.1069	0.0259	0.5139	-0.0205	0.07	0.0285	-0.0788
26	general mf (manufacturers, mechanic, artisan, machinist)	0.1544	0.7597	-0.0457	-0.0044	-0.1389	0.2721	0.1172	-0.0397	-0.0235	-0.111	-0.0408	0.1091
27	ocean, inland and dock transport	0.1614	0.157	0.1719	0.2589	-0.1029	0.725	-0.0912	-0.0849	-0.07	-0.0999	0.081	0.0195
28	road & rail transport	0.3295	0.0968	0.0449	0.4497	0.3578	0.0596	-0.0872	0.0136	-0.3897	-0.1461	0.0148	-0.0105
29	coal dealing	0.0549	0.0877	0.3172	-0.1391	0.0454	0.086	0.1454	0.0639	0.0521	0.0953	0.5988	0.0376
30	timber, hay, corn and agric produce dealing	0.2507	-0.149	0.2562	0.1687	0.1133	0.0003	-0.1709	-0.1581	0.2514	-0.0067	0.3791	0.1599
31	clothing and dress dealing (drapers, hosiers, haberdashers)	0.2966	0.0089	0.6272	0.1856	0.1051	0.1462	0.0161	0.0647	0.0334	0.1853	-0.2669	-0.1072
32	food sales (butchers, fishmongers, cheesemongers, milksellers, grocers)	0.3503	-0.0075	0.5971	0.213	0.3865	0.1476	0.0092	-0.0203	-0.052	0.0139	0.1673	0.0522
33	lodging & drink sales (wine & spirits, hotels, inns, coffee ho)	0.1165	-0.0423	0.6145	0.0517	0.1405	0.1772	-0.1949	0.0083	-0.3006	-0.1661	0.0979	-0.0508
34	stationery dealing (stationers, publishers, newsagents)	0.7154	0.0603	0.2986	0.3118	0.1112	0.0634	-0.0382	0.0977	-0.2314	-0.0318	-0.1019	-0.0884
35	h/h & personal goods dealer (earthenware, glass, jewellers)	0.2447	0.0554	0.0863	0.2005	-0.0465	-0.0064	-0.0481	0.7167	-0.0753	-0.0432	-0.0694	0.2366
36	ironmongers	0.3712	0.0659	0.6438	-0.0554	0.2169	0.0095	0.0053	0.0185	0.1263	0.0281	0.1145	0.0087
37	other retail (general shopkeeper, huckster, hawk)	-0.002	0.1352	0.2494	0.3926	-0.0442	0.1003	0.2408	0.0278	-0.1265	-0.1749	-0.0457	-0.0308
38	chemists, druggists	0.4865	0.063	0.6515	0.0244	0.0317	0.0486	-0.0014	0.0539	-0.0162	-0.0021	0.0735	-0.0433
39	merchants, banks, insurers and brokers	0.8644	0.1363	0.0318	0.0625	-0.0613	0.0113	0.1294	0.1293	-0.0617	-0.0021	0.0965	0.0092
40	other commerce (accountants, salesmen, travellers, officers of cos.)	0.8733	0.066	0.0997	0.0558	0.0325	-0.0391	0.0306	0.0631	0.0151	0.0584	0.0257	-0.0083
41	construction management (builders and contractors)	0.4671	0.1736	0.0156	0.0285	0.6232	0.0221	0.0881	0.0226	0.0655	0.0504	0.099	-0.0255
42	professions (barristers, solicitors, scientific pursuits)	0.7152	0.0436	0.1253	-0.1872	0.1823	-0.0399	-0.0998	-0.0637	0.0318	-0.0897	-0.0288	0.0039
43	professions (doctors, dentists, artists, performers, education)	0.6805	-0.1425	0.3015	-0.0752	0.3779	0.0403	-0.1671	0.0204	-0.067	-0.0715	-0.0066	-0.0014
44	personal services (washing & bathing, hairdressing, chimney sweeps)	0.2793	-0.17	0.3264	0.2015	0.5534	0.1172	-0.1345	0.0054	-0.2717	-0.0415	0.0027	-0.0526
45	Public admin, clergy	0.611	-0.1256	0.1705	0.0668	0.3543	0.2908	-0.1416	-0.0424	-0.0576	-0.0733	-0.1086	-0.0321
46	Military	-0.0029	0.0304	0.0739	-0.1477	0.0866	0.7637	-0.0016	-0.0064	-0.0642	0.0096	-0.0878	0.0435
47	Clerks, weighers, telegraph, non-theological students and apprentices	0.9059	0.1579	0.0709	0.1421	0.0483	0.0692	-0.0081	0.0589	-0.0174	0.0054	0.0301	0.015
48	Domestic and service staff, cooks	0.1316	-0.3355	0.041	-0.1381	0.0918	0.0729	-0.3716	-0.0453	-0.2378	-0.2822	-0.0853	-0.1846
49	Labourers & transport staff (including family on farms)	-0.4488	-0.5601	-0.3208	-0.1063	0.0709	-0.0723	-0.2578	-0.092	0.2058	-0.1544	0.1559	-0.0803
50	Persons of property and unoccupied	-0.0215	-0.1125	0.0528	0.0068	-0.0055	0.1624	-0.0736	0.0122	-0.0698	-0.0487	-0.0071	-0.1108

**Table 2** 12-Factor loadings for each of the 50 aggregated occupational variables.

The different factor loadings can be summarised and interpreted as below:

**Factor 1 (Commercial and professional)** identifies a group of commercial and professional occupations where the analysis of RSDs evidences a clear grouping into the major commercial and professional centres:

Merchants, banks, insurers and brokers

Other commerce (accountants, salesmen, travellers, officers of Cos.)

Professions (barristers, solicitors, scientific pursuits)

Professions (doctors, dentists, artists, performers, education)

As well as occupations associated with these groups in leading business centres:

Stationary dealing (stationers, publishers, newsagents)

Public admin, clergy

Clerks, weighers, telegraph, non-theological students and apprentices



All these occupational groups have factor loadings above 0.5, mostly above 0.7. Apart from stationary dealing this factor excludes retail (although there is a close but smaller relation to chemists and druggists who are more strongly linked to Factor 3). Stationary dealing in this case is primarily wholesale and includes leading media activities as well as some retailing. Clerks, weighers etc. indicate a worker group strongly associated with commerce: they were the bookkeepers and human resource infrastructure of the commercial centres. Public administration and the clergy, however, indicate a different type of clustering: the co-location of the state's administrative functions in the main commercial centres.

**Factor 2 (*Heavy manufacturing and coal*)** identifies heavy manufacturing, metals manufacture, chemicals and coal mining:

Coal mining

Machinery manufacture

Iron & steel manufacture, bolts and nails

Other metal manufacture (copper, tin, brass, whitesmiths, etc.)

Gas, coke and chemical manufacture

General manufacture (manufacturers, mechanic, artisan, machinist)

Of these gas, coke and chemical manufacture has a relative low loading (only 0.28) but this factor is the only one where it has any potentially significant relationship, and is an industry often closely associated with heavy industries. This factor also has two of only three high *negative* loadings in the whole factor analysis, in this case on:

Farming, fishing, market gardeners, horse breeding and keeping (loading -0.60)

Labourers & transport staff (including family on farms) (loading -0.56)

This indicates a strong negative association between heavy manufactures and coal compared with agriculture and general labourers (since most specific labourers are identified to their industry, these are general or undefined labourers who are mostly agricultural). (q.v. Factor 9).

**Factor 3 (*Retail and lodging*)** identifies the prime retail sectors focused on personal and household needs as well as lodging:

Clothing and dress dealing (drapers, hosiers, haberdashers)

Food sales (butchers, fishmongers, cheesemongers, milksellers, grocers)

Lodging & drink sales (wine & spirits, hotels, inns, coffee houses)

Ironmongers

Chemists, druggists

**Factor 4 (*Wood, leather, furnishing and printing manufacture*)** is chiefly a factor grouping manufacturers of leather, wood, wood-using industries (other than building), and printing which all have loadings of 0.5 or greater:

Leather, fur, hair & bone manufacture

Wood manufacture (sawyers, coopers, cane workers)

Furnishing manufacture (cabinet makers, french polishers, undertakers)

Printing & paper manufacture (paper, cardboard, printers, bookbinders)

Lesser loadings (all at 0.4 or greater) are for:

Drink & tobacco manufacture (maltsters, brewers, distillers, tobacco & pipes)

Road & rail transport (which includes small carriers)

Other retail (general shopkeeper, huckster, hawker)

Other retail, which is mainly market stall and street traders, has potentially significant loadings also on Factors 3 and 7. It is clearly a fairly widespread activity with Factor 4 producing the strongest association, but this fits less well than a possibly more natural grouping with Factor 3.

**Factor 5 (*Building and personal service industries*)** combines three occupational groups:

Construction operatives (masons, bricklayers, thatcher, plumbers etc.)

Construction management (builders and contractors)

Personal services (washing & bathing, hairdressing, chimney sweeps)

This is essentially a building factor, but also loads strongly on personal services. Personal services also loads positively on 3, 1 and 4 (in that rank order), which are all consumption goods industries in urban centres. There is not a strong relationship to dirty occupations needing a lot of laundry, like mining and heavy industries (Factor 2). Its close relation to building draws from the relation of building to major urban consumer centres, but may also indicate some relation to a dirty industry needing lots of laundry. There is a secondary and less significant association of these sectors with food sales and ironmongery, which are much more strongly grouped into Factor 3, as well as the more personally-related professions (doctors, dentists, artists etc.) and public administration which are strongly loaded on Factor 1. But these associations indicate that construction, like personal services are strongly clustered around consumer users. However, it is clear that Factor 5 is quite similar in many respects to elements of Factors 1 and 3.

**Factor 6 (*Major transport, transport manufacture and military*)** is an association largely based on ports and major transport hubs, which are also usually the main location for related

manufactures. The military enter this factor because of the large proportion of their personnel who are naval, also concentrated in a few ports.

Ship, road & rail vehicle mf

Ocean, inland and dock transport

Military

**Factor 7 (*Textiles manufacture*)** is a highly concentrated grouping of the main large-scale textile industries:

Woollen manufacture (woollen goods, carpets, blanket, flannel)

Cotton & silk manufacture (including ribbon, weaving, dyeing, bleaching etc.)

Other textile manufacture (flax, hemp, rope, jute, lace, tape, thread)

**Factor 8 (*Tools, instruments and household goods*):**

Tool & weapons manufacture

Watch & instrument manufacture

Household & personal goods dealer (earthenware, glass, jewellers)

This is a fairly heterogeneous group but with a focus on generally highly skilled craft manufactures with a low level of mechanisation.

**Factor 9 (*Rural trades*)** combines three groups that are ubiquitous in rural areas related to agricultural needs and agricultural manufacture:

Blacksmiths

Agricultural produce manufacture (millers, refiners, bakers, confectioners)

Labourers & transport staff (including family on farms)

*Possible: [Farming, fishing, market gardeners, horse breeding and keeping]*

These are mostly maker-dealers. Among these, some such as bakers and confectioners, also occur frequently in urban areas, but are less frequently concentrated in them to the exclusion of other trades. It is noteworthy that agricultural produce manufacturers otherwise only loads strongly on Factor 4. As noted under the strong negative loadings on Factor 4 (wood, leather, furnishing and printing manufacture), which are often related industries. As noted for Factor 2, agriculture and general labourers are mostly agricultural, and hence their grouping with blacksmiths and agricultural produce is consistent, and their negative loading on Factor 2. Farming has its only positive loading on this factor, but only at 0.1959, just at the level used to cut-off identification of other loadings; but it could be added to this factor as its closest link.

***Factor 10 (Apparel and textile maker dealers)***

Clothing manufacture (tailors, milliners, hosiery, hats, gloves, umbrellas, buttons, leather)

Shoe, boot, clog manufacture

Waterproof goods manufacture (floor & oil cloth, rubber etc.)

Generally closely linked industries that are widespread at low densities across many RSDs, but also concentrated into some centres of hand and mechanised manufacture.

***Factor 11 (Dealers with a strong basis in the carrying trade)***

Coal dealing

Agricultural produce dealing, and dealers in timber, hay, corn

The main distribution industries at both a wholesale and retail level where heavier loads need dedicated carriers. Often focused on railway stations (large and small) and/or canal and ports mainly across rural areas, but also in some urban areas. This factor also has the only significant loading for other mining and quarrying, but it is negative (-0.53). The different sign shows the polar relation with the coal dealing and other dealing sectors, but is a very clear identifier of almost all the main mine and quarry areas: in the SW, Wales, limestone and clay ears of the Midlands, Derbys., S and W. Yorks., N. Yorks., Durham, Northumberland, Cumberland and Westmorland, as well as small quarry owners elsewhere such as N. Kent and Isle of Purbeck.

***Factor 12 (Earthenware and glass manufacture)*** has only one occupational group loading, but that at a high level (0.8). This group includes all Pottery, brick and tile manufacture, within which Pottery, brick and tile manufacture is a major element. This is fairly widespread in addition to the concentrated centres such as Staffs. It indicates a concentration of this industry in a group of RSDs, but its emergence as the last factor indicates its localisation to a few RSDs.

**3.2 25-Factor Study.**

The results for a factor analysis allowing the method to run to 25 factors are shown in Tables 3 and 4. This is primarily used as a guide for two purposes: first, to assess the robustness of the factors identified in the 12-factor study; and second, to check on the presence of significant groupings, like that in earthenware and glass manufacture, which are highly clustered but only in a limited range of locations so that the total variance that they can explain is limited.

Factor	Variance	Difference	Proportion	Cumulative
Factor1	6.12524	3.47196	0.1225	0.1225
Factor2	2.65328	0.44259	0.0531	0.1756
Factor3	2.21069	0.11888	0.0442	0.2198
Factor4	2.09181	0.16437	0.0418	0.2616
Factor5	1.92743	0.12914	0.0385	0.3002
Factor6	1.79830	0.14941	0.0360	0.3361
Factor7	1.64889	0.02632	0.0330	0.3691
Factor8	1.62257	0.01454	0.0325	0.4016
Factor9	1.60802	0.23454	0.0322	0.4337
Factor10	1.37349	0.00153	0.0275	0.4612
Factor11	1.37196	0.05750	0.0274	0.4886
Factor12	1.31446	0.01752	0.0263	0.5149
Factor13	1.29694	0.00920	0.0259	0.5409
Factor14	1.28774	0.09408	0.0258	0.5666
Factor15	1.19366	0.01591	0.0239	0.5905
Factor16	1.17775	0.00248	0.0236	0.6140
Factor17	1.17527	0.02062	0.0235	0.6375
Factor18	1.15465	0.01734	0.0231	0.6606
Factor19	1.13730	0.02205	0.0227	0.6834
Factor20	1.11525	0.00323	0.0223	0.7057
Factor21	1.11201	0.01682	0.0222	0.7279
Factor22	1.09519	0.00542	0.0219	0.7498
Factor23	1.08978	0.05080	0.0218	0.7716
Factor24	1.03898	0.01717	0.0208	0.7924
Factor25	1.02180	-	0.0204	0.8128

**Table 3:** Factor analysis for all economically active (for workers, employers and OA jointly), 25-factor variance.

Number of obs = 2,110  
Method: principal-component factors      Retained factors = 25  
Rotation: orthogonal varimax (Kaiser off)      Number of params = 950  
LR test: independent vs. saturated:  $\chi^2(1225) = 6.2e+04$  Prob> $\chi^2 = 0.0000$

In general the patterns are very similar, although because the variance is now spread between a large number of factors the loadings in most cases are lower. Table 3 indicates the variance is again chiefly explained by the first 7 or 8 factors, but the larger number of factors allows increases the overall explanatory power considerably, up to 81% for the full 25 factors. The level of variance explained by the first 12 factors is comparable, though slightly lower than shown in Table 1.

Table 4 indicates similar factor loadings and structure of factors for the 25-factor as the 12-factor study. Factor 1 is still the main commercial and professional grouping, but now has many dealers and small manufactures added to it; somewhat combining the 12-factor groups for Factors 1,3, 4, 5, 10, and 11. There is a notable high negative loading of farming and agricultural labourers on Factor 1. Factor 2 now combines heavy manufactures and textiles (Factors 2 and 7 of the 12-factor study). This has a notably high negative loading of farming, agricultural labourers and domestic staff. Factor 3 combines Factors 2, 6 and 9 of the 12-factor study generally related to metal trades. Factor 4 groups wood, agricultural produce and other retail. From Factor 5 onwards there is generally only one lead occupation associated with the factor.

SOID	SOID	factor1	factor2	factor3	factor4	factor5	factor6	factor7	factor8	factor9	factor10	factor11	factor12	factor13
1	farming, fishing, market gardeners, horse breeding and keeping	-0.6066	-0.5472	-0.0689	-0.0733	0.1417	0.0306	0.0407	0.1057	0.0938	0.0801	0.149	0.0182	0.034
2	coal mining	-0.1652	0.459	0.1072	-0.2268	0.0603	-0.2366	-0.3219	-0.3634	-0.1192	-0.118	-0.012	-0.0302	0.0614
3	other mining & quarrying, brickmaking, gravel, salt works	-0.1488	0.1187	0.0094	-0.1501	-0.0265	-0.1589	-0.2938	-0.1363	0.3391	0.1484	0.1004	0.2958	0.0763
4	construction operatives (masons, bricklayers, thatcher, plumbers etc.)	0.3026	-0.4677	0.2537	-0.0207	-0.1228	0.311	-0.0149	-0.1581	0.0135	0.1948	-0.3496	0.0485	0.0502
5	machinery mf	0.3555	0.4954	0.4925	0.0615	-0.0139	0.1816	0.2262	-0.0276	0.1626	0.0303	0.0008	-0.056	-0.0504
6	tool & weapons mf	0.1138	0.1987	-0.0152	0.0168	0.4739	0.233	-0.1705	0.4602	-0.0464	0.0579	-0.0994	0.0333	0.1501
7	iron & steel mf, bolts and nails	0.0541	0.462	0.3775	-0.0761	0.1199	0.2246	-0.1195	-0.0916	-0.081	0.0946	0.0344	-0.3028	-0.0352
8	blacksmiths	-0.4191	-0.0238	0.6267	-0.0096	0.1986	0.2177	-0.0256	-0.1576	0.1384	0.188	0.0821	-0.0098	-0.0504
9	other metal mf (copper, tin, brass, whitesmiths, etc.)	0.1546	0.3771	0.1299	-0.0368	0.2483	0.0792	-0.1458	0.0106	-0.0175	0.1313	0.0416	-0.3449	0.0926
10	ship, road & rail vehicle mf	0.2023	0.0328	0.6185	0.2045	0.0086	-0.0162	0.1632	0.2865	0.1575	-0.0622	0.0365	0.0406	-0.185
11	earthenware & glass mf	-0.001	0.1872	0.0581	-0.0032	0.2132	-0.0038	-0.189	-0.0937	-0.3724	-0.2438	-0.2656	0.5435	-0.1436
12	gas, coke and chemical mf	0.1698	0.2245	0.16	0.013	0.0129	0.0037	0.1909	-0.2468	-0.0827	-0.1508	-0.0337	0.0797	0.3146
13	leather, fur, hair & bone mf	0.3169	0.2087	-0.2297	0.3543	0.0896	0.1216	0.117	-0.0676	0.1843	0.0047	0.0592	-0.0101	0.0047
14	wood mf (sawyers, coopers, cane workers)	0.3089	0.1087	-0.0889	0.5537	0.165	0.1522	0.1592	-0.2428	-0.0384	-0.1104	0.0637	0.122	0.0852
15	furnishing mf (cabinet makers, french polishers, undertakers)	0.478	0.083	-0.1724	0.3383	0.1441	0.0464	-0.0785	-0.0809	0.0664	0.1032	0.021	-0.0007	0.0237
16	printing & paper mf (paper, cardboard, printers, bookbinders)	0.508	0.2013	-0.2997	0.2933	0.1788	-0.0789	0.1534	-0.0594	0.0226	0.0967	0.0674	-0.113	-0.0201
17	waterproof goods mf (floor & oil cloth, rubber etc.)	0.1028	0.1462	-0.0654	0.0261	-0.0504	0.0867	0.0727	0.0575	0.2741	-0.2198	-0.1585	-0.0664	-0.1073
18	woollen mf (woollen goods, carpets, blanket, flannel)	-0.0324	0.3338	-0.1895	-0.0594	-0.3717	0.0774	0.1007	0.1083	-0.0391	0.4684	-0.0399	0.2687	0.0933
19	cotton & silk mf (incl ribbon, weaving, dyeing, bleaching etc.)	-0.0695	0.4161	-0.305	-0.1219	-0.3164	-0.0225	0.1513	0.2104	-0.1823	-0.0905	0.0113	-0.2084	-0.1103
20	other textile mf (flax, hemp, rope, jute, lace, tape, thread)	0.0429	0.3702	-0.2602	0.0368	-0.4582	0.1586	0.1371	0.1549	-0.0068	0.2497	-0.0443	0.1373	-0.0082
21	clothing mf (tailors, milliners, hosiery, hats, gloves, umbrellas, buttons, leather)	-0.0266	0.1163	-0.163	0.0582	-0.2209	0.1586	-0.0945	0.0461	0.1796	-0.493	-0.2226	-0.0966	0.1836
22	shoe, boot, clog mf	0.025	0.0379	-0.163	0.1947	-0.1089	0.1077	-0.1754	-0.0604	0.4967	-0.2709	-0.063	-0.0387	-0.0697
23	agric produce mf (millers, refiners, bakers, confectioners)	-0.2323	-0.2821	0.1075	0.2694	0.0207	0.2212	0.1716	-0.0265	-0.0754	0.0258	0.4311	0.1441	0.0069
24	drink & tobacco mf (malsters, brewers, distillers, tobacco & pipes)	0.3124	-0.0174	-0.0339	0.3449	-0.0654	0.0836	-0.1029	-0.1831	-0.1332	-0.0374	0.1235	0.006	-0.1803
25	watch & instrument mf	0.4155	0.1313	-0.0387	0.0392	0.2895	0.1238	-0.0006	0.3227	0.0942	0.0407	-0.0701	-0.0091	-0.017
26	general mf (manufacturers, mechanic, artisan, machinist)	0.2346	0.6608	0.3779	-0.1059	-0.0533	-0.262	0.0244	-0.0986	-0.093	0.0388	0.0043	-0.0233	0.0626
27	ocean, inland and dock transport	0.3935	0.0716	0.3477	0.3349	-0.07	-0.4673	0.2053	0.1424	-0.0514	-0.1485	0.1208	0.0518	-0.0277
28	road & rail transport	0.5719	-0.051	-0.15	0.1739	0.1213	-0.13	0.211	-0.2062	-0.1677	0.0861	-0.273	-0.1542	-0.0551
29	coal dealing	0.2081	0.0251	0.183	0.0323	-0.3417	0.2905	-0.1039	0.3343	-0.2992	-0.1866	0.0445	-0.0927	0.0012
30	timber, hay, corn and agric produce dealing	0.3117	-0.2867	0.1357	0.097	-0.0826	0.268	0.0429	-0.1015	-0.2308	-0.261	0.2309	0.0776	0.1733
31	clothing and dress dealing (drapers, hosiers, haberdashers)	0.5895	-0.1306	0.0205	0.2018	-0.1138	-0.063	-0.3469	-0.0059	0.3241	0.089	0.1049	0.0634	-0.0162
32	food sales (butchers, fishmongers, cheesemongers, milksealers, grocers)	0.7143	-0.2668	0.1127	0.1932	-0.2192	0.0995	-0.1536	-0.0148	-0.1116	0.0169	-0.0602	0.0201	0.0014
33	lodging & drink sales (wine & spirits, hotels, inns, coffee ho)	0.4586	-0.3268	0.069	0.1757	-0.1146	-0.2479	-0.3097	0.0916	-0.2118	0.0346	-0.0185	-0.1922	-0.0337
34	stationary dealing (stationers, publishers, newsgagents)	0.8457	-0.0297	-0.2057	-0.0349	0.0951	-0.1324	0.0219	-0.0558	0.0569	0.0406	0.0689	-0.0492	-0.0557
35	h/h & personal goods dealer (earthenware, glass, jewellers)	0.3737	0.2021	-0.1422	0.0906	0.5496	0.073	-0.2099	0.2883	-0.0937	0.0241	-0.096	0.1873	0.0079
36	ironmongers	0.5948	-0.1958	0.1791	-0.0482	-0.2125	0.1759	-0.3392	0.037	-0.0312	0.0335	0.1248	0.0141	0.0188
37	other retail (general shopkeeper, huckster, hawkker)	0.2629	0.1799	-0.0917	0.3616	-0.0929	-0.1315	-0.0279	-0.0344	-0.1192	0.2583	0.0723	0.0202	0.0408
38	chemists, druggists	0.6865	-0.1203	0.0319	-0.0359	-0.1612	0.0068	-0.3246	0.0895	-0.0315	0.0088	0.2238	-0.0291	0.0043
39	merchants, banks, insurers and brokers	0.7268	0.2004	-0.1738	-0.3612	0.0558	0.0374	0.177	0.0958	-0.0209	-0.079	0.1874	0.0734	-0.0133
40	other commerce (accountants, salesmen, travellers, officers of cos.)	0.7419	0.0512	-0.1435	-0.3663	0.059	0.0906	0.1219	-0.0069	0.078	-0.0993	0.1897	0.0739	-0.0063
41	construction management (builders and contractors)	0.5702	-0.0653	0.1858	-0.198	-0.0636	0.31	0.2172	-0.1016	0.0466	0.1101	-0.298	-0.0073	0.0512
42	professions (barristers, solicitors, scientific pursuits)	0.5718	-0.1556	0.0501	-0.4979	0.025	0.0173	0.0445	-0.0837	0.0165	-0.0131	0.0998	0.0316	0.0338
43	professions (doctors, dentists, artists, performers, education)	0.7091	-0.4037	0.019	-0.3031	0.04	0.0217	-0.0084	-0.0139	0.0049	0.001	-0.0374	0.0263	-0.0153
44	personal services (washing & bathing, hairdressing, chimney sweeps)	0.5777	-0.4436	-0.0265	0.1355	-0.0281	-0.0335	0.0134	-0.0643	-0.0332	0.0901	-0.3113	-0.0291	0.0073
45	Public admin, clergy	0.6696	-0.3402	0.0992	-0.1384	0.0496	-0.1506	0.1836	-0.0275	0.1119	0.0138	-0.0532	0.0888	-0.0134
46	Military	0.1483	-0.0596	0.4313	0.1106	-0.1293	-0.4503	0.1246	0.3071	0.1355	-0.0606	-0.1624	0.177	0.0393
47	Clerks, weighers, telegraph, non-theological students and apprentices	0.8214	-0.1114	-0.0717	-0.3103	0.1033	0.0061	0.1929	-0.0373	0.0368	-0.1083	0.167	0.0642	-0.0185
48	Domestic and service staff, cooks	0.0673	-0.5176	-0.0578	-0.1539	0.1839	-0.3147	0.0534	0.043	-0.056	0.0505	0.0094	-0.1982	-0.0786
49	Labourers & transport staff (including family on farms)	-0.6325	-0.2351	0.0251	0.0821	0.1555	0.1444	0.2429	0.0456	-0.0867	-0.0417	0.0377	-0.0312	-0.0338
50	Persons of property and unoccupied	0.0237	-0.1399	0.024	0.0816	0.01	-0.144	0.0377	0.1114	0.0307	0.0119	0.0176	-0.0638	0.7995

S01D	S01D	factor14	factor15	factor16	factor17	factor18	factor19	factor20	factor21	factor22	factor23	factor24	factor25
1	farming, fishing, market gardeners, horse breeding and keeping	0.0051	0.0141	-0.0217	0.0396	0.0461	0.0727	-0.064	-0.0105	0.0337	-0.0311	-0.0548	-0.121
2	coal mining	0.0445	0.0186	-0.2299	-0.2218	-0.1482	-0.1269	0.0352	-0.2018	-0.2849	0.0105	0.0409	0.0542
3	other mining & quarrying, brickmaking, gravel, salt works	-0.487	0.0662	0.4053	0.2241	-0.0377	-0.0948	0.1066	0.1996	0.0246	0.0043	0.1116	-0.0167
4	construction operatives (masons, bricklayers, thatcher, plumbers etc.)	-0.12	-0.0115	0.0328	0.0131	0.0405	-0.0317	0.0143	-0.1489	-0.0056	-0.0489	0.0024	0.0292
5	machinery mf	0.0678	-0.0679	-0.078	0.0751	0.0253	-0.0226	-0.0866	0.1389	0.0453	0.0332	0.0047	0.0175
6	tool & weapons mf	-0.0739	0.03	0.1428	-0.3051	-0.094	-0.1366	0.1081	0.0737	-0.0576	0.2168	-0.2277	0.0656
7	iron & steel mf, bolts and nails	0.1527	-0.0059	0.1078	0.1988	0.0635	0.0203	0.009	0.2854	-0.0004	0.112	-0.1035	0.0875
8	blacksmiths	0.023	0.0534	-0.0801	0.1076	0.0097	-0.0508	-0.106	0.0403	-0.0201	0.0819	-0.0323	-0.0409
9	other metal mf (copper, tin, brass, whitesmiths, etc.)	0.0027	0.1332	0.1189	0.0447	-0.0807	0.3032	0.117	-0.4081	0.3392	-0.2356	0.1367	-0.11
10	ship, road & rail vehicle mf	-0.0193	-0.0889	-0.1535	0.0318	-0.0592	-0.0188	-0.1007	0.0142	-0.1426	-0.1272	0.1931	-0.1249
11	earthenware & glass mf	0.2131	0.003	-0.0875	0.2819	0.2047	0.0503	-0.018	0.0426	0.0712	-0.0262	0.1643	-0.0202
12	gas, coke and chemical mf	-0.2331	-0.0051	0.071	-0.4735	0.4426	0.0622	-0.2756	0.0712	0.1763	-0.0648	-0.0344	-0.1492
13	leather, fur, hair & bone mf	0.1623	-0.0534	0.1829	-0.0846	0.0413	-0.004	0.0284	-0.1145	-0.066	0.4747	0.3437	-0.2032
14	wood mf (sawyers, coopers, cane workers)	-0.1959	-0.1007	-0.0322	0.0453	-0.0925	0.2849	0.0334	0.0857	-0.0508	-0.0396	-0.1401	0.0124
15	furnishing mf (cabinet makers, french polishers, undertakers)	-0.1353	-0.1607	-0.1702	0.1392	-0.0408	0.3347	-0.0822	0.0242	-0.2141	-0.119	-0.2675	0.1
16	printing & paper mf (paper, cardboard, printers, bookbinders)	-0.0431	-0.0435	-0.0385	0.1806	0.0303	-0.1327	-0.1776	-0.0339	-0.0087	0.0304	0.1621	-0.0132
17	waterproof goods mf (floor & oil cloth, rubber etc.)	-0.1343	0.7137	-0.2117	0.0822	0.2738	0.0735	0.2099	-0.0318	-0.1701	0.0735	-0.1187	-0.0698
18	woollen mf (woollen goods, carpets, blanket, flannel)	0.2232	0.1183	0.0454	-0.1492	-0.0882	0.2043	-0.0197	0.0417	-0.0403	-0.1053	0.0753	0.1651
19	cotton & silk mf (incl ribbon, weaving, dyeing, bleaching etc.)	-0.3101	-0.3241	-0.1277	0.1809	0.1652	-0.1553	0.1031	-0.0677	0.0938	0.1028	-0.1309	-0.0019
20	other textile mf (flax, hemp, rope, jute, lace, tape, thread)	0.0237	0.0804	-0.1508	-0.0557	-0.0361	0.1805	0.0024	0.0521	0.0082	0.1317	0.0612	-0.0685
21	clothing mf (tailors, milliners, hosiery, hats, gloves, umbrellas, buttons, leather)	0.0086	0.1746	-0.0123	0.0678	-0.4463	-0.0506	-0.3954	0.1114	0.2362	0.0281	0.0524	0.1303
22	shoe, boot, clog mf	0.4188	-0.258	0.2657	-0.1247	0.2511	-0.0027	0.1641	-0.0198	-0.0937	-0.1657	-0.1006	0.1193
23	agric produce mf (millers, refiners, bakers, confectioners)	-0.0071	0.187	-0.026	-0.0047	0.1158	-0.1999	0.0115	-0.1822	0.1518	0.05	0.0256	0.5027
24	drink & tobacco mf (malsters, brewers, distillers, tobacco & pipes)	0.0517	0.0468	-0.1695	-0.204	-0.1768	-0.1103	0.4438	0.3479	0.3675	-0.1046	0.0096	-0.1527
25	watch & instrument mf	-0.193	-0.0439	-0.1888	-0.2337	-0.0433	-0.1771	0.0465	0.1101	-0.1867	-0.3059	0.3049	0.0763
26	general mf (manufacturers, mechanic, artisan, machinist)	0.0262	0.0745	0.0668	-0.0618	-0.0581	0.0473	0.0859	-0.0153	-0.0308	0.0616	-0.0047	0.1259
27	ocean, inland and dock transport	-0.0096	0.0978	0.1869	-0.0307	0.0039	0.0293	0.0186	-0.041	0.0141	-0.0378	0.0027	0.122
28	road & rail transport	-0.0592	0.0498	0.1708	0.0918	-0.0203	-0.0934	0.1185	-0.0086	-0.0656	0.0033	0.0709	0.0929
29	coal dealing	-0.0493	0.0375	0.3518	0.1093	0.1259	0.0753	-0.0009	0.0634	-0.1354	-0.204	0.106	-0.0408
30	timber, hay, corn and agric produce dealing	-0.0492	0.0033	0.111	-0.0122	-0.2836	0.132	0.1324	-0.0703	-0.2807	0.1095	0.0048	-0.0839
31	clothing and dress dealing (drapers, hosiers, haberdashers)	-0.011	-0.0028	-0.1319	-0.0018	0.0286	0.0471	-0.055	-0.034	0.132	-0.0069	-0.0117	0.0346
32	food sales (butchers, fishmongers, cheesemongers, milksellers, grocers)	-0.0434	0.0294	0.0215	-0.0065	0.0156	-0.142	0.0192	-0.1018	-0.0149	0.0084	-0.0175	-0.0058
33	lodging & drink sales (wine & spirits, hotels, inns, coffee ho)	0.0231	0.0641	-0.0126	-0.0699	0.1343	0.053	-0.0932	0.1184	0.0247	0.1316	-0.0164	0.1327
34	stationary dealing (stationers, publishers, newsagents)	0.0119	0.0098	-0.0688	0.0534	0.0423	-0.0531	-0.1146	0.0123	-0.0021	-0.0022	0.0506	0.0592
35	h/h & personal goods dealer (earthenware, glass, jewellers)	0.0466	0.0212	0.0251	0.0824	0.0397	0.0453	-0.0738	-0.0829	0.1493	0.0782	-0.0807	-0.0005
36	ironmongers	-0.0426	-0.0561	-0.0896	0.0115	0.0435	0.0096	-0.0126	-0.1361	0.0233	0.1172	0.0281	-0.1375
37	other retail (general shopkeeper, huckster, hawker)	0.2183	0.2311	0.1517	0.0557	-0.0698	-0.3739	-0.2342	0.0098	-0.1056	-0.1859	-0.2877	-0.3063
38	chemists, druggists	0.002	-0.0127	-0.1626	-0.0547	0.1407	0.0482	-0.1274	0.0464	-0.0043	0.0864	0.0334	-0.0171
39	merchants, banks, insurers and brokers	0.0812	0.0486	0.073	0.0538	-0.0074	0.001	0.0113	-0.0156	0.0324	-0.0156	-0.0739	-0.004
40	other commerce (accountants, salesmen, travellers, officers of cos.)	0.0795	0.0501	0.0199	0.0601	-0.0142	-0.0133	0.0088	-0.0455	0.0253	-0.0877	-0.0719	-0.0492
41	construction management (builders and contractors)	0.0325	-0.0849	-0.0201	-0.0031	-0.0028	-0.0626	0.0334	0.0517	0.082	0.0882	-0.0631	0.0833
42	professions (barristers, solicitors, scientific pursuits)	0.0371	-0.026	0.019	-0.0021	-0.0593	-0.0133	0.005	0.0799	-0.0569	0.033	-0.0363	-0.0268
43	professions (doctors, dentists, artists, performers, education)	0.0655	0.0021	-0.026	-0.0078	-0.0209	0.015	0.0065	0.0074	-0.0028	-0.0358	-0.0254	0.0113
44	personal services (washing & bathing, hairdressing, chimney sweeps)	-0.0261	0.0477	0.0755	0.0012	-0.01	-0.0551	0.0361	-0.0765	-0.0054	-0.0499	-0.0342	0.0642
45	Public admin, clergy	-0.0313	-0.0439	0.0161	-0.019	-0.0798	-0.0146	0.0289	-0.0225	0.0841	0.0213	-0.029	-0.0594
46	Military	0.0355	-0.1113	-0.0193	-0.0005	-0.1256	0.0744	0.124	-0.1403	0.1184	0.135	-0.1973	-0.0576
47	Clerks, weighers, telegraph, non-theological students and apprentices	0.0622	0.0373	0.007	0.0043	-0.0117	-0.0244	0.0223	0.3173	-0.0477	-0.0698	-0.0242	0.0082
48	Domestic and service staff, cooks	0.0806	0.1193	0.0747	-0.0708	0.0188	0.3005	-0.0682	0.3173	-0.0477	0.0961	0.1235	0.0381
49	Labourers & transport staff (including family on farms)	0.0977	0.0491	-0.0088	-0.0185	-0.0186	-0.0207	-0.0212	-0.0075	0.0265	-0.0217	-0.0323	-0.1216
50	Persons of property and unoccupied	0.1867	-0.03	-0.2252	0.2846	0.1379	-0.0985	0.2293	0.1275	-0.0193	-0.041	0.111	-0.0159

**Table 4** 25-Factor loadings for each of the 50 aggregated occupational variables.

Table 4 brings out the spatial concentrations in a few RSDs of tools and household goods (Factor 5), agricultural labourers, but at a low level (Factor 7), shoe manufacture (Factor 9), woollen manufacture (Factor 10), earthenware & glass (Factor 12), waterproof goods (Factor 15), other mining and coal dealing (Factor 16), persons of property (Factor 17), gas, coke and chemicals (Factor 18), drink & tobacco (Factor 20), domestics (Factor 21), clothing manufacture (Factor 22), and leather, fur etc. (Factor 23).

Overall, although the variance explained by this extended 25-factor analysis is much greater, the structure of factors is less interpretable. Indeed the automatic cut-off of the statistical estimates in the factor analysis for the economically active is 13 factors. The added insight from the 25-factors over the 12-factors is the dominance of large commercial and manufacturing-dealing locations, and the possible significance of spatial concentrations in less frequent occupational categories (notably shoe manufacture, woollens, waterproof goods) as well as the common finding of earthenware and glass as the 12th factor. The 25-factor study also brings out some of the sectors

with high concentrations of non-entrepreneurs (especially agricultural labourers, domestics) as well as the ambiguous category of persons of property. The overall conclusion is that the 25 factor study is less useful for interpreting because it combines too many occupational groups in complex ways. The rest of the analysis here therefore uses the 12-factor results.

#### 4. Comparisons of RSDs using mapping

The rest of the analysis here uses the 12-factor results which are summarised in Table 5.

Factor	Description and occupation variables	Factor	Description and occupation variables
1	<b>Commerce &amp; professions</b> Merchants etc. Other commerce Construction management Professions (law etc.) Professions (doctors etc.) Stationary dealing Public admin, clergy Clerks etc.	7	<b>Textiles manufacture</b> Woollen mf Cotton & silk mf Other textile mf
2	<b>Mining &amp; heavy metals</b> Coal mining Machinery mf Iron & steel mf Other metal mf Gas and chemical mf General mf	8	<b>Tools, instruments &amp; Hhd goods</b> Tool & weapons mf Watch & instrument mf Hhd goods dealer
3	<b>Retail and lodging</b> Clothing & dress dealing Food sales Lodging & drink sales Ironmongers Chemists, druggists	9	<b>Rural trades</b> Blacksmiths Agricultural produce mf Labourers & transport staff <i>Possible: Farming, etc.</i>
4	<b>Small mf &amp; transport</b> Leather mf Wood mf Furnishing mf Printing & paper mf Drink & tobacco mf Road & rail transport Other retail	10	<b>Apparel and textile maker dealers</b> Clothing manufacture Shoe, boot, clog manufacture Waterproof goods manufacture
5	<b>Building and washing</b> Construction operatives Personal services	11	<b>Dealers-carriers</b> Coal dealing Agric. produce & timber dealing
6	<b>Transport &amp; military</b> Ship, road & rail vehicle mf Ocean & dock transport Military	12	<b>Earthenware &amp; glass mf</b>
<b>Large Negative</b>	Farming; other mining; labourers		
<b>Total</b>	31 (plus 3 negative)		

**Table 5:** Summary of the Factors for the 12-factor analysis, with the loadings that are the highest for that occupation category.



In all the following maps the scales are chosen to indicate the four quartiles for positive loadings (red to yellow), and the 50% point for negative loadings, those above 50%, and additionally all those with the largest negatives of less than -0.5 shown separately (shades of blue).

The spatial distribution of Factor 1 (commerce and professions) shown in Figure 1 is heavily focused in the main urban centres, and those areas like Carlisle or Ulverston that are distant from other main centres. This Factor also brings out the role of some major commercial centres which are also resorts (e.g. Brighton and Southport).

Factor 2 (heavy manufacturing and coal), Figure 2, very closely mirrors the coalfields and related industries concentrated in these for heavy manufacturing, metals manufacture and chemicals. Rural areas in general heavily load negatively on this factor.

Factor 3 (retail and lodging). Figure 3, identifies the areas where their main focus is retail for personal and household needs and lodging, but where there is little commercial or professional development. The spatial distribution covers many small towns and centres in otherwise rural areas, as well as the smaller resorts not captured in Factor 1.

Factor 4 (wood, leather, furnishing and printing manufacture), Figure 4, is a relatively diversified set of occupations which are in fringe urban areas and locations with a local timber industry (such as Herefordshire and Westmorland), or with a high degree of local specialisation wood, timber and printing: such as parts of London, Buckinghamshire and Suffolk.

Factor 5 (building and personal service industries), Figure 5, combines construction operatives and management with personal services (washing & bathing, hairdressing, chimney sweeps). It has a surprisingly strong orientation to the south rather than the north of the country, which may be indicative of the stage of urban development in 1891 and the high level of suburban development associated with rail expansion into wider commuter zones.

Factor 6 (transport, transport manufacture and military mainly naval personnel), Figure 6, is heavily concentrated on ports around most coasts, and in major transport hubs, which are also the main location for related manufactures (such as Crewe, Swindon, Doncaster, and the W. Midlands – especially Coventry). However, there are some concretions that seem difficult to

interpret, such as in Bedfordshire and Buckinghamshire suggesting this factor is picking up a variety of loadings at the margins.

Factor 7 (textiles manufacture), Figure 7, is a highly concentrated grouping in Lancashire and Yorkshire, but with other smaller concentrations in Bedford, Bucks., Wiltshire/Somerset, Devon, Suffolk, rural Wales and scattered rural centres elsewhere.

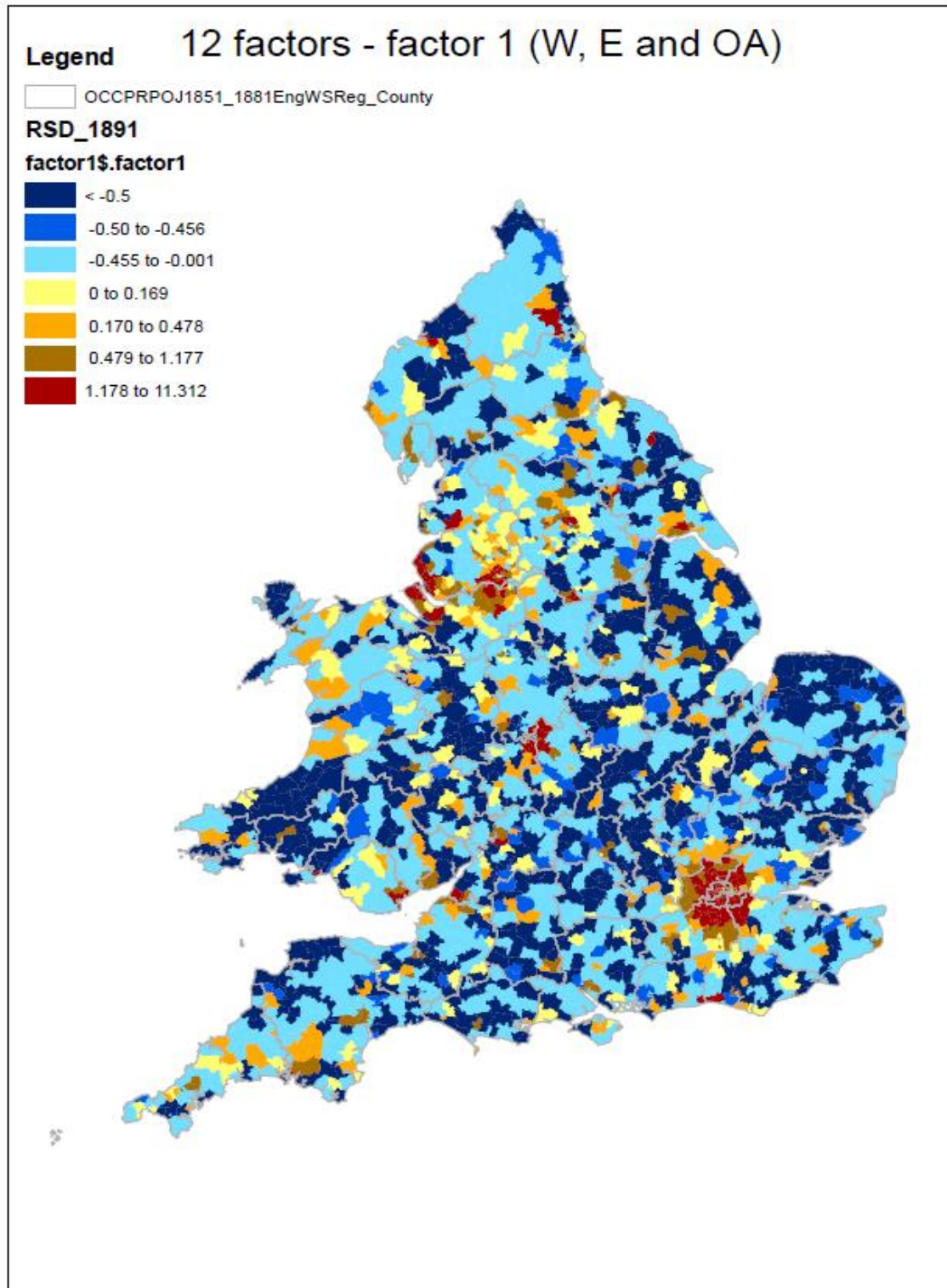
Factor 8 (tools, instruments and household goods dealers), Figure 8, is a heterogeneous group but with strong concentrations in the W. Midlands Black Country, Sheffield. S. Wales and a few smaller centres and a few parts of London. It seems to be picking out the highly skilled craft metal manufactures with a low level of mechanisation.

Factor 9 (rural trades), Figure 9, combines three groups that are ubiquitous in rural areas but not generally in the south of the country, where they are replaced mainly by Factor 5 for building. Factors 5 and 9 are thus somewhat complimentary. The low loading on farming (the only factor where farming appears) is also indicative of its lack of spatial focus in specific areas.

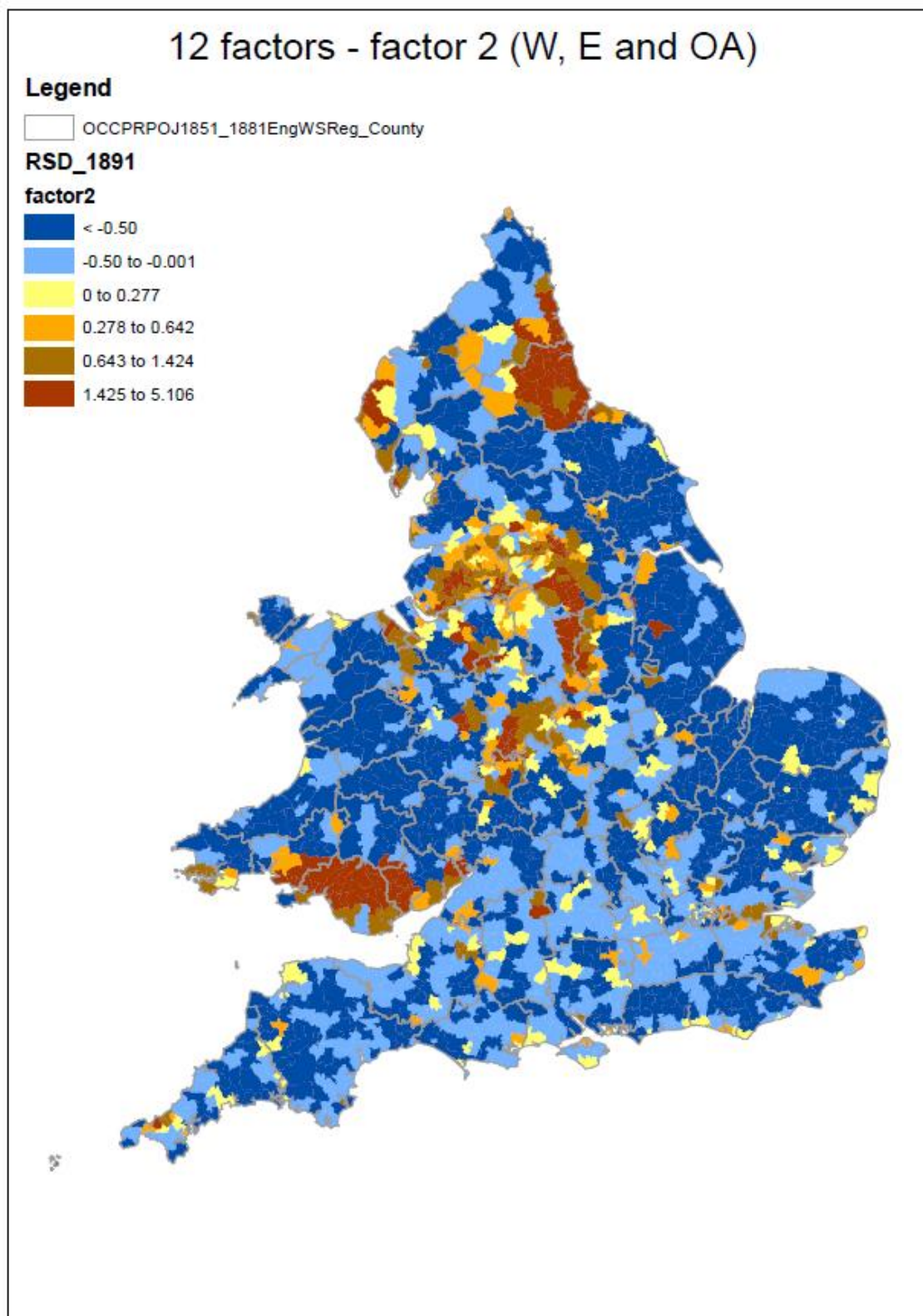
Factor 10 (apparel and textile maker dealers), Figure 10, shows remarkable concentration in the areas with high levels of concentration in clothing manufacture: hats in Bedford and Hertford; hosiery in Leicester, Nottingham and Northants; shoes in Nottingham and Kendal; and gloves in Somerset, Wilts and Dorset. Many of these sectors had a high level of outworkers, and in many ways this Factor brings out areas of outworking very clearly.

Factor 11 (dealers in coal and agricultural produce, timber, hay & corn), Figure 11, brings out the concentration of these sectors in centres with railway stations and/or canal and ports. However, the very large concentrations in Lancashire and Teesside suggest that this factor is also picking up some fringe urban elements.

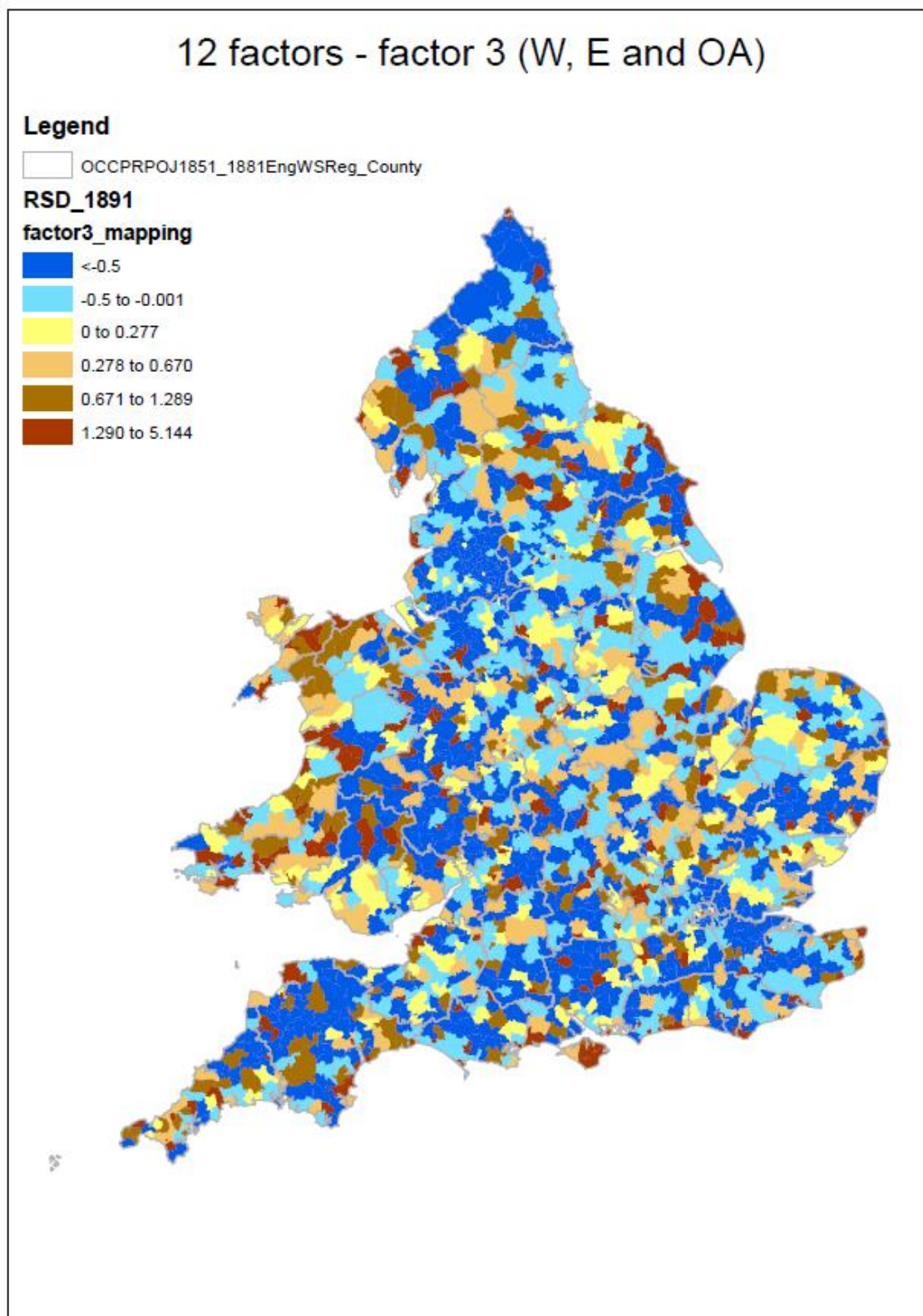
Factor 12 (earthenware, pottery, bricks, tiles, and glass manufacture), Figure 12, has only one occupational group loading. It shows the expected concentration in Staffordshire, but is also much more widespread. It appears to be linked to coal areas, S. Wales, Lancs., Cheshire, and Durham; and to major cement production facilities in places like N. Kent and Warwickshire or stone quarrying as in W. Yorkshire and parts of the South West.



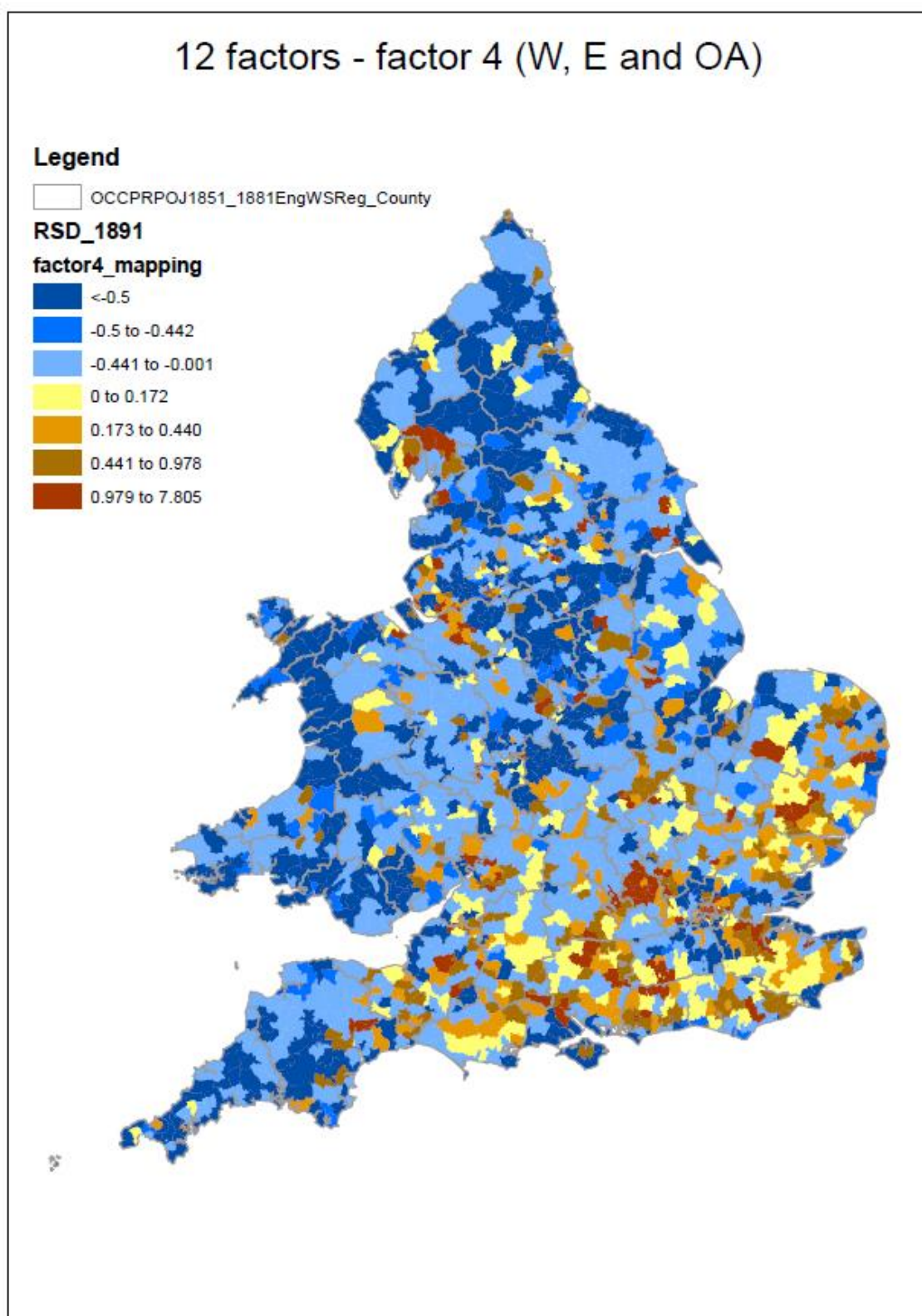
**Figure 1.** Spatial distribution of Factor 1.



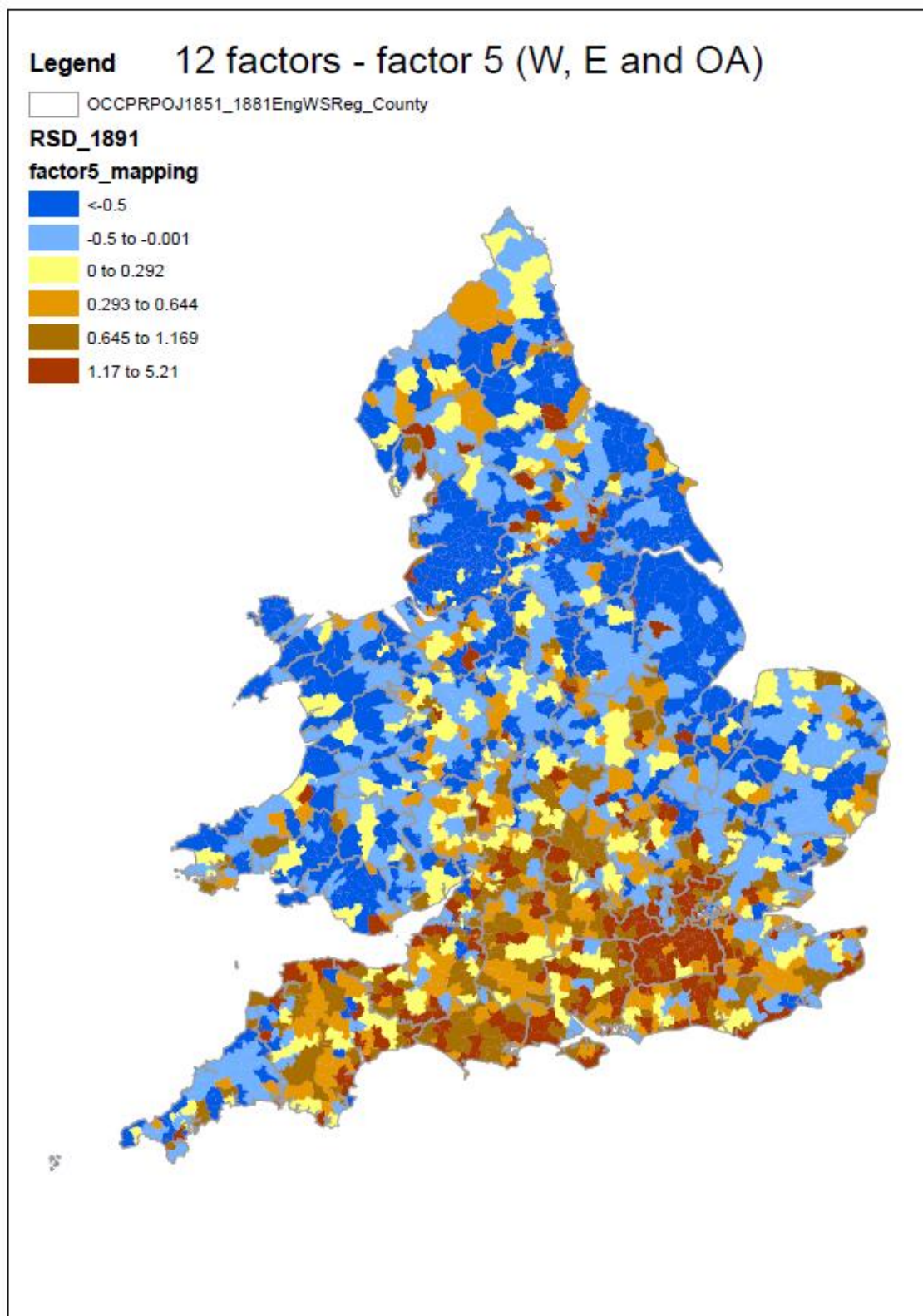
**Figure 2.** Spatial distribution of Factor 2.



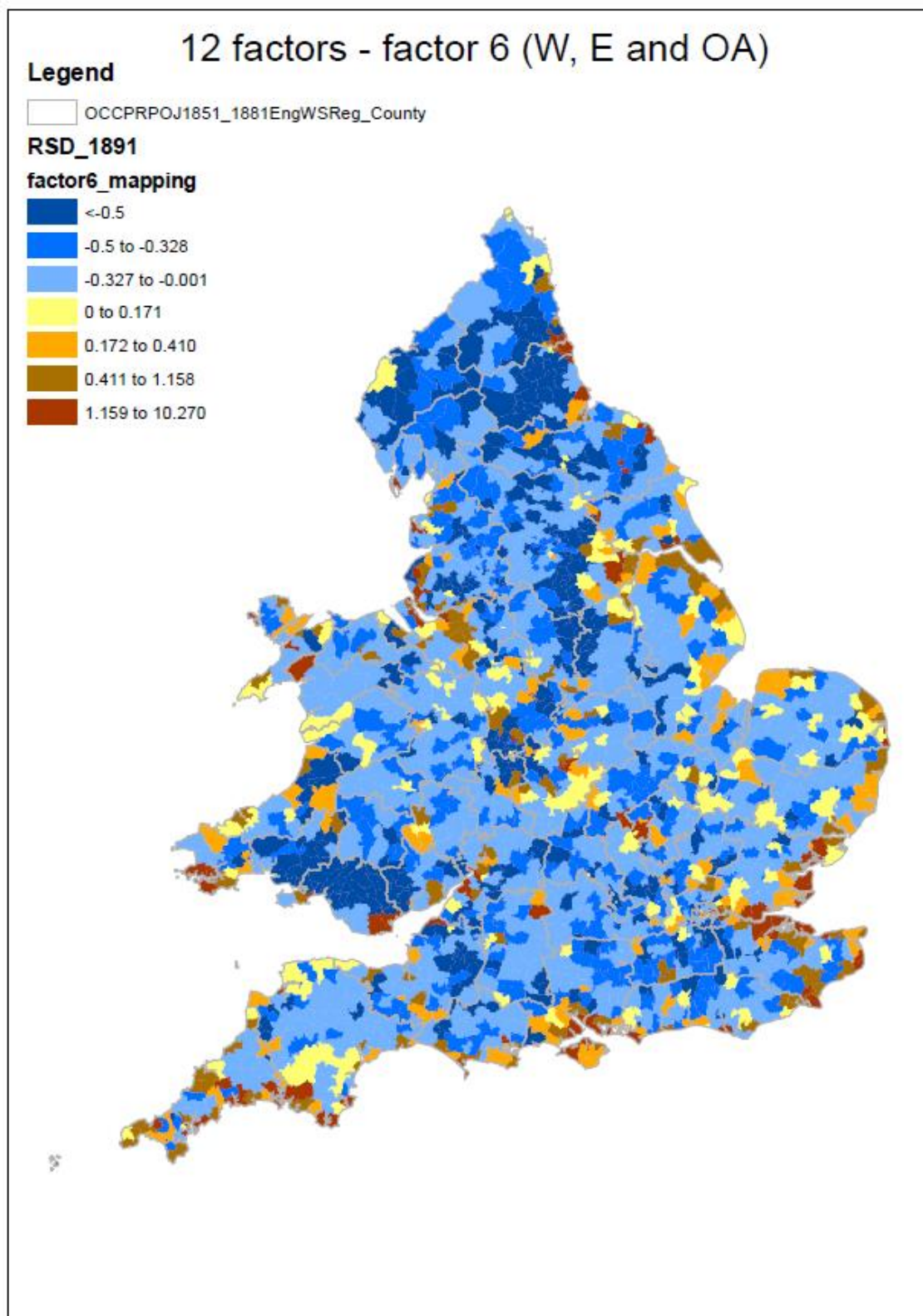
**Figure 3.** Spatial distribution of Factor 3.



**Figure 4.** Spatial distribution of Factor 4.

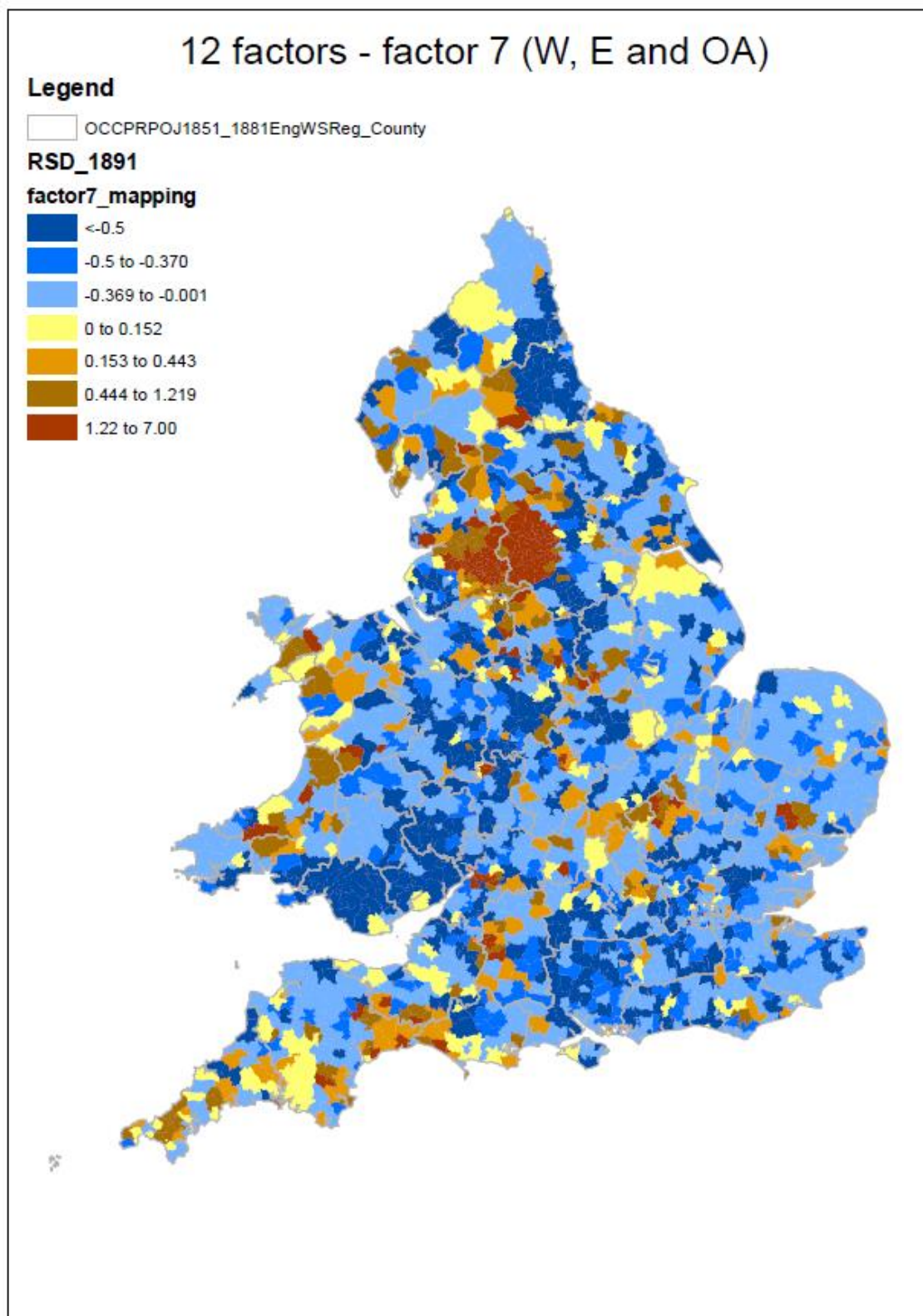


**Figure 5.** Spatial distribution of Factor 5.

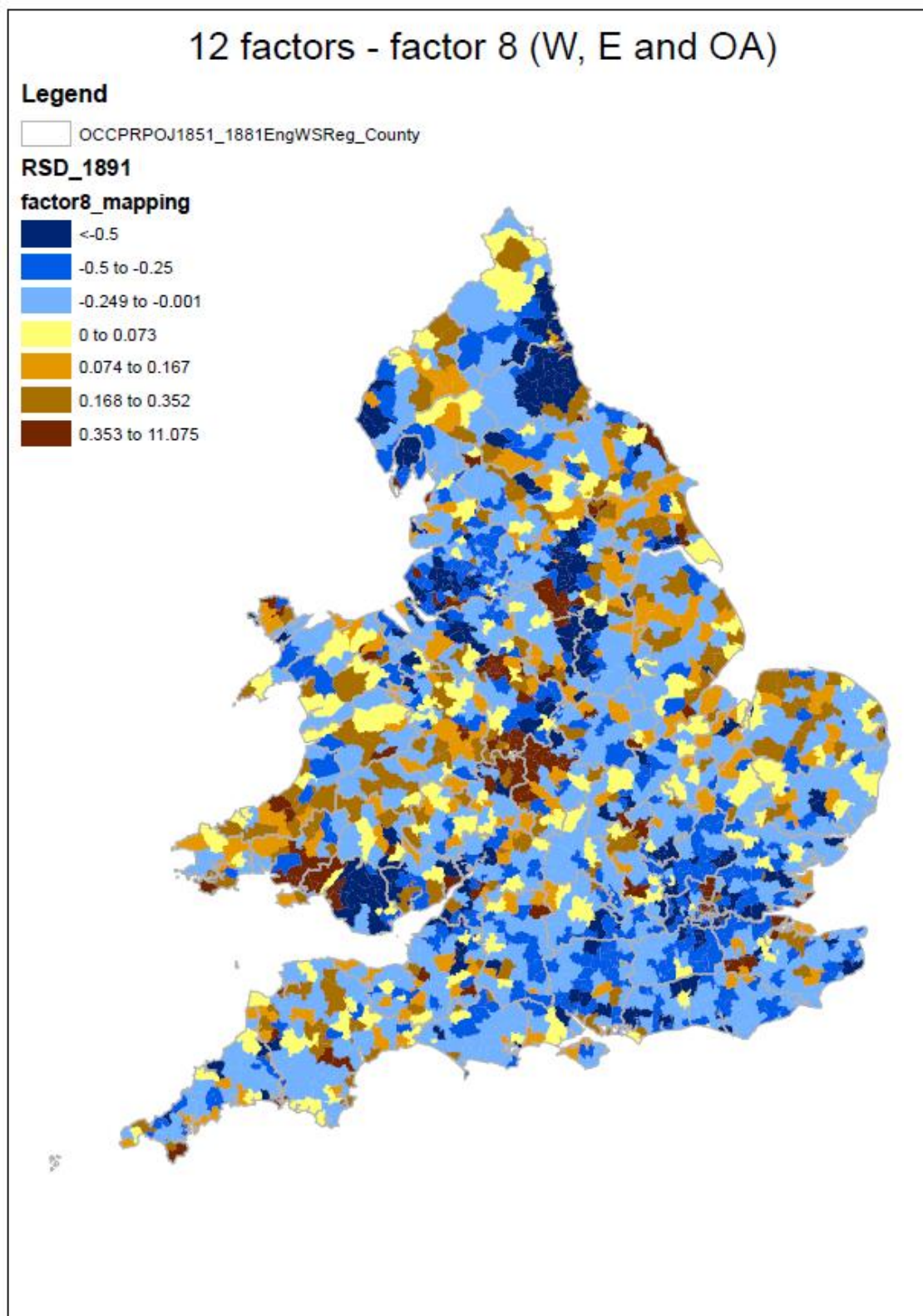


**Figure 6.** Spatial distribution of Factor 6.

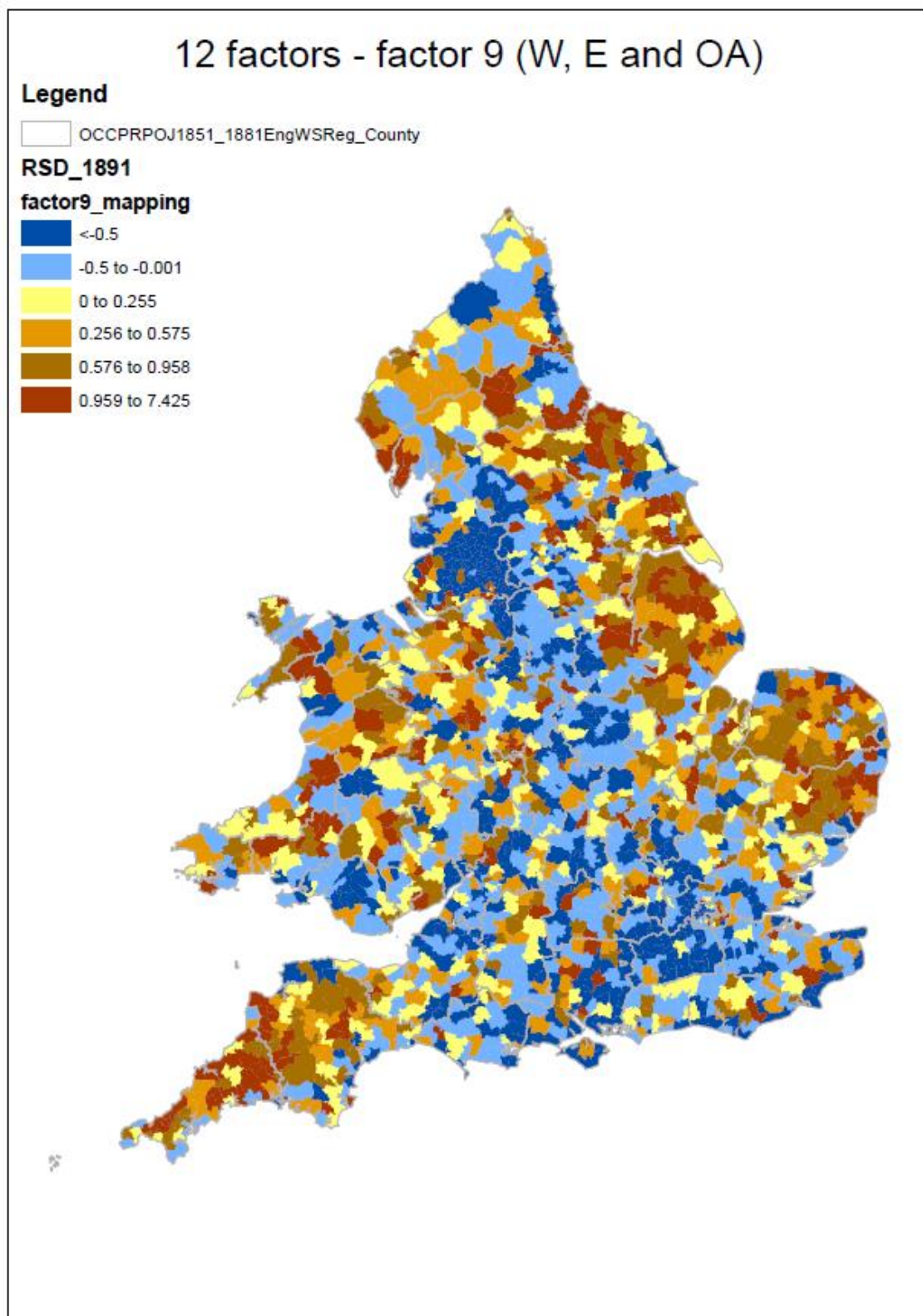




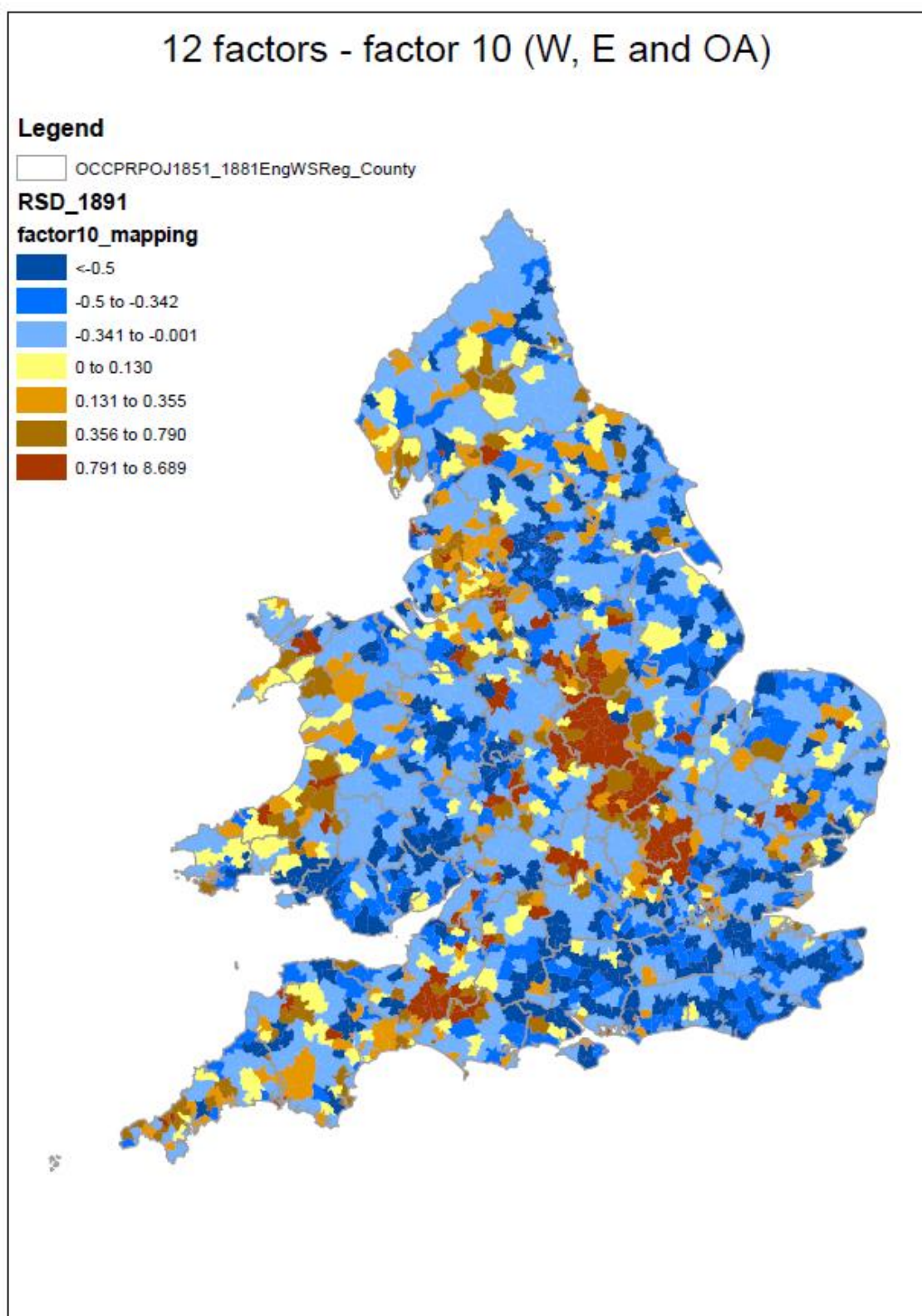
**Figure 7.** Spatial distribution of Factor 7.



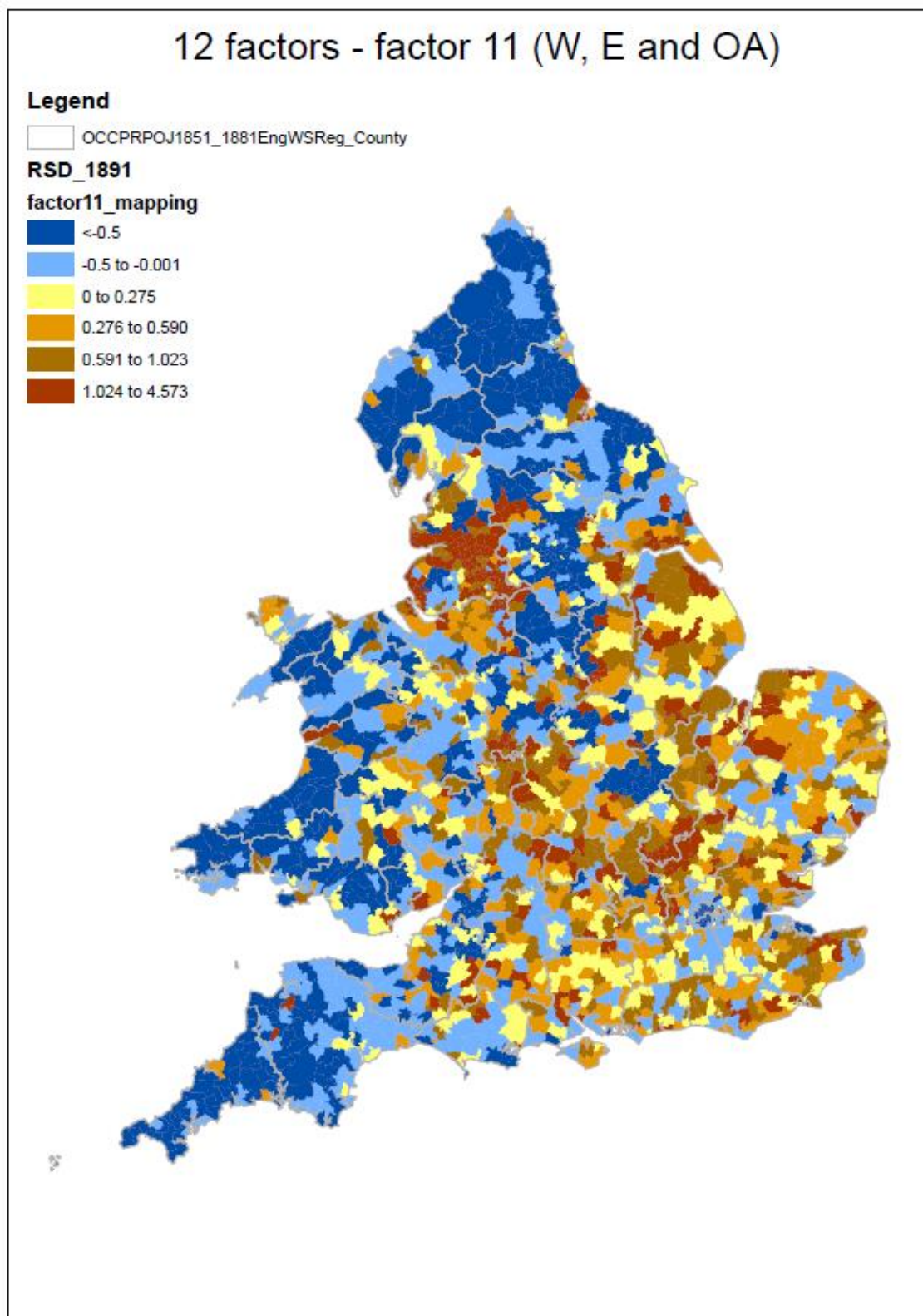
**Figure 8.** Spatial distribution of Factor 8.



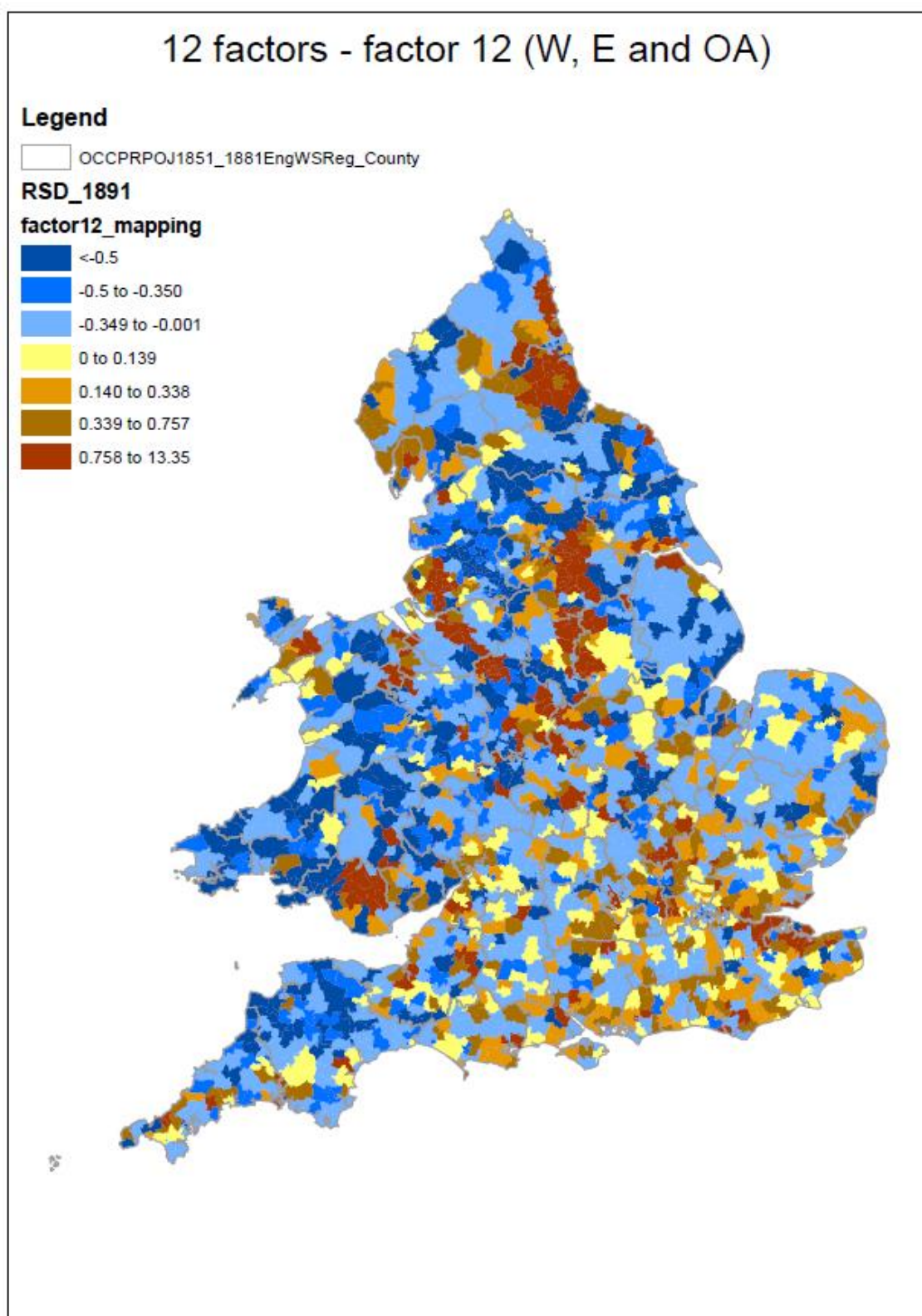
**Figure 9.** Spatial distribution of Factor 9.



**Figure 10.** Spatial distribution of Factor 10.



**Figure 11.** Spatial distribution of Factor 11.



**Figure 12.** Spatial distribution of Factor 12.

## 5. Females all occupied

It is important to assess if there are gender differences among the occupations of the economically active. This section examines female occupations. Taking a comparable 12-factor study, Table 6 shows that the first 3-5 Factors are dominant, with Factor 1 well ahead in loading, and Factors 2 and 3 almost identical, after which potential breaks after Factors 5 and 7.

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Factor	Variance	Difference	Proportion	Cumulative
Factor 1	2.51953	0.33217	0.0681	0.0681
Factor 2	2.18737	0.00156	0.0591	0.1272
Factor 3	2.18581	0.32835	0.0591	0.1863
Factor 4	1.85746	0.02057	0.0502	0.2365
Factor 5	1.83689	0.30667	0.0496	0.2861
Factor 6	1.53023	0.02144	0.0414	0.3275
Factor 7	1.50878	0.18422	0.0408	0.3683
Factor 8	1.32456	0.00947	0.0358	0.4041
Factor 9	1.31509	0.09568	0.0355	0.4396
Factor 10	1.21941	0.04060	0.0330	0.4726
Factor 11	1.17880	0.05473	0.0319	0.5044
Factor 12	1.12407	0.04399	0.0304	0.5348
Factor 13	1.08008		0.0292	0.5640

---

**Table 6:** Factor analysis for female economically active: 13 factors

Number of obs = 2,110

Method: principal-component factors      Retained factors = 13

Rotation: orthogonal varimax (Kaiser off)      Number of params = 403

LR test: independent vs. saturated:  $\chi^2(666) = 2.0e+04$       Prob >  $\chi^2 = 0.0000$

The factor loadings are shown in Table 7.

50ID	50ID	factor1	factor2	factor3	factor4	factor5	factor6	factor7	factor8	factor9	factor10	factor11	factor12	factor13
1	farming, fishing, market gardeners, horse breeding and keepir	-0.1272	-0.6431	-0.0325	0.1243	0.1752	-0.1377	-0.2291	-0.0949	-0.0552	-0.0545	-0.101	-0.0737	-0.1224
2	coal mining	0.0845	0.0068	-0.1495	0.1824	-0.4206	-0.2014	-0.2342	0.1485	-0.0692	-0.1763	0.1416	0.062	0.0718
5	machinery mf	0.4747	0.1408	0.0176	0.0767	-0.016	0.5503	0.0303	0.0063	0.2746	0.0415	-0.0077	0.2428	-0.0143
6	tool & weapons mf	-0.0277	-0.0392	0.787	-0.0275	-0.0274	-0.0031	-0.0301	-0.1322	-0.0113	-0.0625	-0.0146	-0.0371	-0.0087
7	iron & steel mf, bolts and nails	-0.0256	0.0273	0.087	0.0024	-0.0063	-0.0137	-0.0078	-0.0294	0.0334	0.0068	-0.0349	0.0317	0.8528
9	other metal mf (copper, tin, brass, whitesmiths, etc.)	-0.0738	-0.0442	0.1953	0.0203	0.0364	0.048	-0.0069	-0.0224	0.0287	-0.052	0.6451	0.0753	0.0992
10	ship, road & rail vehicle mf	0.0494	0.0173	0.0505	0.0352	0.0153	0.049	0.0012	-0.0072	-0.0177	-0.0293	0.0256	0.8222	0.0604
11	earthenware & glass mf	-0.0445	-0.0021	0.1059	-0.0096	0.0023	0.0044	0.0128	0.9283	0.0099	-0.0032	-0.0128	-0.0062	-0.0085
12	gas, coke and chemical mf	0.0231	0.0246	-0.0256	0.0453	0.0328	0.0639	0.0775	0.0131	0.7353	-0.0536	0.074	0.0196	0.0653
13	leather, fur, hair & bone mf	0.3762	0.0126	0.0445	-0.0126	-0.0741	0.0472	-0.0308	-0.0383	-0.0493	-0.1734	-0.024	0.3573	-0.0993
14	wood mf (sawyers, coopers, cane workers)	0.7196	0.03	0.1623	-0.0298	0.0023	0.1597	-0.0387	0.0005	0.2122	-0.0077	-0.0124	0.0286	-0.0846
15	furnishing mf (cabinet makers, french polishers, undertakers)	0.4265	0.3247	0.5012	0.1198	0.0391	0.0543	0.0231	-0.0793	-0.0068	0.149	0.0621	-0.027	0.0806
16	printing & paper mf (paper, cardboard, printers, bookbinders)	0.6758	0.0671	0.1076	-0.0624	-0.0535	-0.0503	0.0272	-0.0165	-0.0328	-0.0389	0.032	-0.0207	-0.0275
17	waterproof goods mf (floor & oil cloth, rubber etc.)	0.1551	-0.0062	-0.0192	0.064	-0.0534	-0.0421	-0.0634	0.007	0.7303	0.0525	-0.0309	-0.0382	-0.0124
18	woollen mf (woollen goods, carpets, blanket, flannel)	-0.0727	-0.0383	-0.025	-0.1462	-0.1311	-0.0193	0.7271	0.0155	0.0233	-0.0801	-0.0221	-0.0429	-0.0187
19	cotton & silk mf (incl ribbon, weaving, dyeing, bleaching etc.)	-0.0379	-0.0207	-0.0263	-0.2033	-0.8282	-0.0391	0.0399	-0.0435	-0.0034	0.0217	-0.0146	-0.0446	0.0031
20	other textile mf (flax, hemp, rope, jute, lace, tape, thread)	-0.0575	0.0722	0.0228	-0.1146	-0.2698	0.0608	0.4763	-0.0753	0.1417	0.0371	-0.0635	0.0735	-0.1446
21	clothing mf (tailors, milliners, hosiery, hats, gloves, umbrellas,	-0.1468	-0.07	0.04	-0.0755	-0.1515	0.5503	-0.0504	-0.0404	0.0198	0.1376	-0.135	0.0916	-0.041
22	shoe, boot, clog mf	0.0944	0.0063	-0.0592	0.0085	0.0736	0.686	-0.0213	0.0332	-0.0911	0.0788	0.0831	-0.0818	0.0059
24	drink & tobacco mf (maltsters, brewers, distillers, tobacco &	0.4529	0.0856	0.0516	0.1312	0.0274	0.1184	0.153	-0.0166	0.0062	0.267	0.1619	-0.0213	-0.0146
25	watch & instrument mf	0.0673	0.095	0.0316	0.0485	-0.0366	-0.0291	-0.0064	-0.0118	0.0218	0.0169	0.7206	-0.0261	-0.1326
26	general mf (manufacturers, mechanic, artisan, machinist)	-0.0594	0.0428	0.0468	-0.0847	0.2338	-0.2159	-0.0734	-0.0328	0.1217	0.3544	-0.0574	0.3833	-0.2353
27	ocean, inland and dock transport	0.5552	0.0198	0.081	0.0594	0.0269	-0.0735	0.0439	0.0823	-0.0064	0.1231	-0.0678	0.0993	0.2276
31	clothing and dress dealing (drapers, hosiers, haberdashers)	0.0371	0.2152	-0.0371	0.7089	0.2454	0.1619	-0.0829	-0.0223	0.0831	-0.0224	-0.0076	0.031	0.0318
32	food sales (butchers, fishmongers, cheesemongers, milkseller	-0.0348	-0.0968	0.0223	0.7634	0.0714	-0.1533	-0.0644	0.0125	0.0301	0.0801	0.0727	0.0045	0.0161
33	lodging & drink sales (wine & spirits, hotels, inns, coffee ho)	-0.1203	0.1379	-0.0211	0.3734	0.1152	-0.1764	-0.1017	-0.0567	-0.1208	0.4011	0.0649	-0.0665	-0.1625
34	stationary dealing (stationers, publishers, newsagents)	0.3187	0.5127	0.0949	0.2772	0.0267	-0.0405	-0.0172	-0.0375	0.0437	0.2143	0.0306	-0.0853	-0.1002
35	h/h & personal goods dealer (earthenware, glass, jewellers)	0.2984	0.0773	0.6643	0.0184	0.0218	0.0159	-0.032	0.5245	0.0014	0.0215	-0.005	-0.027	-0.0733
37	other retail (general shopkeeper, huckster, hawkker)	0.2589	-0.0671	-0.0431	0.13	0.1801	-0.1161	0.5574	0.0435	-0.1393	0.1295	0.0962	0.0053	0.1409
39	merchants, banks, insurers and brokers	0.0729	0.0144	0.7982	0.02	-0.0091	-0.0278	0.0402	0.2359	-0.0204	0.0403	0.1375	0.1334	0.1515
40	other commerce (accountants, salesmen, travellers, officers c	0.1266	0.1752	0.0158	0.1391	-0.0615	0.0122	-0.0656	0.007	-0.0206	0.5879	-0.1266	-0.0466	0.0496
43	professions (doctors, dentists, artists, performers, education)	-0.209	0.4858	-0.0886	0.1729	0.4072	-0.1953	-0.2259	-0.0402	-0.0364	-0.2238	-0.0882	0.0037	-0.0154
44	personal services (washing & bathing, hairdressing, chimney	0.0413	0.5134	-0.0656	0.0975	0.4054	-0.1088	-0.1033	-0.1393	-0.0747	-0.1736	-0.1246	0.0114	-0.1207
45	Public admin, clergy	-0.1099	0.0979	-0.0157	0.1937	0.2089	-0.194	-0.1483	-0.0653	-0.0594	-0.4261	-0.2015	0.0501	-0.1546
47	Clerks, weighers, telegraph, non-theological students and app	0.0718	0.5896	0.1663	0.1229	0.1293	-0.0486	-0.1285	-0.0638	0.0373	0.0874	-0.0154	-0.0763	-0.0443
48	Domestic and service staff, cooks	-0.1278	-0.1156	-0.1996	-0.4821	0.4866	-0.2743	-0.3926	-0.0098	-0.075	0.0997	0.0745	-0.0638	0.0673
49	Labourers & transport staff (including family on farms)	-0.016	-0.5982	-0.0062	0.0064	0.0885	-0.1251	0.0303	-0.1357	0.0091	-0.1158	-0.1016	-0.1098	-0.0928

**Table 7:** 12-Factor loadings for each of the aggregated *female* occupational.

No factor has any significant loading on coal mining. Only 37 of the 50 occupational groups are of significance and loaded in the analysis. This includes all the rural-related such as agricultural produce, and farming enters only as strongly negative (on Factor 2). The loadings can be summarised as follows:

**1: Factor 1 (Leather & wood mf., printing drink & tobacco & trabsport)** Captures the main female sectors of cane, fur, hair and tobacco pipe workers; transport loading may result from lockkeepers etc.

Leather, fur, hair & bone mf

Wood mf (sawyers, coopers, cane workers)

Printing & paper mf (paper, cardboard, printers, bookbinders)

Drink & tobacco mf (maltsters, brewers, distillers, tobacco & pipes)

Ocean, inland and dock transport

**2: Factor 2 (Stationers, professions, washing, performers & clerks)** Probably stationers relate with post mistresses

Stationary dealing (stationers, publishers, newsagents)

Professions (doctors, dentists, artists, performers, education): mainly teachers

Personal services (washing & bathing, hairdressing, chimney sweeps)



Clerks, weighers, telegraph, non-theological students and apprentices

High *negative* loading for:

Farming, fishing, market gardeners, horse breeding and keeping (-0.64)

**3: Factor 3 (Tools & furniture mf., household goods dealers merchants)** Merchants etc. may be spurious

Tool & weapons mf

Furnishing mf (cabinet makers, french polishers, undertakers)

H/h & personal goods dealer (earthenware, glass, jewellers)

Merchants, banks, insurers and brokers

**4: Factor 4 (Clothing and food dealing)** An expected female sector concentration, but quite distinct from the domestic servants showing a clear distinction of locational differences in residential concentration

Clothing and dress dealing (drapers, hosiers, haberdashers)

Food sales (butchers, fishmongers, cheesemongers, milk sellers, grocers)

High *negative* loading on:

Domestic and service staff, cooks (-0.48)

**5: Factor 5 (Domestic service & clerical)** Another expected female sector concentration, notably distinct from clothing and retail (Factor 4), but also distinct from cotton and silk mf which has no high positive loadings

Public admin, clergy

Domestic and service staff, cooks

High *negative* loading on:

Cotton & silk mf (incl ribbon, weaving, dyeing, bleaching etc.) (-0.83)

**6: Factor 6 (Clothing and shoe mf.)** Also an expected female sector concentration

Clothing mf (tailors, milliners, hosiery, hats, gloves, umbrellas, buttons, leather)

Shoe, boot, clog mf

**7: Factor 7 (Wool, other textiles, small retail)**

Woollen mf (woollen goods, carpets, blanket, flannel)

Other textile mf (flax, hemp, rope, jute, lace, tape, thread)

Other retail (general shopkeeper, huckster, hawker)

This marks the point where the factors become difficult to interpret and may be spurious, except for Factors 10, 11 and 13.

**[Factor 8]** No highest loaded for any occupation; two most highly loaded are same as Factor 3. This factor removed and reallocated.

H/h & personal goods dealer (earthenware, glass, jewellers) (0.52)

Merchants, banks, insurers and brokers (0.24)

**8: Factor 9 (Gas, chemical, explosives & waterproof goods)**

Gas, coke and chemical mf

Waterproof goods mf (floor & oil cloth, rubber etc.)

**9: Factor 10 (lodging & drink sales, other commerce)** An expected female sector concentration for lodgings, but not for other commerce

Lodging & drink sales (wine & spirits, hotels, inns, coffee ho.)

Other commerce (accountants, salesmen, travellers, officers of cos.)

**10: Factor 11 (Tin plate and watch mf.)** Similar to Factor 3, but focusing on other small metal manufactures

Other metal mf (copper, tin, brass, whitesmiths, etc.)

Watch & instrument mf

**11: Factor 12 (Transport and general mf.)**

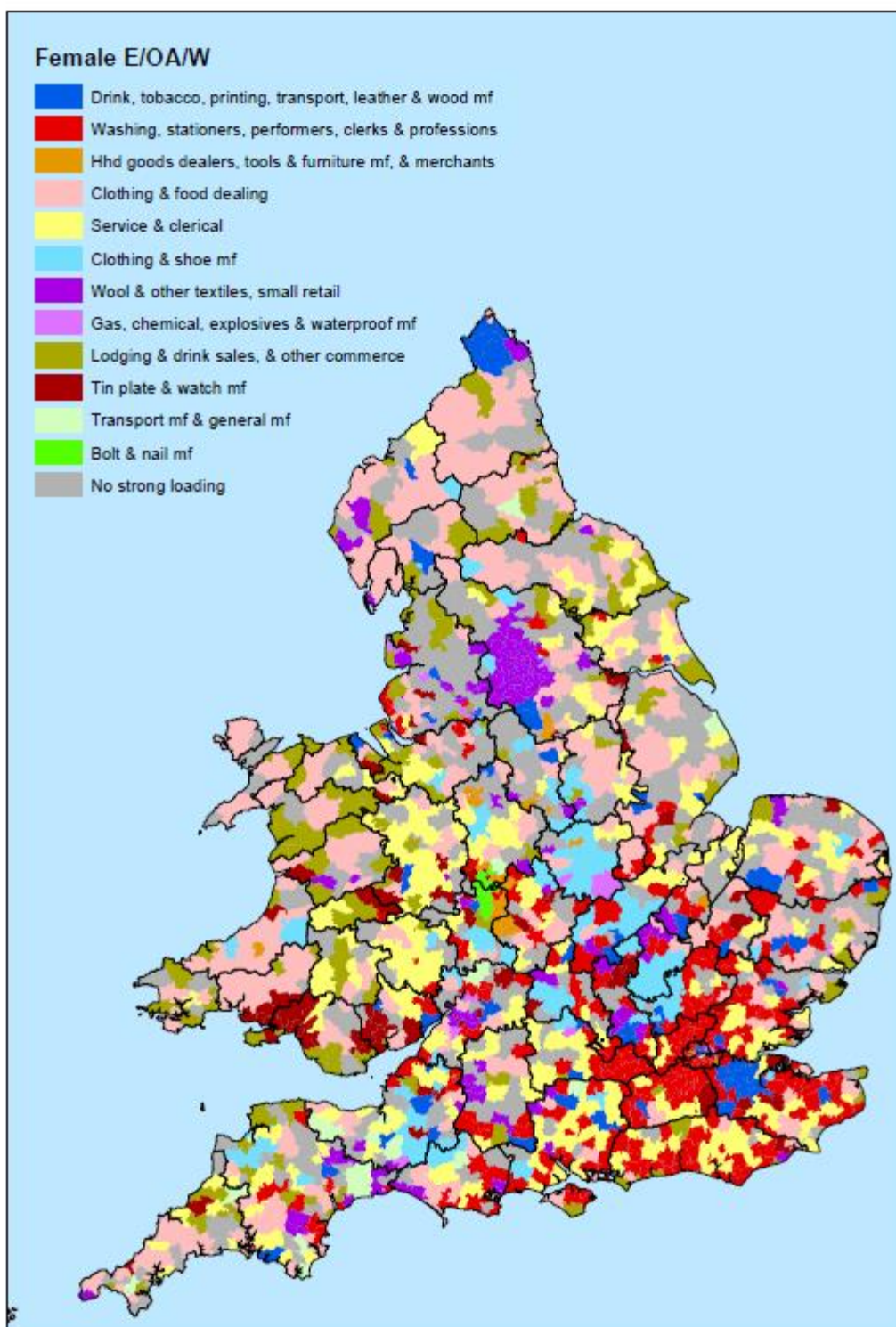
Ship, road & rail vehicle mf

General mf (manufacturers, mechanic, artisan, machinist)

**12: Factor 13 (Bolts and nail mf)** Although not strong female presence in heavy iron and steel, this factor appears to be picking up the female concentrations in small metals.

Iron & steel mf, bolts and nails

The mapping of the female classification for RSDs is shown in Figure 13 after cleaning for small sample sizes, and reallocating Factor 8.



**Figure 13.** Spatial distribution of factors for females only all occupied: final allocation.

## 6. Factor scores

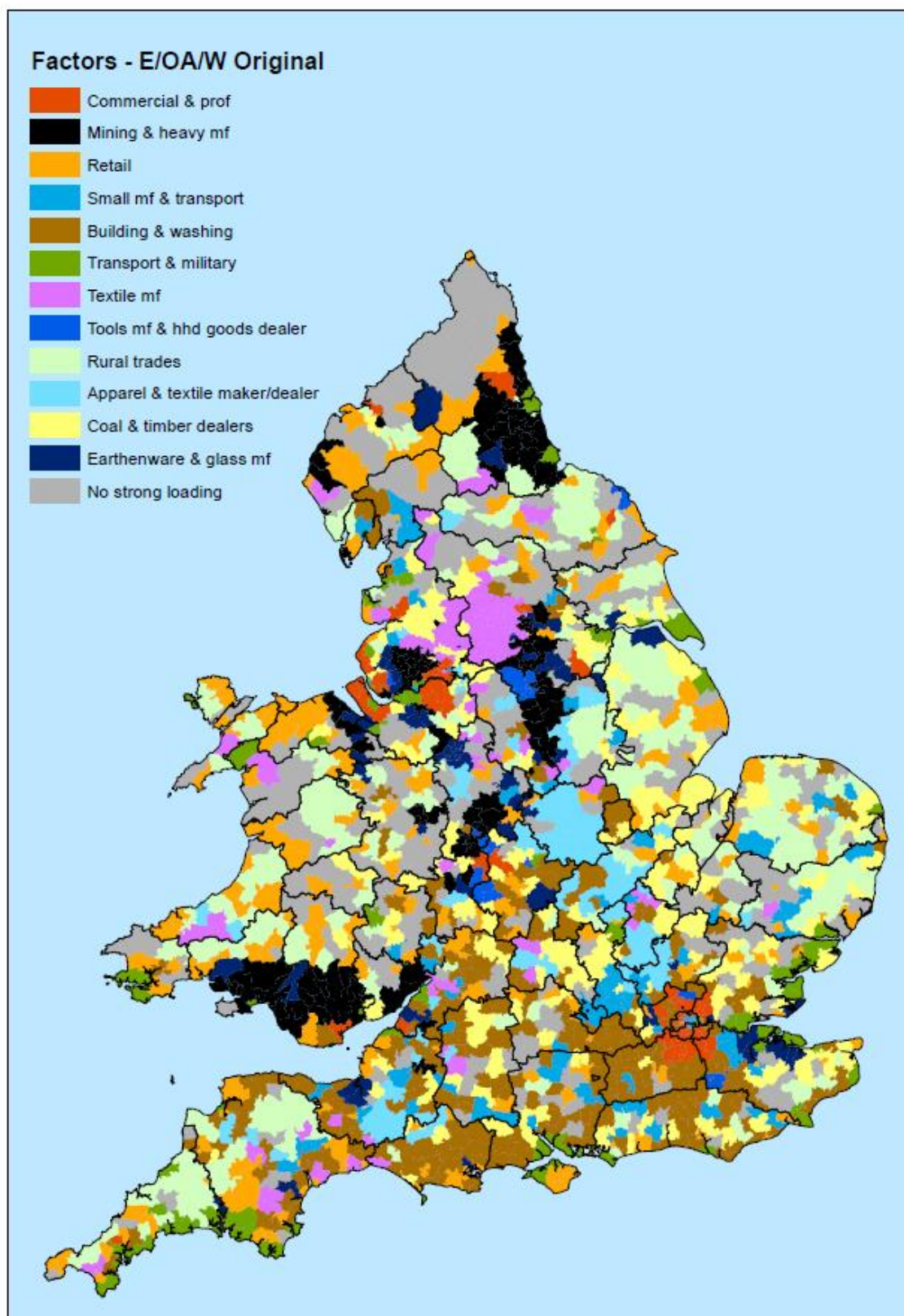
As clear from the mapping discussed above, many RSDs have high scores on several factors. To obtain a more general classification of RSDs it is necessary to assess how far any RSD is primarily loaded on one factor rather than others. This can be achieved by calculating the factor scores for each RSD by summing the loadings attributed to each factor. Only those groups with the highest loadings on that factor are used. It is then necessary to decide to which factor a specific RSD is *primarily* classified. This classification can be largely automated, and there is advantage in using an objective statistical approach throughout.

The judgement on the groupings of RSDs is made by reference to the scores on each of the 12 factors in the 12-factor study, in three stages:

1. Each RSD was classified to the factor on which it had the highest score. This gave a first classification of each RSD which were then scrutinised in stages:
2. Those where the highest score on any factor was below 0.5 were re-allocated to a separate group with ‘no strong loadings’.
3. Those RSDs which had scores over 0.5 were scrutinised to check that none had a strong alternative classification to different factor(s) for which their scores were close to that on the highest factor to which they had been classified. These were candidates for possible reallocation or grouping across factors.

The group of RSDs that did not score highly on any of the factors are allocated to a separate group, termed ‘no strong loadings’ to indicate that they have no high concentrations on any of the occupational variables: they are close to the general average occupational distribution across the country, or have no spatial concentrations high enough on any occupation to give them a high factor loading.

To help in interpretation, there was first a direct mapping of the RSD with their highest scores following the above methodology (‘original’ map). This is shown in Figure 14.



**Figure 14.** ‘Original’ mapping of RSD factor scores.

This map produces a fairly clear picture, but it is apparent that there is a number of potential confusions or ambiguities that make the map difficult to interpret. To overcome this a ‘directed’

approach was undertaken for each RSD for each factor. This combines aspects of the standard approaches of ‘exploratory’ and ‘confirmatory’ factor analysis; where the exploratory approach has been used to inspect the first 12 factors, and the confirmatory approach is used to ensure interpretation meets criteria of interpretability against known patterns: a ‘reality check’. The starting point is the automatic ‘original’ classification, but this was tensioned against alternatives as under step 3 above, and against the known patterns of different locations derived from secondary literature.

The results are summarised below. The method followed was to reallocate all of Factor 5, which is the most difficult to interpret, ‘building and washing’. When examined in detail the RSDs loading highly on this factor mostly have strong alternative similarly high loadings which appear at least as appropriate and: reassigned to second significant factors – mainly Factors 3, 9 and 11, and no strong. Similarly Factors 3 and 4 were often alternates for any RSD, with small differences in loadings between the two. It appears that these, largely rural, areas had close similarities and whilst orthogonal, they could take a high load on either of these factors. Because of this a decision was made to combine them as a joint classification (Factors 3 + 4). Similarly Factors 9 and 11 were also close alternatives and these two factors were combined as one classification. For all Factors, but especially Factors 6 and 9, a check was also made on the sample sizes in each RSD contributing to the factors cores. In Factors 6 and 9 a number of RSDs had very small samples on these critical factors. Whilst geographically distinctive, this often relied on very small numbers of people to distinguish the locality from more general patterns. Where the sample size was small these RSDs were reassigned to no strong loading. The reassignment of the areas with small samples contributes to a general ‘cleaning up’ of the map and the underlying classification removing anomalies.

**Summary of 12-factor analysis 1891 all occupied:** highest occupation loading on each factor and changes made to the ‘original’ automated classification using a ‘directed’ methodology:

***1: Factor 1 (Commercial and professional)***

Merchants, banks, insurers and brokers

Other commerce (accountants, salesmen, travellers, officers of Cos.)

Professions (barristers, solicitors, scientific pursuits)

Professions (doctors, dentists, artists, performers, education)

Also occupations associated with these groups

Stationary dealing (stationers, publishers, newsagents)

Public admin, clergy

Clerks, weighers, telegraph, non-theological students and apprentices

## **2: Factor 2 (Coal mining and heavy manufacturing)**

Coal mining

Machinery manufacture

Iron & steel manufacture, bolts and nails

Other metal manufacture (copper, tin, brass, whitesmiths, etc.)

Gas, coke and chemical manufacture

General manufacture (manufacturers, mechanic, artisan, machinist)

High *negative* loadings on:

Farming, fishing, market gardeners, horse breeding and keeping (loading -0.60)

Labourers & transport staff (including family on farms) (loading -0.56)

## **3: Factor 3 (Retail, small manufactures and lodging)**

Clothing and dress dealing (drapers, hosiers, haberdashers)

Food sales (butchers, fishmongers, cheesemongers, milk sellers, grocers)

Lodging & drink sales (wine & spirits, hotels, inns, coffee houses)

Ironmongers

Chemists, druggists

Combined with Factor 4

## **[Original Factor 4 (Wood, leather, furnishing and printing manufacture)]**

Leather, fur, hair & bone manufacture

Wood manufacture (sawyers, coopers, cane workers)

Furnishing manufacture (cabinet makers, french polishers, undertakers)

Printing & paper manufacture (paper, cardboard, printers, bookbinders)

Combined with Factor 3

**[Reallocated: Factor 5 (Building and personal service industries)** combines three occupational groups]:

Construction operatives (masons, bricklayers, thatcher, plumbers etc.)

Construction management (builders and contractors)

Personal services (washing & bathing, hairdressing, chimney sweeps)

Rationale unclear and mostly strong alternatives: reassigned to second significant factors – mainly Factors 3, 9 and 11, and no strong

**4: Factor 9 (Rural trades, building, coal and timber dealing)**

Blacksmiths

Agricultural produce manufacture (millers, refiners, bakers, confectioners)

Labourers & transport staff (including family on farms)

0.1959 [*Farming, fishing, market gardeners, horse breeding and keeping*]

Combined with Factor 11

Also some small numbers reassigned

**[Original Factor 11 (Dealers with a strong basis in the carrying trade)]**

Coal dealing

Agricultural produce dealing, and dealers in timber, hay, corn

High negative loading on:

Other mining and quarrying (-0.53)

Combined with Factor 9

**5: Factor 6 (Major transport, transport manufacture and military)**

Ship, road & rail vehicle mf

Ocean, inland and dock transport

Military

Retained, but those with small numbers re-assigned

**6: Factor 7 (Textiles manufacture)**

Woollen manufacture (woollen goods, carpets, blanket, flannel)

Cotton & silk manufacture (including ribbon, weaving, dyeing, bleaching etc.)

Other textile manufacture (flax, hemp, rope, jute, lace, tape, thread)

**7: Factor 8 (Tools, instruments and household goods):**

Tool & weapons manufacture

Watch & instrument manufacture

Household & personal goods dealer (earthenware, glass, jewellers)



**8: Factor 10 (*Apparel and textile maker-dealers*)**

Clothing manufacture (tailors, milliners, hosiery, hats, gloves, umbrellas, buttons, leather)

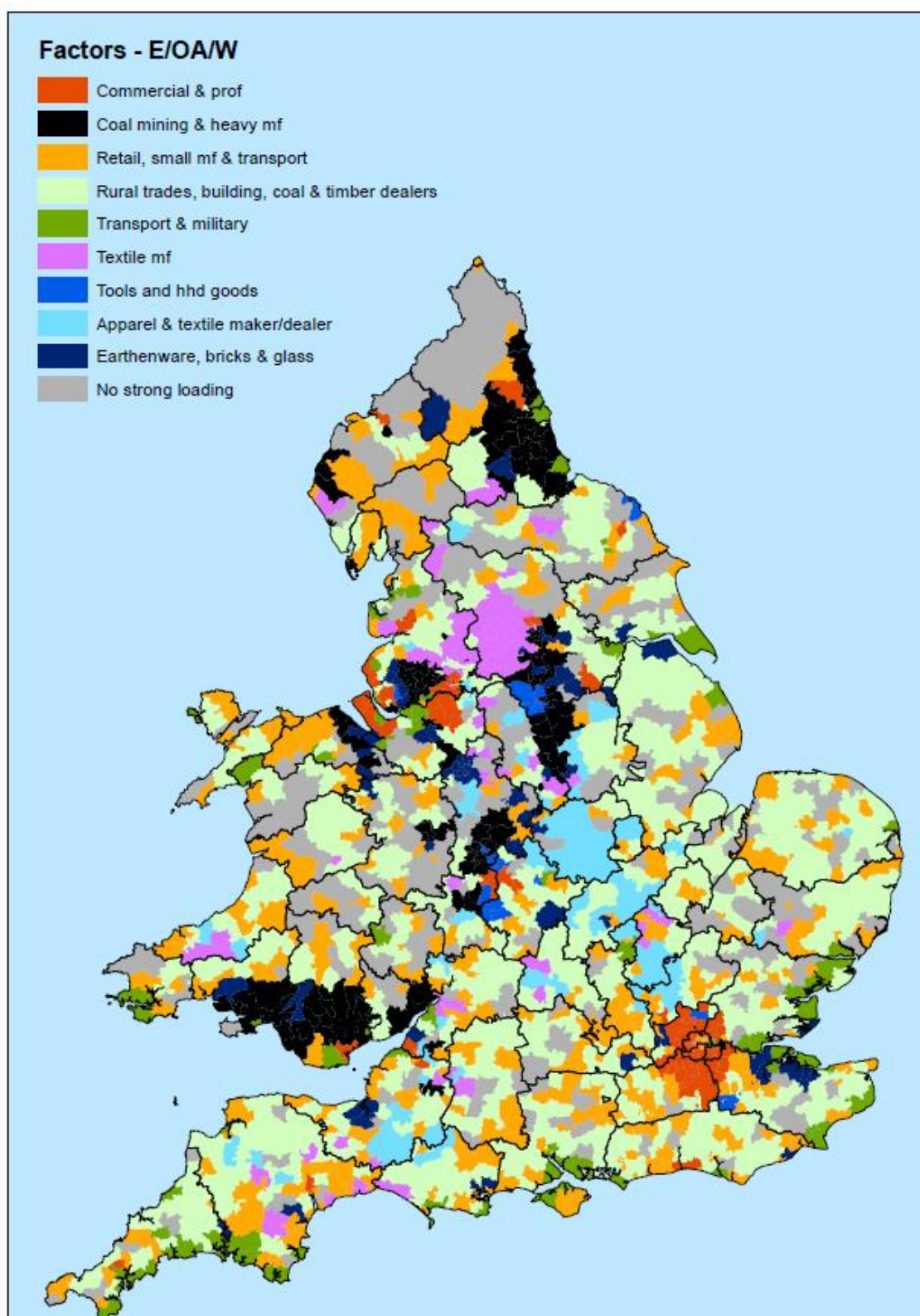
Shoe, boot, clog manufacture

Waterproof goods manufacture (floor & oil cloth, rubber etc.)

**9: Factor 12 (*Earthenware and glass manufacture*) one occupational group**

**10: *No strong loading***

The mapping of the directed 12-Factor study is now reduced to 10 categories, as summarised above, and shown in Figure 15.



**Figure 15.** Final mapping of RSD factor scores for all occupied.

## 7. Conclusion

This Working Paper has developed a classification of RSDs for 1891 based on an aggregation of occupational categories into 50 groups. The final results for all occupied (Figure 15) and female all occupied (Figure 13) appear to fit closely to patterns that are well understood from the literature, and in most cases also develop spatial groups without imposition of any contiguity controls, such as could be used for urban areas. These results are a pilot for the application of similar methods to other census years and for the development of the classification for use for a range of analytical purposes, including a classification of the different employment status categories of employers, own account and workers. These developments are summarised in subsequent Working Papers.

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The census database used derives from K. Schürer, E. Higgs, A.M. Reid, E.M Garrett, *Integrated Census Microdata, 1851-1911, version V. 2 (I-CeM.2)*, (2016) [data collection]. UK Data Service, SN: 7481, <http://dx.doi.org/10.5255/UKDA-SN-7481-1>; enhanced; E. Higgs, C. Jones, K. Schürer and A. Wilkinson, *Integrated Census Microdata (I-CeM) Guide*, 2nd ed. (Colchester: Department of History, University of Essex, 2015). A special acknowledgement of thanks is made to Kevin Schürer for advice and all his help in developing improved versions of I-CeM, and to Alice Reid, Eilidh Garrett, Joe Day, Hanna Jaadla, Xuesheng You, Leigh Shaw-Taylor and other members of the Campop I-CeM group who, with the authors, have collectively worked on the new versions of I-CeM.

The GIS boundary files for RSDs were constructed by Joe Day for the ESRC fertility project directed by Alice Reid:

<http://www.geog.cam.ac.uk/research/projects/victorianfertilitydecline/publications.html>

These used as a starting point the GIS parish files of Satchell, A.E.M., Kitson, P.M.K., Newton, G.H., Shaw-Taylor, L., Wrigley E.A. (2006) *1851 England and Wales census parishes, townships and places*, 2006, ESRC RES-000-23-1579, supported by Leverhulme Trust and the British Academy; Satchell, A.E.M. (2015) *England and Wales census parishes, townships and places*; which is an enhanced and corrected version of Burton, N, Westwood J., and Carter P. (2014) *GIS of the ancient parishes of England and Wales, 1500-1850*, UKDA, SN 4828; which is a GIS version of Kain, R.J.P., and Oliver, R.R. (2001) *Historic parishes of England and Wales: An electronic map of boundaries before 1850 with a gazetteer and metadata*, UKDA, SN 4348.

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### **Other Working Papers:**

Working paper series: ESRC project ES/M010953: '*Drivers of Entrepreneurship and Small Business*', University of Cambridge, Department of Geography and Cambridge Group for the History of Population and Social Structure.

WP 1: Bennett, Robert J., Smith Harry J., van Lieshout, Carry, and Newton, Gill (2017) *Drivers of Entrepreneurship and Small Businesses: Project overview and database design*.

WP 2: Bennett, Robert J., Smith Harry J. and van Lieshout, Carry (2017) *Employers and the self-employed in the censuses 1851-1911: The census as a source for identifying entrepreneurs, business numbers and size distribution*.

WP 3: van Lieshout, Carry, Bennett, Robert J., Smith, Harry J. and Newton, Gill (2017) *Identifying businesses and entrepreneurs in the Censuses 1851-1881*.

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WP 5: Bennett, Robert J., Smith Harry J., van Lieshout, Carry, and Newton, Gill (2017) *Business sectors, occupations and aggregations of census data 1851-1911*.

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WP 7: Smith, Harry, Bennett, Robert J., and Radicic, Dragana (2017) *Classification of towns in 1891 using factor analysis*.

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