Industrial Structure (SIC2007) of Local Authority Districts in Great Britain 1841-2011: challenges and results

Humphrey Southall and Paula Aucott
(University of Portsmouth):
ghgis@port.ac.uk
Structure of presentation

• Objectives
• Methods
• Sources
  – Research draws on nine censuses but we will exemplify them using 1991, 1931 and 1881
• Discussion
• Summarizing long-run trends:
  – Simplified trends 1841-2011 for selected districts
  – Visualising trajectories via ternary diagrams
  – Analysing trends in diversity and specialisation using the Tress and Herfindahl-Hirschman Indices
Aim:

• To create a data set enabling long-run analysis of evolving local economies in Britain

• Data on what people do for a living have been gathered by Census of Population since 1841, but comparisons over time difficult due to:
  – Large variations over time in how economic activities were classified in available published reports
  – Large variations in reporting geographies, especially at sub-county scales
Previous attempt

  - A book consisting mainly of tables
- Results only for counties, so not really ”local economies”
- Two separate time series, for different kinds of county, with break in 1911
- Research done in 1970s, so cannot cover last 40 years of dramatic change
  - And based on 1968 Standard Industrial Classification
- No “audit trail”: digitised historical data and details of re-classifications not available
Specific objective

• To replicate tables WP605EW and WP605SCca from the 2011 census outputs for as many earlier censuses as possible
• So classifications must all be converted to Standard Industrial Classification (2007)
• Geography must be converted to modern system of 380 local authority areas across Great Britain
• Subsidiary aim to make all the underlying data available in digital form
• Some limitations due to project being funded by small contracts for the Greater London Authority and the Centre for Cities, plus our own commercial earnings
  – But is still the work of a 4-person team over 2 years
# Sections in Standard Industrial Classification (2007)

<table>
<thead>
<tr>
<th>Section (A)</th>
<th>Description</th>
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<tbody>
<tr>
<td>A</td>
<td>Agriculture, forestry and fishing</td>
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<td>Real estate activities</td>
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<td>B</td>
<td>Mining and quarrying</td>
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<td>Professional, scientific and technical activities</td>
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<td>Manufacturing</td>
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<td>Administrative and support service activities</td>
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<td>Electricity, gas, steam and air</td>
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<td>Public administration and defence; compulsory social security</td>
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<td>conditioning supply</td>
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<td>Water supply; sewerage, waste</td>
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<td>Education</td>
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<td>management and remediation activities</td>
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<td>F</td>
<td>Construction</td>
<td>Q</td>
<td>Human health and social work activities</td>
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<td>G</td>
<td>Wholesale and retail trade; repair of</td>
<td>R</td>
<td>Arts, entertainment and recreation</td>
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<td>motor vehicles and motorcycles</td>
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<td>H</td>
<td>Transportation and storage</td>
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<td>Other service activities</td>
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<td>I</td>
<td>Accommodation and food service</td>
<td>T</td>
<td>Activities of households as employers; undifferentiated goods-and services-producing activities of households for own use</td>
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<td>activities</td>
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<td>J</td>
<td>Information and communication</td>
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<tr>
<td>K</td>
<td>Financial and insurance activities</td>
<td>U</td>
<td>Activities of extraterritorial organisations and bodies</td>
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</tbody>
</table>

*Date:* 22 June 2017

*Source:* University of Portsmouth
Britain’s administrative geographies are complex!

- Map shows different definitions of “Cambridgeshire” used by census over last 200 years
Redistricting methods

- Generally possible to compare adjacent censuses by ad hoc adjustment based on boundary change lists.
- But over 170-year span of this paper, only viable approach is vector overlay, requiring:
  - GIS software (actually Postgres/PostGIS)
  - Vector boundaries for target modern geography
  - Vector boundaries for each historical reporting unit.
- Method assumes data being redistricted are evenly distributed over the historical polygon, so:
  - Historical geographies usually more detailed than 2011 LAUs
  - Generally re-allocated district data to parishes pro rata to parish populations, then redistricted from the c. 15,000 parishes.
  - Special procedures needed to avoid losing people in sea.
Sources and detailed methods

• Study covers nine censuses, and there is a story to tell about each:
• … and Scotland usually poses different and larger issues from those for England and Wales
• Today, we can outline only three of those stories:
  – 1991: problems with born-digital data
  – 1931: most detailed of all the published industry tables
  – 1881: use of microdata
1991: digital archaeology

• Industrial statistics for 10,766 “frozen wards” available from NOMIS online system

• Cover 60 “classes” but from SIC1980: very different from SIC2007, so insufficiently detailed

• Calculations therefore also use data from 1991 Census of Employment covering 335 “activities” for whole local authorities
  – Two sources combined to estimate 335 categories for wards
  – Census of Employment data NOT public, so dissemination needed authorisation from ONS

• Major problems with available boundary data:
  – NOMIS and UKDS had different IDs for 1991 wards
  – UKDS boundary data were simply missing polygons
1991: digital archaeology

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1931: Computerizing census reports

- Project based on “published data”, but much data entry
- 452,786 cells computerized from 1931 Industry Tables
- England & Wales: 438 categories tabulated for counties & 144 towns > 50,000, 53 for 1,657 other LGDs: *pro rata* calculations
- Scotland: full data for counties, 4 cities and 20 Large Burghs
  - New base map needed
Counties & Burghs in central belt, 1931

- Units are large and small burghs, and Districts of County
- Based on maps from 1950s plus boundary change lists
1881: Calculations from census microdata

- Essex project systematised Mormon transcription of individual-level census data for England and Wales
- Provided us with cross-tabulation of 414 occupational categories against gender and civil parish
  - 863,775 non-null cells in all
- Our contribution to project was GIS of civil parishes
- New project, mapped 1881 classification to SIC2007, and redistricted 14,848 parishes to 2011 LAUs
- Had hoped to take same approach to other pre-1911 censuses, but unable to obtain usable data from ICeM
  - Need to use existing transcriptions for England & Wales is why exact 20 year sequence not sustained
- Scotland based on published 1881 data
Counties & Burghs in central belt, 1881

- Units are counties plus selected burghs
- Burgh boundaries from maps around Glasgow and Edinburgh, otherwise circles proportional to 1911 areas
General issues

• Re-classification is generally more problematic than redistricting

• Before 1951, data based on residence not workplace
  – How large were commuting flows in 1911 between 2011 LAUs? Potential analysis of 1921 travel data

• Before 1931, data are based on individual occupations not "employer’s business"
  – But most occupations industry-specific

• Principles behind classifications change fundamentally
  – This reflects changes in the nature of economic activity; for example, in C19 classifications makers and sellers combined because so many people did both within a single day
Overview of results

• Results comprise over 60,000 counts: workers in 18 categories in 280 districts at 9 censuses
  – Dataset actually bigger: reclassifications were to the 99 SIC2007 Divisions, and males and females separated

• More analytic research planned longer term, exploring consequences for unemployment and health, and potential for forecasting

• For now:
  – Simplified graphs for some selected districts
  – An attempt to present trajectories via ternary diagrams
  – Analyses of trends in specialisation and diversity
Simplifying SIC2007 to a 6- or 7-way classification

- Graphical overview based on further simplification of classification to seven sectors:
  - Agriculture
  - Mining and Manufacturing
    - But keep mining separate where we can as so distinctive
  - Utilities, Transport and Construction
    - These vary relatively little in size between areas or over time
- Including a three-way division of services based on, essentially, who pays:
  - Consumer Services
  - Business Services
    - Including financial and professional services
  - Public Services
    - Includes everyone in education and health care
Today, most areas pretty similar:

- Waverley (Contains Godalming, Haslemere)
- Great Britain
- Rhondda Cynon Taff

• But our census data reveals more diverse histories
Changing Industrial Structure 1841-2011

Industrial Structure of Great Britain 1841-2011

- Agriculture
- Mining
- Manufacturing
- Util+Const+Transp
- Consumer Services
- Business Services
- Public Services
Industrial Structure of Waverley 1841-2011
Industrial Structure of Rhondda Cynon Taff 1841-2011

[Chart showing the changing industrial structure from 1841 to 2011, with categories for Agriculture, Mining, Manufacturing, Util + Const + Transp, Consumer Services, Business Services, and Public Services.]
Summarising local authority “trajectories”

• Possible to plot trajectories of 380 local authorities on one ternary diagram, but not to read the result
• Equally pointless to create this detail then aggregate back to regions
• Three groupings developed:
  – Banding by distance from London:
    • 0-99 km / 100-199 km / 200-299 km / Over 300 km
  – Simple 4-way typology:
    • London, broadly defined
    • LAs within 60 other city regions as defined by Centre for Cities
    • Other areas with more than 2 persons per hectare
    • Areas with under 2 persons per hectare
  – How local authorities voted in 2016 EU referendum
Trajectories of districts grouped by distance from London: three main sectors

<table>
<thead>
<tr>
<th>Distance from London (KM)</th>
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<tbody>
<tr>
<td>0-99</td>
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<td>100-199</td>
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<tr>
<td>200-299</td>
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<td>300 up</td>
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</tbody>
</table>
Trajectories of districts grouped by area type: three main sectors
Trajectories of districts grouped by voting in EU referendum: three main sectors

Brexit Vote
- Leave
- Remain
Summarising Specialisation: The Tress Index

• For method, see Tress, R.C., ‘Unemployment and the diversification of industry’, *The Manchester School*, 9 (1938), pp.140-152
  – An algorithm rather than a formula
  – NB original article computes the Index from the 1931 industry data used here

• Index varies between zero, when all categories in a district contain equal numbers of workers, and one when all workers are in just one category

• Index values clearly affected by the particular classification used, and future work will explore use of different categorisations including original 1931

• Today’s results based on the 18 SIC2007 Sections
Mean Tress Index 1841-2011 for GB Local Authorities (2011) grouped by distance from London

- Computed from 18 SIC2007 Sections (merging RSTU)
- NB these are arithmetic means of the Index values for individual local authorities, not the Index computed across all local authorities in each band
A more modern measure of specialisation: the Herfindahl-Hirschman Index

- Most commonly used as a measure of concentration within an industry, in anti-trust policy

- Method:
  - Compute each SIC Section’s percentage of total employment
  - Square each percentage
  - Sum the result

- Index varies between zero, when all Sections in a district contain equal numbers of workers, and 10,000 when all workers are in just one Section
Mean Herfindahl-Hirschman Index 1841-2011 for GB Local Authorities (2011) grouped by distance from London

- Computed from 18 SIC2007 Sections (merging RSTU)
- NB these are arithmetic means of the Index values for individual local authorities, not the Index computed across all local authorities in each band
Conclusions from analysis of diversity:

- Over time, all parts of the country have become less specialised
- The south has been consistently more diverse than the north
- But recently these differentials have lessened
- Results do not depend on particular index used

Where to next?
- Future research will return to Tress’s original question and examine the relationship between diversity and economic distress
Male Unemployment & Industrial Diversity in 1931

Percentage Unemployed

- < 6.18
- 6.18 - 7.5
- 7.5 - 9.25
- 9.25 - 11.5
- 11.5 - 15.67
- > 15.67

Tress Index (comp. from 18 SIC2007 Sections)

- < 0.64
- 0.64 - 0.67
- 0.67 - 0.69
- 0.69 - 0.72
- 0.72 - 0.77
- > 0.77
Unemployment & Diversity in 1931

Data for 380 local authorities as defined in 2011

\[ y = 0.0026x + 4.6791 \]

\[ R^2 = 0.142 \]
Acknowledgments:

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- David Allan Gatley provided 1861 occupational statistics, while Kevin Schürer and Matthew Woollard provided 1881 occupational data
- Thanks to Michael Stoner for help with redistricting procedures and to Harold Price for data entry
- Special thanks also to Chris Fleet of the National Library of Scotland Map Room, Justin Hayes of UK Data Service Census Support, Sinclair Sutherland of NOMIS and Isabel Trevenna of ONS Census Marketing
Today covered just part of our work on long-run trends for current local authority areas

- Data have been supplied to GLA and Centre for Cities, but profiles for all individual local authorities available from us
- Profiles cover:
- All topics start from 2011 data and go back at least 80 years
- Each authority compared with its region and with Great Britain